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Peripheral intravenous catheter-related phlebitis and infiltration in pediatric patients: A point prevalence study and risk factors

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Abstract

This study aimed to investigate the prevalence of phlebitis and infiltration in pediatric patients with peripheral intravenous catheters (PIVCs), as well as to identify the associated risk factors. An observational point prevalence study was conducted involving 170 pediatric patients with PIVCs. Ethical considerations were also taken into consideration. Data were collected through direct site observations and medical records using the Peripheral Intravenous Catheter Data Form and Phlebitis and Infiltration Grading Scales. of the participants, 60.6% were male, with a mean age of 5.45±6.03 years. The mean dwell time of PIVC use was 72.96 ± 55.2 hours. Phlebitis occurred in 30.6% of the patients, with first-degree in 14.7% and second-degree in 11.8%. Infiltration was observed in 18.2% of the patients, with first-degree in 11.8% and second-degree in 6.5%. Factors such as PIVC dwell time, dressing type, and infusion practices were significantly associated with phlebitis, whereas infiltration was linked to dressing type, crystalloid infusions, and medication therapy ($p<0.05$). This study identified phlebitis and infiltration as common complications in pediatric patients with PIVCs, with risk factors including PIVC dwell time, dressing type, and infusion practices.

Keywords: Catheter care, infiltration, pediatric patients, peripheral intravenous catheters, phlebitis, risk factors

Introduction

Peripheral intravenous catheters (PIVCs) are among the most common clinical procedures performed in hospitalized neonates and pediatric patients. Approximately 80.0% of hospitalized patients receive intravenous therapy via PIVCs [1,2]. Peripheral venous catheterization involves the insertion of a short catheter into a patient's peripheral vein [3,4]. The indications for PIVCs insertion in pediatric patients include the administration of certain medications, replacement and maintenance of fluid and electrolyte balance, regulation of acid-base balance, administration of blood and blood products, and implementation of necessary treatments [5,6].

Nurses are primarily responsible for the insertion, monitoring, and maintenance of PIVCs. They also play a crucial role in preventing complications and ensuring patient safety during intravenous therapy [7-9]. When properly inserted and managed, PIVCs can be life-saving and highly beneficial. However, improper insertion, inadequate assessment, and insufficient care can lead to various complications. Studies show that 90.0% of prematurely removed PIVCs are linked to conditions such as phlebitis, infiltration, extravasation, and bloodstream infections [8,10]. These risks are even higher in neonates and children, with an overall complication rate of 75.0% and an infiltration rate of 65.0% [11]. In addition to their impact on patient health, PIVC-related complications impose a significant financial burden on healthcare systems. Pediatric patients with difficult vascular access often require multiple insertion attempts, causing pain, stress, and anxiety for both them and their families [10,11]. In addition to these physical and emotional challenges, the financial impact is substantial [11]. According to the National Vascular Access Management

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Guideline (2019), the complication rate in Turkey is around 50%, costing an estimated 7.57 million USD (43 million Turkish lira) per year for a 300-bed hospital [12]. Furthermore, with PIVC-related complications occurring approximately every four seconds [12], the need for effective prevention and management strategies is more urgent than ever.

Background

Phlebitis is one of the most common complications of peripheral intravenous catheterization. Sepsis, discomfort, and the need for additional diagnostic procedures and treatments can all arise from phlebitis, leading to longer hospital stays, stress levels, strain on medical personnel, and higher healthcare expenses [12]. Phlebitis is defined as inflammation of the endothelial layer of the vein due to mechanical, chemical, or bacterial irritation [6]. Mechanical phlebitis occurs when the catheter irritates the vein wall or exits the vein. Chemical phlebitis develops when the fluid or drug administered intravenously damages the intimal layer of the vein. Bacterial phlebitis may arise from factors such as improper care of the catheter insertion site, failure to follow catheter-care protocols, or inadequate attention to changing intravenous solutions and sets. In cases of phlebitis, symptoms such as pain, tenderness, swelling, redness, and hardening of the vein at the catheter insertion site may occur [13-15].

The prevalence of phlebitis in adult patients receiving peripheral intravenous therapy ranges from 27.0% to 70.0% [1,4,6,16]. Unlike adults, pediatric patients, including neonates, are more susceptible to PIVC-related complications due to their smaller, more fragile veins, inability to speak, and difficulty expressing pain and discomfort [2,7,11]. This increased vulnerability has been emphasized in multiple studies examining pediatric intravenous therapy [16,17]. The prevalence of phlebitis in pediatric patients varies between 1.5% and 71% [17]. The risk of phlebitis significantly rises on the second and third days following PIVC insertion [5]. For example, De Lima Jacinto et al. (2014) found that 13% of pediatric patients developed phlebitis after PIVC insertion [7]. In Turkey, Olgun et al. (2014) reported a phlebitis rate of 45.9% in pediatric patients [16], while Karaoğlan et al. (2022) reported a rate of 15.8% [18].

In addition to phlebitis, another major complication of peripheral intravenous catheterization is infiltration [7]. Infiltration is defined as the accidental leakage of a non-vesicant substance or solution into surrounding tissues, leading to its accumulation in the skin [12,13]. Common signs of infiltration include swelling at the catheter insertion site, tightness of the skin, skin pallor or coolness, slowed or stopped infusion, and fluid leakage outside the vein [14]. The prevalence of infiltration is reported to range between 2.9% and 40.5%, with limited studies specifically addressing infiltration in pediatric patients [16,18-20]. Factors contributing to the development of infiltration include improper venous access, catheter placement in a mobile joint area, catheter displacement, inappropriate catheter size selection, inadequate securement, needle or catheter tip piercing the vein wall and entering subcutaneous tissue, catheter defects, a history of previous infiltration, the use of infusion pumps, and the formation of clots around the catheter [14-21].

Several studies, including those by Olgun et al. (2014) [16], Karaoğlan et al. (2022) [18], and Özalp Gerçeker et al. (2018) [19], have investigated the prevalence of phlebitis and infiltration in neonates and pediatric patients and identified various risk factors associated with these complications. While these studies have provided valuable insights, differences in study settings, populations, and methodologies highlight the need for continued study on this topic. The present study contributes to the existing literature by further examining the prevalence of phlebitis and infiltration due to PIVCs in neonates and pediatric patients, with a focus on identifying associated risk factors [16,18–20]. This knowledge is essential for guiding clinical practices and developing effective preventive strategies to improve patient outcomes.

Aim of the Study

The primary aim of this study was to determine the prevalence of phlebitis and infiltration among pediatric patients with PIVCs in neonatal and pediatric units, and to identify contributing risk factors, dataset characteristics, and related factors.

Research Questions

What is the prevalence of phlebitis in pediatric patients?

What is the prevalence of infiltration in pediatric patients?

What risk factors affect the prevalence of phlebitis?

What risk factors affect the prevalence of infiltration?

Material and Methods

Study Design

This descriptive, observational point prevalence study was conducted across the pediatric wards and intensive care units of an university hospital in İzmir, Turkey, involving 170 pediatric patients with PIVCs. Data collection was carried out over five consecutive days during daytime working hours in March 2023. All PIVCs in pediatric patients who had a catheter in place on the days of data collection were observed. This university hospital is one of the largest in the Aegean region, with a capacity of 220 beds. The study population consisted of pediatric patients with PIVCs who were hospitalized in various units of the hospital, including the Pediatric Surgery Intensive Care Unit, Neonatal Intensive Care Unit, Pediatric Intensive Care Unit, Pediatric Subspecialty Wards (e.g., Pediatric Endocrinology, Pediatric Infectious Diseases, Pediatric Cardiology, Pediatric Neurology), Infant Ward, Pediatric Oncology Ward, and Pediatric Surgery Ward. The study adhered to the STROBE Checklist guidelines.

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Setting and Participants

A non-probability convenience sampling method was used to select participants, as this approach was deemed appropriate due to the accessibility of participants within the hospital during the study period. The inclusion criteria were: age between 0 and 18 years, receiving inpatient treatment in neonatal and pediatric units, having a PIVC, and providing voluntary consent. Exclusion criteria included declining to participate, being off the unit, being in isolation, or being in the emergency department at the time of data collection. All eligible patients hospitalized in the neonatal and pediatric wards were invited to participate, and those who provided written and verbal consent—either from themselves or their legal guardians—were included in the sample. A total of 170 pediatric patients who met the inclusion criteria participated in this study.

Data Collection Tools

The Peripheral Venous Catheter Data Form, developed based on relevant literature, consists of 26 items divided into two main sections. The first section collects sociodemographic and clinical data (e.g., age, gender, clinical unit, and medical diagnosis), while the second section focuses on PIVC-related variables (e.g., insertion site, catheter gauge, dwell time, and signs of complications) [3,5,11,12,23].

The Phlebitis Grading Scale and Infiltration Grading Scale, both developed by the Infusion Nurses Society, assess phlebitis and infiltration, respectively [24]. Each scale categorizes symptoms into five grades, aiding in precise assessment and classification. The severity of phlebitis was determined by measuring the width of the affected area with a transparent millimeter ruler. The scale categorizes phlebitis into five grades: Grade 0 (no symptoms), Grade 1 (redness and/or pain at the catheter site), Grade 2 (redness, pain, and/or swelling), Grade 3 (redness, pain, swelling, red streaks, and palpable cord-like veins), and Grade 4 (redness, pain, swelling, red streaks, palpable veins over 2.5 cm, and purulent discharge) [12,24].

The Infiltration Grading Scale classifies infiltration into five grades: grade 0 (no symptoms), grade 1 (skin blanching and localized edema at the catheter site, with or without pain), grade 2 (blanching, 2.5–15 cm edema, and cool skin, with or without pain), grade 3 (blanching, translucent skin, extensive edema over 15 cm, coolness, mild to moderate pain, and possible numbness), and grade 4 (blanching, taut and leaking skin, swelling, bruising, discolored skin, deep tissue edema, impaired circulation, and moderate to severe pain) [5,24].

Data Collection

Data were collected from pediatric patients and their parents in İzmir, Turkey. The researchers obtained written permission from the university's Ethics Committee and the units where the study was conducted. Following this approval, the data collection process was carried out by a researcher with a master's degree in nursing and clinical experience in pediatrics. The researcher received training on how to complete The Peripheral Venous Catheter Data Form and how to apply The Phlebitis and The Infiltration Grading Scales. The responsible nurse of each unit was informed of the study, the data collection method was explained, and the data collection time was determined. After explaining the purpose of the study, the researcher obtained both verbal and written informed consent before administering the data collection forms through face-to-face interviews. For the illiterate participants, consent was obtained from their legal guardians. Convenience sampling was used to include all hospitalized pediatric patients with PIVCs during the study period. All patients with ongoing PIVC use were observed for signs of phlebitis or infiltration at least once during the study period. Medical records provided secondary data such as catheter insertion date, type of dressing used, and medication or fluid infused via the catheter. The data collection instruments included the Peripheral Venous Catheter Data Form, which captured demographic information such as age and gender, along with the Phlebitis Grading Scale and the Infiltration Grading Scale. Each form required approximately 10 minutes to complete for each participant.

Statistical Analysis

Data analysis was performed using Statistical Package for the Social Sciences (SPSS), version 23.0. Descriptive statistics, including measures such as mean, standard deviation, median, range (minimum-maximum), and frequency distributions, were applied to summarize the characteristics of the study sample. The chi-square test was used to compare the categorical variables. The Shapiro-Wilk test was conducted to evaluate the normality of the data distribution. For the analysis of non-normally distributed data, as well as for comparisons involving non-parametric and non-repeated measures, the Mann-Whitney U test was used. Statistical significance was determined at a threshold of $p < 0.05$, with this value serving as the criterion for interpreting significant differences or associations within the data.

Ethical Issues

Ethical approval and institutional permission for the study were obtained from the Non-Interventional Clinical Research Ethics Committee of the Health Sciences University Tepecik Training and Research Hospital (Decision No: 2022/12-15, dated January 11, 2023). The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Given that the study involved pediatric patients (aged 0–18 years), written informed consent was obtained from their legal guardians. When age and cognitive capacity allowed, children were also verbally informed in an age-appropriate manner and their assent was obtained. All participants and/or their guardians were clearly informed that participation was voluntary and that refusal or withdrawal would not result in any negative consequences.

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Results

Demographic Characteristics of Participants

The mean age of the neonates and children participating in the study was 5.45±6.03 years (Min: 0.08, Max: 18.0), with 51.2% in the 0-2 age range and 48.8% in the 2-18 age range. Of the participants, 60.6% were male. Among pediatric patients, 25.9% were hospitalized in subspecialty wards, 22.4% in neonatal intensive care units, and 21.8% in infant wards. At the time of the study, the mean dwell time of the PIVC catheter was 72.96 ± 55.2 hours (min: 24, max: 360). In 92.4% of pediatric patients, the PIVC insertion time was not recorded on nurse observation sheets or in the system.

When examining the indications for PIVC insertion, 82.4% of the pediatric patients required intravenous drug therapy, 45.3% required intravenous fluid therapy, 17.6% required blood sampling, and 8.8% required parenteral nutrition. All PIVCs were inserted by nurses, with 61.2% placed in general wards, 28.8% in intensive care units, and 10.0% in the emergency departments or operating rooms. Regarding catheter size, 43.5% of the PIVCs were 24-gauge catheters, 21.8% were 26-gauge catheters, and 31.2% were 22-gauge catheters. The PIVCs were inserted into the antecubital area in 24.7% of cases, wrist in 21.1%, hand in 16.4%, and forearm in 16.4% (Table 1).

Regarding local complications associated with PIVCs, no complications were observed in 65.9% of pediatric patients. However, 31.2% experienced pain and tenderness upon manual examination, 26.5% had redness greater than 1 cm at the insertion site, 13.5% had swelling > 1 cm, 11.8% had a red streak along the vein, 5.9% experienced itching or rash under the occlusive dressing, and 1.8% had extravasation. It was found that 77.1% of PIVCs had no documented evaluations in the last 24 h. In 82.4% of pediatric patients, only adhesive tape was used to secure the PIVC, 14.1% had sterile gauze and adhesive tape, and 3.5% had chlorhexidine-impregnated dressings. When assessing the condition of the catheter dressings, 72.4% were clean, dry, and intact; 13.5% were soiled with dried blood or leakage; 8.2% were soiled with wet blood or leakage; and 5.9% had loose or lifted edges. Regarding PIVC stabilization, 67.1% were secured with sterile gauze and adhesive tape, 30.6% with non-sterile adhesive tape, and 6.5% with splints, bandages, or tubular netting.

Among the PIVCs, 55.3% were infused using an intravenous (IV) cap, whereas 30.6% were connected directly to an infusion set. At the time of the study, 41.8% of the pediatric patients received continuous infusion, 40.0% received intermittent infusion, 34.7% received crystalloid infusion, and 25.9% received parenteral nutrition via IV. Additionally, 63.5% of the pediatric patients received antibiotics, 26.5% received electrolytes, and 25.9% received pain medications intravenously. To prevent PIVC occlusion, 37.6% of the pediatric patients had their catheters flushed every 4 hours, and 17.1% had flushed every 12 hours.

Phlebitis and Infiltration Prevalence

Phlebitis was observed in 30.6% of pediatric patients, with 14.7% experiencing grade 1 phlebitis, 11.8% in grade 2, and 4.1% in grade 3. Infiltration developed in 18.2% of the pediatric patients, with 11.8% showing grade 1 infiltration and 6.5% showing grade 2 infiltration (Table 2).

Factors Affecting the Development of Phlebitis and Infiltration

No significant relationship was found between the development of phlebitis and infiltration and factors such as pediatric patients' gender, age group, ward of hospitalization, ward where the PIVC was placed, PIVC number, type of PIVC dressing, and frequency of PIVC line flushing ($p>0.05$). However, a significant difference in the development of phlebitis was observed among pediatric patients based on PIVC dwell time during the study period ($Z=-3.325$, $p=.001$). In contrast, no significant difference was found in the development of infiltration based on PIVC dwell time ($Z=-1.710$, $p>0.05$).

This study evaluated the relationship between different PIVC securement methods and the development of phlebitis and infiltration. The use of sterile gauze and tape was significantly associated with a reduced risk of phlebitis ($\chi^2=35.697$, $p=0.001$) and infiltration ($\chi^2=29.208$, $p=0.001$), whereas the use of non-sterile tape significantly increased the risk of phlebitis ($\chi^2=29.730$, $p=0.001$) and infiltration ($\chi^2=29.110$, $p=0.001$). The use of non-sterile tape around the stabilizer showed no significant association with phlebitis ($\chi^2=1.872$, $p=0.222$) or infiltration ($\chi^2=0.467$, $p=0.456$), and the use of a splint, bandage, or tubular net for catheter securement was also not significantly associated with phlebitis ($\chi^2=1.224$, $p=0.315$) or infiltration ($\chi^2=0.000$, $p=1.000$). These findings show a statistically significant association between sterile gauze and tape use with lower rates of phlebitis and infiltration, whereas non-sterile tape use was associated with higher rates of these complications.

Regarding the types of intravenous connectors used, a significant relationship was found between pediatric patients who had infusion sets directly connected to the PIVC and those using other types of connectors concerning both phlebitis and infiltration development ($\chi^2=8.54$, $p=.003$;$\chi^2=10.50$, $p=.001$).

Significant relationships were identified between crystalloid infusions and phlebitis and infiltration development ($\chi^2=5.91$, $p<0.05$;$\chi^2=9.12$, $p=0.05$). Although no significant relationship was found between parenteral nutrition and phlebitis development ($p>0.05$), a significant relationship was observed with infiltration development ($\chi^2=7.34$, $p<0.05$). Additionally, a significant relationship was noted between the continuous and intermittent infusion groups and the development of infiltration compared to the other pediatric patient groups ($\chi^2=8.06$, $p=0.005$;$\chi^2=6.73$, $p=0.009$).

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Table 1. Comparison of phlebitis and infiltration presence by demographic and clinical characteristics in pediatric patients

Demographic and Clinical Characteristics		Phlebitis Presence			Infiltration Presence		
	N (%)	Yes N (%)	No N (%)	p	Yes N (%)	No N (%)	p
Gender							
Girl	80 (47.1)	27 (33.8)	53 (66.3)	x^2=.711	16 (17.8)	74 (82.2)	x^2=.027
Boy	90 (52.9)	25 (27.8)	65 (72.2)	p=0.399	15 (18.8)	65 (81.3)	p=0.870
Age groups							
0-1 years	68 (40.0)	22 (32.4)	46 (67.6)		14 (20.6)	54 (79.4)	
1-3 years	19 (11.2)	6 (31.6)	13 (68.4)	x^2=2.246	4 (21.1)	15 (78.9)	x^2=1.508
3-5 years	14 (8.2)	2 (14.3)	12 (85.7)	p=0.698	1 (7.1)	13 (92.9)	p=0.840
6-12 years	32 (18.8)	9 (28.1)	23 (71.9)		5 (15.6)	27 (84.4)	
12 years and above	37 (21.8)	13 (35.1)	24 (64.9)		7 (18.9)	30 81.1)	
The patient's ward							
Infant Ward	37 (21.8)	11 (29.7)	26 (70.3)		4 (10.8)	33 (89.2)	
Subspecialty Ward	44 (25.9)	15 (34.1)	29 (65.9)		11 (25.0)	33 (75.0)	
Neonatal Intensive Care Unit	38 (22.4)	12 (31.6)	26 (68.4)	x^2=4.845	9 (23.7)	29 (76.3)	x^2=3.393
Surgical Ward	20 (11.8)	5 (25.0)	15 (75.0)	p=0.651	3 (15.0)	17 (85.0)	p=0.481
Surgical Neonatal Intensive Care	5 (2.9)	0 (0.0)	5 (100.0)		0 (0.0)	5 (100.0)	
Pediatric Intensive Care Unit	7 (4.1)	1 (14.3)	6 (85.7)		0 (0.0)	7 (100.0)	
Pediatric Oncology	19 (11.2)	8 (42.1)	11 (57.9)		4 (21.1)	15 (78.9)	
Department where PIVC inserted							
Emergency room /Operating room	17 (10.0)	7 (41.2)	10 (58.8)	x^2=1.820	4 (23.5)	13 (76.5)	x^2=0.581
Intensive care unit	49 (28.8)	12 (24.5)	37 (75.5)	p=0.403	9 (18.4)	40 (81.6)	p=0.796
Ward	104 (61.2)	33 (31.7)	71 (68.3		18 (17.3)	86 (82.7)	
PIVC insertion sites							
Hand	28 (16.5)	7 (25.0)	21 (75.0)		3 (10.7)	25 (89.3)	
Wrist	36 (21.2)	9 (25.0)	27 (75.0)		5 (13.9)	31 (86.1)	
Forearm	28 (16.5)	10 (35.7)	18 (64.3)	x^2=4.565	4 (14.3)	24 (85.7)	x^2=6.491
Antecubital	42 (24.7)	17 (40.5)	25 (59.5)	p=0.601	12 (28.6)	30 (71.4)	p=0.341
Upper arm	2 (1.2)	1 (50.0)	1 (50.0)		1 (50.0)	1 (50.0)	
Foot	24 (14.1)	6 (25.0)	18 (75.0)		5 (20.8)	19 (79.2)	
Other	10 (5.9)	2 (20.0)	8 (80.0)		1 (10.0)	9 (90.0)	
PIVC size							
20 gauge (pink)	6 (3.5)	3 (50.0)	3 (50.0)		2 (33.3)	4 (66.7)	
22 gauge (blue)	53 (31.2)	17 (32.1)	36 (67.9)	x^2=1.931	8 (15.1)	45 (84.9)	x^2=1.936
24 gauge (yellow)	74 (43.5)	23 (31.1)	51 (68.9)	p=0.601	13 (17.6)	61 (82.4)	p=0.582
26 gauge (purple)	37 (21.8)	9 (24.3)	28 (75.7)		8 (21.6)	29 (78.4)	
PIVC dressing type							
Other (other non allerjik tape)	6 (3.5)	1 (16.7)	5 (83.3)	x^2=0.441	1 (16.7)	5 (83.3)	x^2=1.110
Sterile gauze and tape	24 (14.1)	7 (29.2)	17 (70.8)	p=0.879	6 (25.0)	18 (75.0)	p=0.628
Tape only	140 (82.4)	44 (31.4)	96 (68.6)		24 (17.1)	116 (82.9)	
PIVC securement[β]							
Sterile gauze and tape around PIVC	114 (67.1)	18 (15.8)	96 (84.2)	x^2=35.697 **p=0.001****	8 (7.0)	106 (93.0)	x^2=29.208 **p=0.001****
Non-sterile tape around dressing	52 (30.6)	31 (59.6)	21 (40.4)	x^2=29.730 **p=0.001****	22 (42.3)	30 (57.7)	x^2=29.110 **p=0.001****
Non-sterile tape around the stabilizer	3 (1.8)	2 (66.7)	1 (33.3)	x^2=1.872 p=0.222	1 (33.3)	6 (66.7)	x^2=0.467 p=0.456
Splint/bandage/tubular net	11 (6.5)	5 (45.5)	6 (54.5)	x^2=1.224 p=0.315	2 (18.2)	9 (81.8)	x^2=0.000 p=1.000
PIVC insertion day							
X̄+SD	3.04+2.3	3.59+1.9	2.81+2.5	Z=-3.325 **p=0.001****	3.37+1.9	2.98+2.4	Z=-1.710 p=0.087
Age (years)							
X̄+SD				5.45 +6.03			
Min -Max				0.08-18.0			

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Table 1 (continued)

IV connectors$^{\beta}$							
Extension tubing	9 (5.3)	0 (0.0)	9 (100.0)	x^2=4.188 p=0.058	0 (0.0)	9 (100.0)	x^2=2.119 p=0.368
Stopcock/3-way tap	12 (7.1)	2 (16.7)	10 (83.3)	x^2=1.179 p=0.348	1 (8.3)	11 (91.7)	x^2=.849 p=0.697
Needless connector/IV cap	5 (2.9)	2 (40.0)	3 (60.0)	x^2=.215 p=0.642	1 (20.0)	4 (80.0)	x^2=.011 p=1.000
PIVC end cap (PRN adapter)	94 (55.3)	25 (26.6)	69 (73.4)	x^2=1.579 p=0.209	13 (13.8)	81 (86.2)	x^2=2.737 p=0.098
Direct connection to infusion set	52 (30.6)	24 (46.2)	28 (53.8)	x^2=8.549 **p=0.003***	17 (32.7)	35 (67.3)	x^2=10.501 **p=0.001****
PIVC fluids today$^{\beta}$							
Crytalloid (örn. SF, %5 Desktroz)	59 (34.7)	25 (42.4)	34 (57.6)	x^2=5.910 **p=0.015***	18 (30.5)	41 (69.5)	x^2=9.129 **p=0.003***
Colloid or blood products	39 (22.9)	15 (38.5)	24 (61.59	x^2=1.478 p=0.224	11 (28.2)	28 (71.8)	x^2=3.374 p=0.066
Parenteral nutrition	44 (25.9)	18 (40.9)	26 (59.1)	x^2=2.978 p=0.084	14 (31.8)	30 (68.2)	x^2=7.346 **p=0.007***
None	30 (17.6)	6 (20.0)	24 (80.0)	x^2=1.924 p=0.165	4 (13.3)	26 (86.7)	x^2=.587 p=0.444
Not documented / not on the chart	16 (9.4)	4 (25.0)	12 (75.0)	x^2=.260 p=0.778	2 (12.59	14 (87.5)	x^2=.390 p=0.739
Continuous infusion	71 (41.8)	27 (38.0)	44 (62.0)	x^2=3.179 p=0.075	20 (28.2)	51 (71.8)	x^2=8.069 **p=0.005***
Intermittent infusion	68 (40.0)	18 (26.5)	50 (73.5)	x^2=.905 p=0.341	6 (8.8)	62 (91.2)	x^2=6.733 **p=0.009***
Bolus injection	8 (4.5)	4 (50.0)	4 (50.0)	x^2=1.490 p=0.250	2 (25.0)	6 (75.0)	x^2=.258 p=0.639
Flush frequency							
Every 4 hours Every 8 hours Every 12 hours Once a day Not documented Other	64 (37.6) 25 (14.7) 29 (17.1) 23 (13.5) 16 (9.4) 13 (7.6)	17 (26.6) 7 (28.0) 7 (24.1) 8 (34.8) 8 (50.0) 5 8 (8.5)	47 (73.4) 18 (72.0) 22 (75.9) 15 (65.2) 8 (50.0) 8 (61.5)	x^2=4.545 p=0.476	11 (17.2) 5 (20.0) 3 (10.3) 6 (26.1) 3 (18.8) 3 (23.1)	53 (82.8) 20 (80.0) 26 (89.7) 17 (73.9) 13 (81.3) 10 (76.9)	x^2=2.468 p=0.741
PIVC medications today$^{\beta}$							
Electrolytes (KCl, Mg, etc.)	45 (26.5)	16 (35.6)	29 (64.4)	x^2=.711 p=0.399	13 (28.9)	32 (71.1)	x^2=4.659 **p=0.031***
Antibiotic	108 (63.5)	1.5(34)	74 (68.5)	x^2=.111 p=0.739	20 (18.5)	88 (81.5)	x^2=.016 p=0.900
Analgesia /PCA	44 (25.9)	13 (29.5)	31 (70.5)	x^2=.030 p=0.862	11 (25.0)	33 (75.0)	x^2=1.822 p=0.177
Sedation	8 (4.7)	3 (37.5)	5 (62.5)	x^2=.189 p=0.701	2 (25.0)	6 (75.0)	x^2=.258 p=0.639
Diuretic	18 (10.6)	8 (44.4)	10 (55.6)	x^2=1.820 p=0.177	5 (27.8)	13 (72.2)	x^2=1.229 p=0.329
Anti-emetic	12 (7.1)	4 (33.3)	8 (66.7)	x^2=.046 p=1.000	2 (16.7)	10 (83.3)	x^2=.021 p=1.000
Gastric protection	17 (10.0)	7 (41.2)	10 (58.8)	x^2=.997 p=0.318	6 (35.3)	11 (64.7)	x^2=3.687 p=0.090
Anticonvulsant	9 (5.3)	4 (44.4)	5 (55.6)	x^2=.859 p=0.458	3 (33.3)	6 (66.7)	x^2=1.453 p=0.212
Chemotherapy	12 (7.1)	4 (33.3)	8 (66.7)	x^2=.046 p=1.000	1 (8.3)	11 (91.7)	x^2=.849 p=0.697
Other	6 (3.5)	4 (66.7)	2 (33.3)	x^2=3.813 p=0.072	3 (50.0)	3 (50.0)	x^2=4.209 p=0.075
None	30 (17.6)	10 (33.3)	20 (66.7)	x^2=.129 p=0.827	6 (20.0)	24 (80.0)	x^2=.076 p=0.796

*: Multiple options; x^2: Chi-square; Z: Mann-Whitney U test; $\bar{X}$+SD: Mean+ Standard deviation; *: p<0.05; **: p<0.000

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Table 2. Peripheral intravenous catheter insertion, usage, and assessment characteristics

Characteristics	Number	%
PIVC inserter		
Nurse	170	100.0
Time of the day PIVC inserted		
Documented	13	7.6
Not documented	157	92.4
Reasons for PIVC insertion		
IV fluids	77	45.3
IV medications	140	82.4
Blood raw	30	17.6
Unstable patient (resuscitation required)	8	4.7
Blood transfusion	6	3.5
Parenteral nutrition	15	8.8
Chemotherapy	13	7.6
Unknown	17	10.0
PIVC assessment record in the last 24 hours		
Yes	39	22.9
No	131	77.1
Dressing assessment		
Clean, dry and intact	123	72.4
Moist and dirty due to blood/leakage	14	8.2
Dry and dirty due to blood/leakage	23	13.5
Loose or lifted edges	10	5.9
PIVC local complications		
No complications	112	65.9
Pain/Tenderness on palpation	53	31.2
Redness >1 cm from insertion site	45	26.5
Swelling >1 cm from insertion site	23	13.5
Itching/rash under dressing	10	5.9
Bruising/dried blood around PIVC	3	1.8
Palpable hard vein beyond catheter tip	15	8.8
Red streak along vein	20	11.8
Induration/firmness > 1 cm	1	0.6
PIVC leakage	1	0.6
Extravasation/infiltration	3	1.8

Table 3. Prevalence and grading of phlebitis and infiltration in peripheral intravenous catheters

Phlebitis/Infiltration Status	Number	%
Presence of Phlebitis		
Yes	52	30.6
No	118	69.4
Phlebitis Grade		
Grade 0	118	69.4
Grade 1	25	14.7
Grade 2	20	11.8
Grade 3	7	4.1
Presence of Infiltration		
Yes	31	18.2
No	139	81.8
Infiltration Grade		
Grade 1	20	11.8
Grade 2	11	6.4

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When examining the types of medications administered through PIVCs, no significant relationship was found between the development of phlebitis and the types of medications used, including electrolytes (KCL, Mg, etc.), antibiotics, analgesics/analgesics/patient-controlled analgesia (PCA), sedatives, diuretics, antiemetics, gastric protectors, anticonvulsants, chemotherapy, and other medications ($p>0.05$). Similarly, no significant relationship was observed between these medication types and infiltration development ($p>0.05$). However, a significant relationship was identified between electrolyte medications (KCL, Mg, etc.) and the development of infiltration ($\chi^2 = 4.65$, $p = 0.031$) (Table 3).

Discussion

Infiltration and phlebitis are painful conditions in neonates and children that can interrupt treatment and prolong hospitalization [24]. Establishing standardized protocols for intravenous catheterization, along with proper catheter insertion and post-catheterization monitoring, is essential for preventing these adverse events [19,24-26]. In this study, infiltration was observed in 18.2% of pediatric patients, with 11.8% classified as Grade 1, while phlebitis was observed in 30.6%, including 14.7% with Grade 1 severity. Reported rates in the literature vary widely. For example, Indarwati et al. (2020) documented infiltration rates ranging from 6% to 87% and phlebitis rates from 0.6% to 18% in pediatric patients [27], while Park et al. (2016) found markedly lower infiltration rates—0.9% in the experimental group and 4.4% in the control group [23]. Other studies reported intermediate to high rates: Ben Abdulaziz et al. (2017) noted 37.2% infiltration and 5.1% phlebitis [28]; Baye et al. (2023) found 42.1% and 29.7%, respectively [11]; and Suliman et al. (2020) reported 53.4% phlebitis, with 56.7% classified as Grade 1 [5]. Similarly, Şimşek et al. (2023) observed 57.9% infiltration—mostly first-degree [29]—and Temizsoy et al. (2017) reported a 35.0% infiltration rate in pediatric patients [30]. Taken together, these studies highlight substantial variability in complication rates, yet the findings of this study fall within the reported range. In light of these results, and despite advances in pediatric care and medical technology, infiltration and phlebitis remain persistent safety concerns, affecting not only patient outcomes but also quality of care and healthcare costs. In this study, there is a clear clinical need for vigilant monitoring, accurate assessment, and timely intervention during peripheral intravenous catheter use. From a practical perspective, the findings suggest that current routine care may not be sufficient to prevent such events, emphasizing the importance of integrating standardized protocols and targeted staff training into daily clinical workflows to reduce adverse outcomes and related healthcare costs. Theoretically, these results provide pediatric-specific evidence reinforcing that infiltration and phlebitis remain significant challenges despite advances in technology and clinical practice, and they support further investigation into modifiable institutional and procedural factors that may influence complication rates.

Peripheral catheters are recommended to be changed based on clinical indications rather than routine time intervals due to insufficient evidence supporting scheduled replacement [8,31]. In this study, the mean dwell time of peripheral catheters in pediatric patients was 72.96 ± 55.2 hours, and a statistically significant relationship was found between catheter dwell time and the development of phlebitis and infiltration. Previous studies have reported variable dwell times — 68.82 ± 35.7 hours [28] and 55.6 hours [32] — likely reflecting differences in patient characteristics, protocols, and catheter management strategies. Building on these observations, the findings of this study point to the critical role of ongoing site assessment and prompt action at the earliest signs of complications, moving beyond a sole reliance on fixed dwell time limits. An individualized approach can reduce unnecessary catheter replacements while minimizing complication risks, supporting the integration of dwell time assessment into evidence-based vascular access protocols.

Structured catheter care bundles have been shown to extend dwell time, as reported by Tasdelen & Çağlar (2021) [26], and Kleidon et al. (2019) [33], yet this study did not implement such a bundle. The absence of standardized protocols may have contributed to variability in catheter longevity and complication rates. Additionally, Park et al. (2016) highlighted the role of early infiltration detection in reducing dwell time [23], emphasizing the need for continuous monitoring. Unlike longitudinal studies, this research was conducted as a point prevalence study, limiting real-time assessment of catheter-related complications. Findings from this study indicate that appropriate PIVC securement methods have the potential to reduce complication risk and extend catheter dwell time in pediatric patients.

Effective catheter dressing and securement are critical for preventing complications and ensuring pediatric patient safety [34]. Proper techniques help maintain catheter stability, minimize micro-movements that cause irritation, thrombosis, and infection, and provide a barrier against microbial colonization [21,27,35]. In this study, sterile gauze and tape securement was associated with lower infiltration and phlebitis rates, whereas non-sterile tape significantly increased these risks. Corley et al. (2019) similarly reported that the most common securement methods worldwide were sterile tape around the catheter hub (27%) and non-sterile tape over the primary dressing (25%) [34]. While sutureless devices were more prevalent in North America (22%), non-sterile tape use remained widespread in Asian hospitals (46%) and was even higher in low-income countries (55%) [34]. Previous studies have reported inconsistent infiltration rates depending on the securement method—some showing no significant difference [36], while others demonstrated lower infiltration with transparent dressings [26,32,37,38]. Conversely, Tasdelen & Çağlar (2021) and Abusafia & Boztepe (2017) found higher infiltration rates prior to the implementation of intravenous

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management programs [26,37]. These discrepancies may be related to variations in pediatric populations, securement materials, and catheter care practices, underscoring the need for standardized protocols. In line with this need, in this study sterile securement methods were linked to fewer complications and longer catheter dwell times. These low-cost, easily applied techniques can be readily adopted in routine care, offering pediatric-specific evidence that supports their role as a key element of evidence-based vascular access management.

In infusion practice, additional devices (e.g., single or multi-lumen extension sets and needle-free connectors) should only be used when clinically indicated. Systems that minimize manipulation and reduce multiple connections, such as compatible extension sets, are preferable [12,13,25]. Consistent with previous studies, in this study groups without additional infusion sets had significantly lower rates of phlebitis and infiltration [4,39,40]. Given these results, large-sample studies are warranted to further explore the impact of infusion sets and pumps on PIVC complications in pediatric patients. Minimizing unnecessary components may reduce PIVC-related complication risks in pediatric patients, streamline procedures, lower costs, and lessen nursing workload.

The pharmacokinetic properties of drugs, osmolarity of fluids, duration of administration, and structural characteristics of the veins are key factors influencing the risk of infiltration [26,28,31]. High-density drugs and rapid bolus administration can damage the vein wall, increasing the likelihood of infiltration and phlebitis [21]. In this study, continuous infusion was observed more frequently among pediatric patients with infiltration, whereas intermittent infusion was observed less frequently. Given the observational, point-prevalence design, this association does not clarify whether these infusion types are protective or risk-enhancing. When contextualized within the broader literature, previous studies have identified several risk factors for PIVC-related complications in pediatric patients. Braga et al. (2018) reported that longer hospital stays and higher catheter numbers increased phlebitis risk, while piperacillin/tazobactam use and catheter number were associated with higher infiltration rates [13]. Uslusoy and Mete (2008) found phlebitis in 57% of pediatric patients receiving no fluids, 45% receiving isotonic fluids, and 73% receiving hypertonic fluids, with no significant difference by infusion duration [4]. Other studies have consistently shown that hypertonic and high-dextrose fluids increase complication rates [6,27,35]. Similarly, Abusafia and Boztepe (2017) observed more complications in pediatric patients receiving antibiotics compared with those not receiving antibiotics [37]; Wallis et al. (2014) reported a 69.0% phlebitis rate among pediatric patients receiving antibiotics [9]; and Pasalioglu and Kaya (2014) found a 2.4-fold higher prevalence in this group [40]. In this study, fluid selection emerged as a potentially modifiable factor in PIVC management for pediatric patients. Choosing fluids with osmolarity suited to the vein and patient condition, and avoiding unnecessary antibiotics, may help lower complication risk, improve safety, and reduce repeated catheter insertions. These findings also emphasize the need for closer monitoring by nurses when administering high-osmolarity fluids or antibiotics, and add pediatric-specific evidence that fluid characteristics play a key role in complication risk and patient safety.

Limitations and Strengths

This study had several limitations that should be acknowledged. First, the population consisted solely of pediatric patients from specific units of a university hospital, which may limit the generalizability of the findings. Additionally, a longer follow-up period is needed to better evaluate PIVC-related complications and long-term effects. Furthermore, the observational, descriptive, and point-prevalence design of the study restricts the ability to establish causal relationships, as it focuses on capturing a snapshot of the current situation rather than tracking changes over time. Another limitation is the reliance on nurse notes and patient records, which may have led to incomplete or inconsistent data, potentially affecting result accuracy. Finally, as a single-center study, this study did not control for factors such as vein selection, catheter gauge, insertion technique, and clinical decision-making, which may have influenced the findings.

Despite these limitations, this study had several strengths. It offers valuable insights into the prevalence of phlebitis and infiltration among diverse pediatric populations, enhancing the understanding of these prevalent complications. A comprehensive data collection approach, which utilizes interviews, direct observations, and medical record reviews, enhances the reliability of the findings. Including various pediatric units increases the representativeness of the sample, providing broader insights into the factors influencing complications in different clinical settings.

Recommendations for Further Research

Future research should focus on larger multicenter studies aimed at developing robust evidence-based guidelines that enhance safety and pediatric patient satisfaction. Conducting long-term follow-up studies will yield valuable insights into the enduring effects of PIVC. Additionally, creating comprehensive educational programs for pediatric patients and caregivers regarding PIVC application and care is vital to minimize complications. Lastly, promoting the widespread adoption of advanced technologies for PIVC placement and monitoring will further enhance its safety and efficacy in pediatric care.

Implications for Practice

The results of this study have significant implications for pediatric nursing in the management of PIVCs. To improve outcomes, it is vital to implement robust monitoring protocols that ensure early detection of complications such as phlebitis and infiltration. Ongoing education and training of nurses on best practices, including proper dressing techniques and recognizing early warning signs, are essential. Standardizing the use of transparent adhesive dressings can enhance visibility at the

catheter site, aiding in prompt intervention. Additionally, clear guidelines for administering fluids and medications, particularly hypertonic solutions, are crucial to minimize complications. Effective collaboration and communication among healthcare team members will further enhance the catheter management.

Conclusion

This study identified notable rates of phlebitis (30.6%) and infiltration (18%) associated with PIVC use in pediatric patients. Key factors influencing these complications included dressing type, intravenous connector and fluid types, and infusion methods. The use of nonsterile adhesive tape significantly increased the risk of both phlebitis and infiltration, while electrolyte-containing medications were associated with higher infiltration rates. These results underscore the importance of comprehensive catheter management, including appropriate dressing and securement methods, monitoring catheter dwell time, carefully evaluating infusion types, and minimizing unnecessary device connections to reduce the risk of phlebitis and infiltration in pediatric patients.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
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Ethical Approval
Ethical approval and institutional permission for the study were obtained from the Non-Interventional Clinical Research Ethics Committee of the Health Sciences University Tepecik Training and Research Hospital (Decision No: 2022/12-15, dated January 11, 2023).

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