Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 32s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Enhancing Phlebitis Detection In Paediatric Patients Through Routine Physician Inspections-A Prospective Observational Study

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Cite this paper as: Malraj Sai Rohit ,Sudha Reddy V R, (2025) Enhancing Phlebitis Detection In Paediatric Patients Through Routine Physician Inspections-A Prospective Observational Study. *Journal of Neonatal Surgery*, 14 (32s), 8087-8094.

ABSTRACT

Background: Phlebitis (inflammation of the vein) is a common complication of peripheral intravenous (IV) cannulation, particularly among the pediatric population .Its prompt recognition is essential to avoid complications such as thrombophlebitis, bloodstream infections, and increased length of stay. Although nurses routinely monitor IV sites, doctors inspecting the IV sites may improve detection of phlebitis and minimize negative outcomes associated with the complication.

Objective: To assess the impact of a routine physician inspection of the peripheral IV site on the identification of phlebitis in hospitalized children at a tertiary care hospital and to determine risk factors related to the condition.

Methods: Twenty-four month prospective observational study was conducted at R.L. Jalappa Hospital & Research Centre. A total of 237 children (aged 1 month to 12 years) requiring IV cannulation were included. Phlebitis was determined using the Visual Infusion Phlebitis (VIP) score, and nurses monitored once every 8 hours (3 times daily) and doctors inspected twice daily. The FLACC and Wong-Baker pain scores were used when appropriate.

Results:A total of 237 children were assessed, with phlebitis diagnosed in 33 samples (13.92%). The nurse detected 14 phlebitis cases (5.9%), and the doctor identified 19 phlebitis cases; however, the statistical significance showed that the number of cases the doctor identified was higher than the number of samples the nurse identified ($p < 0.05$). More phlebitis was observed in younger children (≤3 years).

Conclusion: Regularly performed physician inspection was superior to nursing alone in detecting phlebitis in children. Since younger children are more likely to develop phlebitis, monitoring is vital. There is a need to explore a dual surveillance model that incorporates nursing and physician assessment to prevent diagnosis from being missed. It is expected that the clinical outcome will also improve..

1. INTRODUCTION

Phlebitis is due to inflammation of a vein, which is a frequent complication of the peripheral IV catheters (PIVCs). Among complications related to IV intravenous cannulation (IV) are extravasation and thrombophlebitis in pediatric patients[1]. Symptoms include discomfort, pain, erythema, and swelling at the catheter insertion site. If untreated, phlebitis may develop into advanced infections or even systemic complications. Early diagnosis and treatment is necessary to avoid such outcomes.

Phlebitis in pediatric patients presents unique challenges. Due to the fragility of puny veins, immature immune systems, and failure of children to accurately communicate pain or discomfort, diagnosis of phlebitis becomes complicated.

The basis of phlebitis is pathophysiological, where an inflammatory response occurs following injury to endothelial cells. There are multiple causes of endothelial engagement: the catheter may produce mechanical trauma, infusion may lead to chemical irritation, or the patient may have a microbial infection. An inflammatory process follows and produces the classic signs of pain, swelling, and redness.

Risk factors for pediatric phlebitis are related to catheter characteristics, such as size, material, or duration of placement, and

patient factors, such as age, comorbidities, and vein fragility. Specific medications, especially hyperosmolar or irritant drugs, increase this risk. Other factors, such as poor catheter management, lack of hygiene, and infrequent inspection of the filament, lengthen exposure to phlebitis.

Regular physician examination is an important intervention for the identification and management of phlebitis. Although the nursing team undertakes regular observations, physicians provide a broader perspective. By utilizing routine inspections, the early signs of phlebitis can be recognized and treated swiftly, which helps to prevent complications.

Children are significantly more likely to be affected by complications resulting from phlebitis. While there have been some limited studies exploring peripheral venous cannulation adverse events (PVCAE), there are sparse data available for the exclusively pediatric group .[2,3] PVACEs are routinely recorded on nursing observations using the Visual Infusion Phlebitis (VIP) score.[4,5]

By using the VIP score tool to assess early signs of phlebitis and removal of PIVCs, the rate has been effectively lowered below the acceptable benchmark of five percent[6].

This study aims to evaluate the impact of routine physician inspection on the detection rates of phlebitis in pediatric patients.

2. AIMS & OBJECTIVES

AIMS:

To evaluate the effectiveness of routine physician inspection in enhancing the detection of phlebitis in pediatric patients.

OBJECTIVES:

Identify phlebitis in children aged 1 month to 12 years who required IV cannulation by using VIP Scores.

To determine phlebitis in children aged between 1 month and 12 years of age requiring IV cannulation by applying VIP scores by doctors.

To compare rates of phlebitis between the observations by nurses and doctors.

To determine the factors associated with phlebitis

3. MATERIALS AND METHODS

The study was a prospective observational study conducted over 1 year and 6 months (May 2023 to October 2024) at R.L. Jalappa Hospital & Research Centre (RLJH&RC), including all pediatric patients aged 1 month to 12 years admitted to the PICU and pediatric wards who required IV cannulation and provided consent to participate.

INCLUSION CRITERIA:

All pediatric patients aged between 1 month and 12 years of age admitted to the PICU and paediatric wards at RLJH&RC who were on IV therapy.

EXCLUSION CRITERIA:

1. Children with a central venous catheter.
2. Children with scalp vein cannulation.
3. Children with dermatological disorders.
4. Children diagnosed with a primary vasculitis.
5. Children receiving chemotherapeutic agents.
6. Children on mechanical ventilator support.

SAMPLE SIZE:

The sample size was calculated based on a reported phlebitis incidence of 19% in patients who underwent IV cannulation, as noted in the study by Sengupta M[6].

Assuming a 95% confidence level, the required sample size was calculated to be 237 participants.

4. METHODOLOGY:

This study was conducted at RLJH&RC, affiliated to Sri Devaraj Urs Medical College, a constituent of Sri Devaraj Urs Academy of Higher Education and Research. VIP score was applied to the included patients, and they were graded from 0 to 5 as follows[7] :

Table 1: The Visual Infusion Phlebitis score

APPEARANCE	RATING	PHASE
IV site looks to be in a good condition Action: Monitor the cannula	0	No indications of phlebitis
An obvious indication was present from the options provided ● Mild discomfort at the IV location or ● Mild redness surrounding the IV insertion site Action: To Monitor IV cannula	1	Possibly first Indication of phlebitis
Any two of the following were noticeable. ● Discomfort at the IV site ● Inflammation ● Enlargement Action: To recite the cannula	2	Early stage of phlebitis
All of the subsequent signs were apparent. ● Discomfort along the path of the cannula ● Inflammation surrounding the area ● Enlargement Action: recited the cannula and consider treatment	3	Medium stage of phlebitis
All of the following signs were evident and extensive ● Discomfort along the route of the cannula ● Discoloration of the surrounding area ● Swelling ● Palpable venous cord Action: To recite the cannula and consider treatment	4	Advanced stage of phlebitis or start of thrombophlebitis
All of the following signs were evident and extensive Discomfort in the area where the cannula is placed. Inflammation and swelling around the area. Noticeable vein-like structure Fever Action: initiated treatment/ recited cannula	5	Advanced stage thrombophlebitis

Information such as the patient's age, gender, size of the cannula, insertion location, duration of indwelling, specifics of intravenous fluids, medications given, and any blood products used were recorded.

All patients fulfilling the inclusion criteria were visited daily, and the cannula insertion site was examined for signs of phlebitis using VIP scoring by staff nurses thrice a day, at 8 am, at 2 pm, and at 8 pm. If the site looked healthy, then a saline flush with 2ml normal saline was given.

Pain at the IV site and along the path of the cannula was assessed using the FLACC Scale [8] in infants 3 years and below and the Wong Baker Faces pain scale was used for children 3 years and above [9].

On the same day, the patient was examined by the physician using VIP scoring twice a day, at 9 am and at 4 pm. Altogether, a total of 5 observations were done in a day.

VIP score more than or equal to 2 was considered phlebitis and warranted a change of cannula.

The monitoring was carried out on a daily basis until the patient was discharged or the cannula was removed because of thrombophlebitis.

Thrombophlebitis cases noted by doctors and nurses were analyzed to determine if there was a statistically significant difference in the rates of detection. Based on the grades, suitable measures were implemented.

STATISTICAL ANALYSIS: Samples were analyzed and assessed using a Paired T-test. A P-value of <0.05 was considered statistically significant. The confidence interval was set at 95%.

OBSERVATIONS AND RESULTS

A total of 237 patients were included in the study.

Table 2: Distribution of subjects based on indwelling time of cannula (n=237)

Duration of Cannula	No of Patients	Percentage
≤3 days	113	47.67%
>3 days	124	52.32%

Table 2 depict that 124 children (52.32%) had cannulas in place for more than 3 days, whereas 113 children (47.67%) had cannulas inserted for 3 days or less.

Table 3: Distribution of subjects based on intravenous (IV) fluids and medication administered

IV Fluids and Medication Administered	**No. of Patients**	**Percentage**
Maintenance IV Fluids (with potassium)	65	27.42%
Antibiotics	61	25.72%
Blood Products	26	10.97%
3% NS	15	6.32%
Mannitol	11	4.64%
Saline Bolus Infusion	23	9.70%
Antiepileptics	17	7.17%
Calcium Infusion	19	8.01%

Table 3 depict that the most used fluid was maintenance IV fluids with potassium (27.4%). This was followed by antibiotics (25.72%) and blood products (10.9%). Saline bolus infusion was used in 9.70% of the cases followed by 3% normal saline (6.32%) and mannitol (4.64%). Antiepileptics were used in 7.17% of cases and calcium infusion was administered in 8.01% of the patients.

Table 4: Distribution of occurrence of phlebitis (VIP Score ≥ 2) detected by nurses & physician (n=237)

No of cannulas assessed	No of Phlebitis cases detected by Nurses	No of phlebitis cases detected by the Physician	Total phlebitis detected	p-value
237	14 (5.90%)	19 (8.02%)	33 (13.92%)	<0.05

Table 4 depicts that out of 273 cannulations, 33 (13.92%) had phlebitis. Nurses identified 14 cases (5.90%), and physicians identified a further 5 cases above what the nurses had identified, totaling up to 19 instances (8.02%). Statistical Significance was observed in phlebitis detection rates between nurses (5.9%) and doctors (8.02%) (p <0.05).

Table 5: Comparison of cannula sites in Phlebitis and Non-Phlebitis Groups

Site of Cannula	With Phlebitis (N = 33)	Without Phlebitis (N = 204)	P-value
Cephalic Vein	4 (12.12%)	53 (25.98%)	<0.05
Basilic Vein	7 (21.21%)	38 (18.62%)	
Median Cubital Vein	5 (15.15%)	26 (12.74%)	
Great Saphenous Vein	6 (18.18%)	26 (12.74%)	
Dorsal Venous Network (Hand)	9 (27.27%)	44 (21.56%)	
Dorsal Venous Network (Foot)	2 (6.06%)	17 (8.35%)	

Table 5 depicts that incidence of phlebitis was higher in the Dorsal Venous Network of the hand (27.27%). The Dorsal Venous network of foot had a much lower phlebitis rate (6.06%). Great saphenous vein showed a moderate association with phlebitis (18.18%) followed by the Basilic Vein (21.21%), the Median cubital vein (15.15%) and Cephalic vein (12.12%). The association between the cannula site and phlebitis showed a highly significant p value of <0.05

Table 6: Comparison of IV fluids and medications administered in Phlebitis and Non-Phlebitis Groups

IV Fluids/Medication	With Phlebitis (N = 33)	Without Phlebitis (N = 204)	P-value
Maintenance IVF (with potassium)	15 (45.45%)	50 (24.50%)	0.02
Antibiotics	10 (30.30%)	51 (25.00%)	0.01
Blood Products	6 (18.18%)	20 (9.80%)	0.03
3% NS	1 (3.03%)	14 (6.86%)	1.00 (NS)
Mannitol	0 (0%)	11 (5.39%)	0.5 (NS)
Saline Bolus Infusion	1(3.03%)	22 (10.78%)	1.0 (NS)
Antiepileptics	0 (0%)	17 (8.33%)	1.0 (NS)
Calcium Infusion	0 (0%)	19 (9.31%)	1.0 (NS)

Table 6 depicts the comparison of phlebitis with the type of IV fluids and medications administered. Among patients who developed phlebitis, 45.45% received maintenance IV fluids with potassium, 30.30% received antibiotics, and 18.18% received blood products. In contrast, only 3.03% each were administered 3% NS and saline bolus infusion. Maintenance IV fluids with potassium, antibiotics, and blood products were shown to be statistically significant among patients with phlebitis, with a p-value less than 0.05.

5. DISCUSSION:

This prospective observational study conducted in a tertiary care Hospital focused on improving the early detection of phlebitis in pediatric patients through routine physician assessments. This study evaluated the impact of clinical assessments to identify phlebitis in children with an IV cannula. This resulted in the detection of more phlebitis cases by doctors than Nurses, improving early intervention opportunities. Risk-associated factors such as cannula size, type of IV fluids given, duration of cannula, medicine administered, and the cannula site were also identified. Routine physician inspections led to better VIP scoring accuracy.

Occurrence of phlebitis (VIP Score ≥ 2) detected by nurses and physicians

The present study showed that out of 237 cannulas assessed, an overall phlebitis rate of 13.92% was detected. Nurses identified 14 cases of phlebitis (5.90%), while doctors detected 19 cases (8.02%). Nurses reported a mean score of 0.36 ± 0.28, whereas doctors reported a higher mean score of 0.51 ± 0.47. The difference between the two groups is statistically significant, indicating that doctors tend to rate the severity of phlebitis higher than nurses.

Robert et al. [1] revealed that nearly 45% of total phlebitis cases were detected through additional physician observation beyond routine nursing assessment, which aligns well with our study.

In a study by Gallant et al. [5] demonstrated about trend of phlebitis using Visual Infusion Phlebitis (VIP) scores ≥ 2. At 24 hours, 1.0% of the 789 catheters had significant phlebitis scores, slightly increasing to 1.8% and 1.9% at 48 and 72 hours, respectively. The incidence of phlebitis then fluctuated, with 1.1% at 96 hours and a peak of 2.8% at 120 hours. By 144 and 170 hours, the rates dropped to 0.9% and 0%, respectively.

Phlebitis of subjects based on Age and Gender:

Phlebitis was commonly seen in children aged 1 month and 3 years (36.66%) and in children between 3 and 6 years (27.27%), with a highly significant value of $p<0.05$. Children age above 6 years had fewer cases of phlebitis with statistically significantly lower rates.

Andriyani R et al [10], found that the median age of the participants in the case group (with phlebitis) was 1 year and 6 months, and in the control group, it was slightly higher (1 year and 9 months). The age range in both groups was comparable, with the case group ranging from 2 months to 16 years and the control group from 1 month to 16 years.

In regard to gender distribution, a slightly higher proportion of female subjects were observed in the present study (54.44% vs. 45.56%). There was no statistically significant difference in the occurrence of phlebitis between males and females ($p>0.05$). Similar observations were made by Sumathy et al [11], where the majority of the patients belonged to the female category (55%), and 45% belonged to the male category out of 40 pediatric patients.

Phlebitis of subjects based on the Site of the Cannula:

In the present study, Phlebitis was significantly higher in children with cannulas inserted into the dorsal venous network of the hand (27.27%), basilic vein (21.21%), and great saphenous vein (8.18%) with a highly significant value of $p < 0.05$. The median cubital vein accounted for 15.15% of the phlebitis cases. The dorsal venous network of the foot had a lower incidence, with only 2 out of 33 patients developing phlebitis (6.06%).

Similar to our findings, Nikhila et al [12]Their study revealed a preference of cannulation site in the upper extremity (Metacarpal vein, Cubital fossa, and wrist). However, our study observed higher use of the dorsal hand vein and the basilic vein.

Resnick et al [13]In his study, he revealed that the dorsal hand was the most common site (46.2%), especially in younger children (used in 75% of infants aged 0–3 months), which aligns well with our study.

Distribution of subjects based on size of cannula:

Our study revealed that 24G cannulas were more commonly used (58.22%) compared to 22G cannulas (41.77%). Among patients who developed phlebitis, 66.66% had 24G cannulas, while 33.33% had 22G cannulas with a significant value of $p<0.05$. In the non-phlebitis group, 56.86% had 24G and 43.13% had 22G cannulas.

Nikhila et al[12], showed the large bore cannulas was less frequently used (18G- 11% and 16G - 0.7%), and the most commonly used IV Cannula gauge was 20G(64.4%) and 22G (24%), which is similar to our study.

In a study conducted by Kumar P et al [14] found a significant variation in the use of the size of the cannula, with the 24-gauge cannula being the predominant option. A total of 72 patients (83.7%) used a 24G cannula, and the 22G cannula was used in 14 patients (16.3%), which aligns well with our study.

In contrast, Mandal et al [15]in their study observed that phlebitis was seen more commonly with large-bore catheters. The incidence was found to be 37.97% with 18G catheters and 23.94% with 20 G catheters.

Phlebitis of subjects based on the duration of the cannula:

The present study revealed that out of 237 patients, 52.32% of cannulas were in place for more than 3 days, while 47.67% were used for less than 3 days. Among patients who developed phlebitis, 63.63% had cannulas inserted for more than 3 days, compared to 36.36% of the pateints who had cannulas for less than 3 days. In the non-phlebitis group, the distribution was more balanced, with 54.90% having cannulas for more than 3 days and 45.09% for less than 3 days. The association between longer cannula duration and phlebitis was found to be statistically significant ($p < 0.05$).

In a study conducted by Rita Andriyani [10]The duration of the cannula was categorized as <72 hours or ≥72 hours. The mean duration of the cannula was found to be 66 hours (2 days and 18 hours). In their study

In a study by Sumathy [11], revealed that 37.5% of the participants received infusions for less than 2 hours daily, whereas a smaller proportion of participants received infusions for longer durations (2.5% for both 5–6 hours and >6 hours). The

majority of the participants (60%) received infusions for 2 to 4 hours a day.

The study by Kaphan et al [16], revealed that 95.4% of the cases had a catheter dwell time of less than 4 days. Only 3.2% of the cases had a catheter in place for more than 4 days, while 1.4% had an unknown catheter dwell time.

Phlebitis of subjects based on the IV Fluids and Medications Administered:

The present study revealed that the most commonly administered drugs were the maintenance IV fluids containing potassium (27.42%) and antibiotics (25.72%). A significant association was observed between potassium-containing fluids and phlebitis, with 45.45% of phlebitis cases receiving maintenance IV fluids containing potassium compared to 24.50% in the non-phlebitis group ($p < 0.05$). 30.30% had received antibiotics, and 18.18% of patients received blood products, while 3% NS and saline bolus were less frequently used (3.03%). No phlebitis cases were identified among patients who received mannitol, antiepileptics, or calcium infusion.

Similar to our study, Robert et al [1], found that the administration of IV Fluids containing potassium was significantly associated with phlebitis rate (31 out of 35 cases). High-risk Medication (HRM) and fluid boluses were also significant.

In a study conducted by Shinzato et al [17]The most common administered drugs included fentanyl (16.6%), followed by lipid emulsion (9.8%) and heparin (9.4%), with significant associations observed in phlebitis incidence. Dexmedetomidine and ampicillin were also frequently used in their study.

Mandal et al[15], showed that the use of antibiotics was associated with a higher incidence of phlebitis compared to those who did not receive Antibiotics. Administration of Blood Products also resulted in the incidence of phlebitis, with no significance.

According to Kaur's findings, [18] 46% of children were given free water solution (Dextrose Normal Saline). Additionally, 87% of the children in their study received antibiotics, indicating a higher prevalence or wider use of intravenous antibiotic therapy in that context.

6. CONCLUSION:

Routine physician inspections significantly enhanced early phlebitis detection, showing higher VIP scores and identifying more cases than nurses.

The occurrence of phlebitis was significantly influenced by the cannula insertion site, gauge size, duration of use, and the administration of IV Fluids with potassium maintenance, Antibiotics, and blood products.

Younger pediatric patients (especially under 6 years) are more vulnerable to phlebitis, reinforcing the need for regular and vigilant observations by physicians in this age group

7. LIMITATIONS

In this study, a detailed comparison between Nurses and doctors' detection of Phlebitis was not done by having case and control groups. This can be incorporated in future studies.

The knowledge and practice with regard to the management of Phlebitis of Nurses and Doctors is not documented, which can be done in future studies.

The experience of Doctors and Nurses can also be taken into consideration in future studies to assess who picks up phlebitis quicker based on their exposure of being in various Hospital setups.

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