

## ORIGINAL ARTICLE

# INTRAVENOUS CANNULATION IN CHILDREN: COMPLICATIONS AND RISK FACTORS. A CROSS-SECTIONAL STUDY

Muhammad Shabbir<sup>1</sup>, Farooq Abdullah<sup>2</sup>, Adulrahman Saad Alfaiz<sup>1</sup>, Ambreen Liaqat<sup>1</sup>, Muhammad Mohsin Sajjad<sup>3</sup>, Olena Pokryshko<sup>4</sup>, Muhammad Ijaz<sup>5</sup>, Fouad Ayidh Awn Alshubayshiri<sup>1</sup>, Ali Hamad Alwarthan<sup>1</sup> Muath AlAmmar<sup>1</sup>

<sup>1</sup>Department of Medicine, College of Medicine Shaqra, Shaqra University, Saudi Arabia, Departments of Surgery, <sup>2</sup>Lady Reading Hospital, Peshawar, & <sup>3</sup>Shifa International Hospital, Islamabad, Pakistan, <sup>4</sup>Department of Microbiology, Ternopil State Medical University, Ukraine, <sup>5</sup>Department of Pediatrics, Khyber Teaching Hospital, Peshawar, Pakistan

## ABSTRACT

**Background:** Intravenous cannulation (IVC) is a common medical procedure for administering fluids and medications, but it carries risks such as phlebitis and infection, particularly in children. This study aimed to determine the incidence of complications associated with IVC in children and identify associated risk factors.

**Materials & Methods:** A cross-sectional descriptive study was conducted at Lady Reading Hospital, Peshawar, from January 2023 to March 2023. Data were collected from pediatric surgery and pediatric medicine units. A standardized Proforma was used to collect patient demographics, IVC insertion details, and complications. Data were analyzed using appropriate statistical methods (quantitative data as mean and standard deviations, qualitative data as frequency and percentages). Chi square test was used to determine significance with p-value less than 0.05 as significant at 95% confidence interval.

**Results:** Among 279 patients, the most common complication was phlebitis (53.4%). The predominant insertion sites were the right and left hand dorsum (23.3% each), with 24G cannula being most frequently used (94.6%). Complications were more prevalent in patients with comorbidities. Longer duration of catheter placement correlated with increased complication rates. Phlebitis incidence rose from 2.3% on day 1 to 83.7% on day 3. Interestingly, complications were higher with glove use during insertion.

**Conclusion:** Complications associated with IVC insertion are higher in children with comorbid, using dominant hand and IVC on bony prominences or joints. Use of aseptic measures decreases the incidence of these complications. Further research is needed to explore preventive strategies and improve patient outcomes.

**KEY WORDS:** Intravenous cannula; Phlebitis; Venous Access.

**Cite as:** Shabbir M, Abdullah F, Alfaiz AS, Liaqat A, Sajjad MM, Pokryshko O, et al. Intravenous cannulation in children: complications and risk factors. a cross-sectional study. Gomal J Med Sci 2024 Apr-Jun;22(2):87-91. <https://doi.org/1046903/gjms/22.02.1397>

## INTRODUCTION

Intravenous Cannulation is performed in patients who require intravenous therapy. Health care providers like nurses and doctors are responsible for insertion

### Corresponding Author:

Dr. Farooq Abdullah  
Assistant Professor  
Department of Pediatric Surgery  
Lady Reading Hospital,  
Peshawar, Pakistan.

E-mail: [drfarooqabdullah1986@gmail.com](mailto:drfarooqabdullah1986@gmail.com)

**Date Submitted:** 23-07-2023

**Date Revised:** 15-03-2024

**Date Accepted:** 06-04-2024

of a cannula, taking care of maintaining it and preventing its complications. It has been estimated that one in three patients admitted in a hospital has an IV cannula. <sup>1</sup> In France, up to 25 million of Intravenous Cannulas (IVCs) are inserted annually and nearly 20% of hospitalized patients have such a device.<sup>2</sup> In the United States about 200 million iv catheters are used per year. Fifty percent of the hospitalized patients in Spain receive IVCs, being 95% constitute peripheral.<sup>3</sup> More than 70% of hospitalized patients require peripheral intravenous Cannulation.<sup>4</sup> Some other studies show the use of intravenous catheters in 86.4% and 80.6% of the patients.<sup>5,6</sup>

IVCs are used for administration of fluids, drugs, blood products and contrast media. Those sites are

selected for cannulation where the veins are straight and superficial like the cephalic or basilic veins of the lower arm; or the dorsal venous arch located on the back of the hand.<sup>7</sup> The superficial veins of the lower limbs can also be cannulated, but they are associated with a higher risk of infection and embolism.<sup>8</sup>

Intravenous cannulation, while commonly employed and advantageous, can pose potential risks to patient safety. These complications include clotting, occlusion, leakage, infiltration, extravasation, phlebitis, and infection contributing to increased hospitalization, treatment costs, and patient discomfort.<sup>9</sup> Studies show that a phlebitis incidence rate varies widely from 2% to 80%, depending on the definitions used.<sup>2</sup> Recently a lot of gadgets have been developed to assist in iv cannulation hence preventing extravasation and missed attempts, certain antimicrobial impregnated dressings have been introduced that decreased local infection.<sup>10</sup>

Although scattered reports have examined the incidence of complications of IV cannula in different age groups, however to author’s knowledge no such study has been conducted in Pakistan specifically in children. Hence we have designed this study to assess the incidence of IV cannula associated infectious complications in children. We also looked for the risk factors associated with these complications.

**MATERIAL AND METHODS**

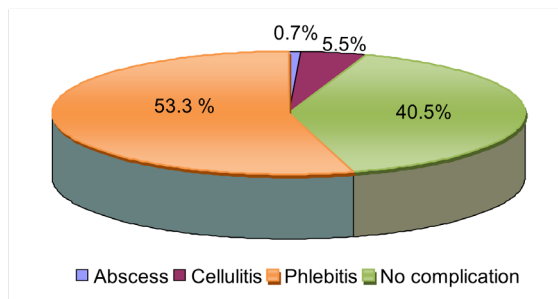
The study employed a cross-sectional descriptive design conducted at Lady Reading Hospital, Peshawar, from January 2023 to March 2023, following ethical approval. The sample included patients admitted to the pediatric surgery and pediatric medicine units with an IV Cannula (IVC). Exclusion criteria encompassed patients with prior IV cannula insertion at other facilities, those with skin diseases or trauma, and those whose parents declined participation.

Data collection utilized standardized proforma, collating patient demographics (age, gender, comorbidities), hospital admission and discharge dates, cannula insertion details (site, gauge), and antiseptic measures. Parameters recorded included insertion and removal

dates, use of alcohol swabs and gloves, and reasons for cannula withdrawal. The IVC was monitored daily post-removal for complications such as phlebitis, cellulitis, and abscess. Signs and symptoms observed included swelling, redness, tenderness, edema, indurations, and presence of pus or hematoma. Statistical analysis was conducted using appropriate tests to assess associations between variables, with data presented in tables and graphs to facilitate interpretation. Data were analyzed using appropriate statistical methods (quantitative data as mean and standard deviations, qualitative data as frequency and percentages). Chi square test was used to determine significance with p-value less than 0.05 as significant at 95% confidence interval.

**RESULTS**

The study included 279 pediatric patients, with females comprising 51.3% (n=143) and males 48.7% (n=136). (Table 1) The age ranged from 1 day to 16 years, with a mean age of 52.3 months ±18.9. Regarding cannula insertion, the most common sites were the Right Hand Dorsum and Left Hand Dorsum, each accounting for 23.3% of cases. A 24-gauge catheter was predominantly used (94.6%), and insertion success was achieved in 96.1% of cases on the first attempt. The mean duration of catheter permanence was 2.75 ± 0.941 days, with 53.8% of patients having catheters for up to 3 days and 12.6% for longer durations.



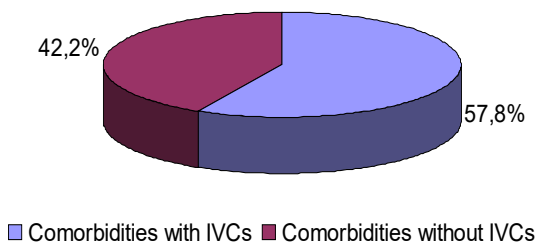
**Figure 1: Distribution of peripheral venous cannula associated complications**

**Table 1. Stratification of complications with age, Aseptic measures and disposable gloves use**

	Patients	Frequency of usage				p-value
		n	%	n	%	
Gender	Males	136	48.7	70	51.5	0.935
	Females	143	51.3	79	55.2	
Aseptic Measures	Used	2	0.7	0	0	0.003
	Didn't use	277	99.3	149	53.8	
Disposable Gloves	Used	26	9.3	23	88.5	0.671
	Didn't use	253	90.7	126	49.8	

**Table 2. Stratification of Complications with cannula site insertion**

Site	Number of patients	Complications	p-value
Right hand Dorsum	64	41 (65%)	0.763
Left hand dorsum	64	24 (37.5%)	
Right cubital fossa	47	37 (80%)	
Left cubital fossa	30	19 (63%)	
Right forearm	17	11 (65%)	
Left forearm	15	7 (46.7%)	
Right foot	15	12 (80%)	
Left foot	13	8 (61.5%)	
Scalp	10	5 (50%)	
Neck	4	2 (50%)	
Total	279	166 (59.5%)	



**Figure 2: Combination of comorbidities with peripheral venous cannula associated complications**

Complications related to IVCs affected 59.5% of patients, with higher prevalence among those with comorbidities, particularly congenital immunodeficiency syndromes. Phlebitis was the most common complication, observed in 53.4% of patients, followed by cellulitis in 5.7% and abscess in 0.7%. (Figure 1) There was no significant difference in phlebitis incidence between genders. Interestingly, the absence of phlebitis was noted in patients where antiseptic measures were employed. However, 88.5% of patients developed phlebitis when disposable gloves were used, compared to 49.8% without glove use. (Table 1)

Phlebitis incidence varied across insertion sites, with the highest rates in the Right Cubital Fossa and Right Foot (80% each), followed by the Right Hand Dorsum and Right Forearm (65% each). Lower rates were observed in the Left Hand Dorsum and Left Forearm (37.5% and 46.7% respectively). Furthermore, the incidence of phlebitis correlated with catheter gauge, with 75% of cases associated with 24-gauge cannulas, compared to 44.4% and 33% for 22-gauge and 20-gauge respectively. (Table 2)

Regarding duration, the percentage of phlebitis cases increased with prolonged catheterization, reaching 100% by day 7. Incidence rates were 2.3%, 22.5%, and 83.7% on days 1, 2, and 3 respectively (p-value 0.67). Additionally, a higher number of insertion attempts correlated with increased complication rates, reaching 100% by the 5th attempt.

**DISCUSSION**

The findings of our study reveal a higher incidence of complications associated with intravenous cannulation (IVC) compared to those reported in previous literature, particularly in terms of phlebitis.<sup>11</sup> This aligns with existing studies, although caution must be exercised in making direct comparisons due to variations in definition criteria.<sup>12</sup> Factors such as inadequate aseptic techniques, prolonged duration of IV cannula insertion, and underlying comorbidities likely contribute to the heightened incidence of complications observed in our study.

Our study showed that placement greater than 72 hours was a risk factor for complication (p value 0.67) and it was in concordance with a prospective cohort study from Brazil which reported that phlebitis was more frequently associated with catheters having duration greater than 72 hours.<sup>13</sup> Majority of studies in literature reported that catheter duration for more than 120 hours is unusual.<sup>4</sup> In a prospective cohort study, this occurred in only 7.8% of cases. Our study also showed the same results with only 2.5% of patients with duration of 120 hours or greater. Mean duration of catheter was similar to that reported in an earlier study (mean duration, 2.75 days).<sup>14</sup> Another prospective study reported that permanence of most peripherally inserted catheters was 72 hours or less (93%); 5.8% were in place for 73 to 96 hours, and the

others (1.2%), more than 96 hours.<sup>15</sup> Another study identified higher occurrence of phlebitis in those who used 18- and 20-gauge catheter size however their study identified more complications in catheter with permanence equal to or more than 72 hours.<sup>1</sup> Insertion site emerged as a crucial factor influencing complication rates, with cannulation at the cubital fossa significantly associated with higher incidence of complications in our study. This contradicts some studies which found lower complication rates with cubital fossa insertion.<sup>16</sup> For phlebitis, some studies found that insertion at forearm and cubital fossa was associated with a higher risk compared with hand dorsum or wrist, whereas insertion at the hand dorsum and the cubital fossa was associated with occlusion and accidental removal but not with phlebitis.<sup>17</sup> However, our findings highlight a higher frequency of complications when cannulation occurs at joints such as the wrist and elbow, underscoring the importance of careful site selection.

Notably, our study revealed a higher incidence of complications in cannulation of the dominant limb, possibly due to increased mobility and usage of the limb in daily activities. International guidelines emphasize the importance of prompt removal of catheters inserted in emergency situations with compromised aseptic techniques to mitigate infectious complications.<sup>18</sup>

An unexpected finding in our study was the increased complication rate associated with cannulation performed with gloved hands compared to those without gloves. While literature supporting this observation is lacking,<sup>19</sup> potential factors such as glove quality, use of powdered latex gloves, and inadequate hand hygiene warrant further investigation.

## CONCLUSION

Complications associated with IVC insertion are higher in children with comorbidities, using dominant hand and IVC on bony prominences or joints. Use of aseptic measures decreases the incidence of these complications.

**Recommendations:** The author recommends further larger and multicenter studies on this topic. The role of the use of gadgets like vein locators, antibiotics impregnated dressings etc. in reducing these complications should be explored.

## REFERENCES

1. Mandal A, Raghu K. Study on incidence of phlebitis following the use of peripheral intravenous catheter. *J Fam Med Prim care*. 2019 Sep;8(9):2827-31. [https://doi.org/10.4103/jfmpc.jfmpc\\_559\\_19](https://doi.org/10.4103/jfmpc.jfmpc_559_19)
2. Miliiani K, Taravella R, Thillard D, Chauvin V, Martin E, Edouard S, et al. Peripheral Venous Catheter-Related Adverse Events: Evaluation from a Multicentre Epidemiological Study in

- France (the CATHEVAL Project). *PLoS One*. 2017;12(1):e0168637. <https://doi.org/10.1371/journal.pone.0168637>
3. Lim S, Gangoli G, Adams E, Hyde R, Broder MS, Chang E, et al. Increased Clinical and Economic Burden Associated With Peripheral Intravenous Catheter-Related Complications: Analysis of a US Hospital Discharge Database. *Inquiry*. 2019;56:46958019875562. <https://doi.org/10.1177/0046958019875562>
4. Lulie M, Tadesse A, Tsegaye T, Yesuf T, Silamsaw M. Incidence of peripheral intravenous catheter phlebitis and its associated factors among patients admitted to University of Gondar hospital, Northwest Ethiopia: a prospective, observational study. *Thromb J*. 2021 Jul;19(1):48. <https://doi.org/10.1186/s12959-021-00301-x>
5. Lee S, Kim K, Kim J-S. A Model of Phlebitis Associated with Peripheral Intravenous Catheters in Orthopedic Inpatients. *Int J Environ Res Public Health*. 2019 Sep;16(18). <https://doi.org/10.3390/ijerph16183412>
6. New KA, Webster J, Marsh NM, Hewer B. Intravascular device use, management, documentation and complications: a point prevalence survey. *Aust Health Rev*. 2014 Jun;38(3):345-9. <https://doi.org/10.1071/AH13111>
7. Kleidon T, Ullman A. Right Pediatric Site Selection and Technology BT - Vessel Health and Preservation: The Right Approach for Vascular Access. In: Moureau NL, editor. Cham: Springer International Publishing; 2019. p. 197-208. [https://doi.org/10.1007/978-3-030-03149-7\\_15](https://doi.org/10.1007/978-3-030-03149-7_15)
8. Suliman M, Saleh W, Al-shiekh H, Taan W, AlBashtawy M. The Incidence of Peripheral Intravenous Catheter Phlebitis and Risk Factors among Pediatric Patients. *J Pediatr Nurs [Internet]*. 2020;50:89-93. <https://doi.org/10.1016/j.pedn.2019.11.006>
9. Simin D, Milutinović D, Turkulov V, Brkić S. Incidence, severity and risk factors of peripheral intravenous cannula-induced complications: An observational prospective study. *J Clin Nurs*. 2019 May;28(9-10):1585-99. <https://doi.org/10.1111/jocn.14760>
10. Ben Abdelaziz R, Hafsi H, Hajji H, Boudabous H, Ben Chehida A, Mrabet A, et al. Peripheral venous catheter complications in children: predisposing factors in a multicenter prospective cohort study. *BMC Pediatr*. 2017 Dec;17(1):208. <https://doi.org/10.1186/s12887-017-0965-y>
11. Chen C-Y, Chen W-C, Chen J-Y, Lai C-C, Wei Y-F. Comparison of clinically indicated replacement and routine replacement of peripheral intravenous catheters: A systematic review and meta-analysis of randomized controlled trials [Internet]. Vol. 9, *Frontiers in Medicine*. 2022. <https://doi.org/10.3389/fmed.2022.964096>
12. Zingg W, Barton A, Bitmead J, Eggimann P, Pujol M, Simon A, et al. Best practice in the use of peripheral venous catheters: A scoping review and expert consensus. *Infect Prev Pract [Internet]*.

- 2023;5(2):100271. [https://doi.org/10.1016/j-inf-pip.2023.100271](https://doi.org/10.1016/j.inf-pip.2023.100271)
13. Urbanetto J de S, Peixoto CG, May TA. Incidence of phlebitis associated with the use of peripheral IV catheter and following catheter removal. *Rev Lat Am Enfermagem*. 2016 Aug;24:e2746. <https://doi.org/10.1590/1518-8345.0604.2746>
  14. Alloubani A, Awwad M, Akhu-Zaheya L. Optimal Timing for Peripheral Intravenous Cannula Replacement. *Open Infect Dis J*. 2019;11(1):1-6. <https://doi.org/10.2174/1874279301911010001>
  15. Hasselberg D, Ivarsson B, Andersson R, Tingstedt B. The handling of peripheral venous catheters--from non-compliance to evidence-based needs. *J Clin Nurs*. 2010 Dec;19(23-24):3358-63. <https://doi.org/10.1111/j.1365-2702.2010.03410.x>
  16. Baye ND, Teshome AA, Ayenew AA, Amare TJ, Mulu AT, Abebe EC, et al. Incidence, time to occurrence and predictors of peripheral intravenous cannula-related complications among neonates and infants in Northwest Ethiopia: an institutional-based prospective study. *BMC Nurs* [Internet]. 2023;22(1):11. <https://doi.org/10.1186/s12912-022-01164-x>
  17. Chaudhary MK, Dhakaita SK, Ray R, Baruah TD. Local complications of intravenous access - an often underestimated entity. *J Fam Med Prim care*. 2020 Dec;9(12):6073-7. [https://doi.org/10.4103/jfmprc.jfmprc\\_1649\\_20](https://doi.org/10.4103/jfmprc.jfmprc_1649_20)
  18. Wright W, Everett F, Newcombe P. *Clinical Skills for Nursing Adults : Step by Step* [Internet]. London: SAGE Publications Ltd; 2019. Available from: <http://digital.casalini.it/9781526453037>
  19. Ramadhan Allo R, Hussien Murad S, Thamir Mayouf T. Nursing Errors during Intravenous Infusion. *J Glob Sci Res* [Internet]. 2022;7(4):2022-234. Available from: [www.gsjpublications.com/jgsr](http://www.gsjpublications.com/jgsr)

#### CONFLICT OF INTEREST

Authors declare no conflict of interest.

#### GRANT SUPPORT AND FINANCIAL DISCLOSURE

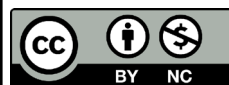
None declared.

#### AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	MS, FA, ASA
Acquisition, Analysis or Interpretation of Data:	MS, FA, ASA, AL, MMS, OP, MI
Manuscript Writing & Approval:	MS, FA, ASA, AL, FAAA, AHA, MA

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.



Copyright © 2024. Muhammad Shabbir, et al. This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License, which permits unrestricted use, distribution & reproduction in any medium provided that original work is cited properly.