

Monitoring Peripheral Intravenous Catheters Complications in Pediatric Patients in Erbil City/Iraq

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ABSTRACT

Backgrounds and Objectives: Although most problems of peripheral intravenous catheterization are inconsiderable and easily treated, some are dangerous and require rapid management. This study aimed to explore peripheral intravenous catheter-related complications and the quality of nursing care for dressing sites of peripheral intravenous catheterization among the pediatric population.

Methods: The study was conducted at Raparin Teaching Hospital for Children inpatient units in Erbil City/Iraq, using an observational study design. A purposive sample from 296 hospitalized children with peripheral intravenous catheterization was chosen for this study. The data was collected using a special check List (PIVC-miniQ) developed for checking the signs and symptoms and the quality of care for the catheter insertion site. Furthermore, the obtained data on peripheral intravenous catheterization problems was evaluated for exploring grades of phlebitis using the Phlebitis Scale developed by the Infusion Nursing Society in 2011. The data was processed and analyzed using SPSS using descriptive statistical analysis (frequency, percentage) and inferential statistical tests (Chi-squared, contingency coefficient). The probability value of ≤ 0.05 was regarded as statistically significant.

Results: Most (82.4%) of patients were recruited in the emergency unit, with the highest percentage (36.8%) were toddlers. More than two-thirds (72.3%) of participants were assessed within the first peripheral catheter insertion. Regarding overall grades of patients' peripheral intravenous catheterization complications (PIVC), less than a quarter (21.6%) were within the first grade, indicating being at risk for complications, and 6.8% were within the second grade, indicating slight phlebitis. Regarding the nursing care for PIVC site care, 62.5% of participants received fair care, and 22.3% received poor care.

Conclusions: A quarter of observed children were at risk for having phlebitis and less than ten percent had slight phlebitis. About a quarter of patients received poor nursing care for the catheter insertion site. Most participants have not a documentation of peripheral intravenous catheter insertion date on the dressing and on the patient's chart.

Keywords: Quality of Care; Peripheral Intravenous Catheters; Complications.

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INTRODUCTION

Peripheral intravenous (IV) catheterization (PIVC) is one of the most commonly used procedures in hospitalized children [1]. Each year worldwide, over a billion PIVCs

are inserted in hospitalized children [2]. It is also calculated that above 80% of patients undergo this procedure across hospitalization [1, 3]. The procedure is applied

to assist in various managements, such as hydro-electrolytic imbalances, blood losses, and dysfunctions of multiple organs [4]. It can also be injected in some patients prophylactically before procedures and in unsteady patients for crisis use [5,3]. Although PIVC is common, the risk of complications is high [6] and sometimes can lead to local and systemic complications. These complications include hematoma, occlusion, phlebitis, thrombophlebitis, infiltration, leakage, pain, edema and local infection [7,8]. While most problems are minor and manageable, some can be life-threatening and necessitate immediate attention. The most frequently seen consequences are infections and mechanical issues such as occlusion, leakage, and dislodgment [9]. Over a person's lifetime, particularly if hospitalization starts in childhood, informed and patient-focused IV care is vital [10]. Most of the post-insertion IV care and maintenance is handled by nurses, who frequently perform PIVC insertions [11]. As a result, nurses are crucial in monitoring and preventing PIVC problems and failure. The global trend of PIVC insertion studies and experiences are more than conservation. When maintenance of PIVC have important role in confirming catheter patency for many days [14]. The nurse must document using a standardized scale, the signs and symptoms of phlebitis, the interventions used, and the patient's reaction to treatment in the patient's charts. International data on prevalence and management of PIVCs are lacking, although PIVC use is highly evident in hospitalized patients internationally [15]. In addition, there are no published studies in Iraq on PIVC among pediatric patients. The national and international quality agency recommended strategies for prevention of PIVC complications including designated trained personnel to insert and maintain PIVCs, surveillance, hand hygiene, proper use of

aseptic non-touch technique and recommendations regarding catheter site care and early removal when no longer necessary [16]. This study aimed to explore peripheral intravenous catheter-related complications and nursing care for the dressing at the site of PIVC among the pediatric population in Erbil city and to determine the association between grades of PIVC complication and levels of nursing care for the PIVC site, inserted PIVC number, and children age.

METHODS

An observational design was used for conducting this study in 2022 at inpatient units (emergency, surgical, and neonatal care) of Riparian Teaching Hospital for Children (RTHCH) in Erbil city Kurdistan region, Iraq. The sample size estimation in this study has been calculated through this formula: $n = Z^2 P (1-P) / d^2$ [22,24]. When n is representing sample size, Z is the statistic corresponding to level of confidence, P is expected proportion in population (expected prevalence or based on previous studies), and d is precision or absolute error. The level of confidence is 95%, precision is 5%, and expected prevalence is 40%. A sample size of 303 children with PIVC was recruited. The sample size was 296 after seven children were discharged before 24 hours of hospitalization. The sample included hospitalized children who required at least one PIVC in RTHCH during the data collection period. Patients referred from other hospitals with previously inserted PIVC were excluded from sample. Data were collected between April and July 2022. The researcher preformed the sample selection during routine morning visits. Each patient was given a case number, and the PIVC followed after 24 hours to assess the complications and the failure. Each patient needs ten to fifteen minutes for taking the relevant information. Nurses were

not informed about the study. After a review of many previous articles, the researcher decided to use Peripheral Intravenous Catheter mini Questionnaire (PIVC-mini Q) <https://doi.org/10.1186/s12913-019-4497-z>; this tool is developed by Hovik et al., and tested for reliability in measuring rates of PIVC problems. The tool included four sections. The first section reveals phlebitis related signs and symptoms at/around insertion site (9 items: PIVC pain or tenderness, redness, swelling, warmth, purulence, hardness of tissue, streak/red line along vein, palpable hard vein beyond IV tip, and partial/complete dislodgement). The second section reveals PIVC dressing, and IV connection related to PIVC failure (5 items: dressing soiled with blood or fluids, loose or lifting dressing edges, dressing fixed with tape only, blood in the line, and absence of insertion date on PIVC dressing). The third area consisted of 1 item, lack of documentation of PIVC in patient chart. The fourth section consisted of 1 item, indication for PIVC use. Each problem that accounts for 1 point. Overall score (0-16) reflects PIVC quality [17]. Furthermore, the obtained data on PIVC problems was evaluated for exploring grades of phlebitis using the Phlebitis Scale developed by the Infusion Nursing Society in 2011 that has already obtained validity and inter-rater reliability [15]. The official permission to conduct the study was obtained from the Erbil General Directorate of Health. The College of Nursing/Hawler Medical University research ethics committee evaluated and approved the study protocol. Verbal informed consent for participation in the study was obtained from all mothers of children. The data were analyzed using the statistical package for social science (SPSS, Version 23). Statistical tests frequency and percentage were used for categorical data. Chi-squared and nominal contingency coefficient were used for

inferential data. The results were considered statistically significant at p -value ≤ 0.05 .

RESULTS

Table 1 shows that the majority (82.4%) of participants were recruited from the emergency unit. The highest percentage (36.8%) were toddlers, and more than half (58.4) of the patients were male. More than two-thirds (72.3%) of participants were assessed within the first PIVC insertion, and more than three quarter (76.6) of inserted PIVCs size was 24 gauge of yellow color. Concerning the site of PIVC insertion, 64.2% of children had the cannula in their hands, and 64.2% on the right side. Regarding the indication of insertion, almost all the children (99.3%) used it for medication or receiving fluid. Table 2 reveals just above a quarter (26%) of patients had pain or tenderness, 26.7% had redness at the site of insertion, 67.6% complained of warmth at the site of insertion, 26.7% had swelling >1cm from the insertion site, 67.6% had hard vein beyond IV tip when palpated, and 21.3% had partial/complete dislodgement. Regarding IV dressing and connection, 66.6% had loose or lifting edges of the tape, 98.0% did not have PIVC insertion date documented on dressing, and 73% lack the date of PIVC insertion in the patient's chart. Table 3 shows the overall grades of PIVC complication. The highest percentage (71.6%) of participants were within grade zero indicating no complications, 21.6% were within the first grade indicating being at risk for complications, and 6.8% were within second grade which indicates having slight phlebitis. Table 4 displays statistically significant associations between grades of PIVC complication and levels of nursing care for the PIVC site ($p=0.04$), and no statistically significant association with inserted PIVC number ($p=0.24$), and children's age ($p=0.183$).

Table 1: Characteristics of Children with PIVC at RCHTH (296)

Item	Category	F.	(%)
Patient unit	Emergency	244	(82.4)
	NCU	14	(8.1)
	Surgical	28	(9.5)
Age/months	Newborn < 1 m	13	(4.4)
	Infant 1-<12 m	91	(30.7)
	Toddler 12 -<36 m	109	(36.8)
	Preschool 36- < 60 m	83	(28)
Gender	Male	173	(58.4)
	Female	123	(41.6)
Number of inserted PIVC in current hospitalization	1 st	214	(72.3)
	2 nd	46	(15.5)
	≤ 3 rd	36	(9.2)
Insertion Environment	Emergency unit	234	(79)
	Surgical unit	33	(11.2)
	NCU	29	(9.8)
Insertion site	Right	184	(62.2)
	Left	112	(37.8)
PIVC size (gauge)	24 G yellow	227	(76.7)
	22 G Blue	69	(23.3)
PIVC site	Hand	190	(64.2)
	Wrist	38	(12.8)
	Forearm	11	(3.7)
	Antecubital fossa	12	(4.1)
	Foot	42	(14.2)
	Head and neck	1	(0.3)
	Upper arm	2	(0.7)
Reason for PIVC insertion	Medication or fluid	294	(99.3)
	Unknown indication	2	(0.7)

Table 2: Distribution of participants (n=296) children according to the assessed signs and symptom of PIVCs complications

Signs and symptoms	NO		YES	
	F.	(%)	F.	(%)
PIVC site assessment				
Pain/tenderness on palpitation	219	(74)	77	(26)
Redness >1 cm from insertion site	228	(77)	68	(23)
Swelling >1 cm from insertion site	217	(73.3)	79	(26.7)
Warmth	96	(32.4)	200	(67.6)
Purulence	296	(100)	0	(0)
Streak/ red line along vein	290	(98)	6	(2)
Induration/ hardness of tissues >1 cm	240	(81.1)	56	(18.9)
Palpable hard vein beyond IV tip	96	(32.4)	200	(67.6)
Partial/ complete dislodgement PIVC	233	(78.7)	63	(21.3)
IV dressing and connection assessment				
Soiled with blood or fluids	273	(92.2)	23	(7.8)
Loose or lifting edges	99	(33.4)	197	(66.6)
Tape only	149	(50.3)	147	(49.7)
Blood in line	167	(56.4)	129	(43.6)
PIVC insertion date not documented on dressing	6	(2)	290	(98)
Indication for PIVC				
Medication and Fluid Documentation	2	(0.7)	294	(99.3)
Date of PIVC insertion In patient chart is lacking	80	(27)	216	(73)

Table 3: Distribution of participants among the levels of PIVC complications

Grades of PIVC complication	F	(%)
Grade 0 (without clinical signs; healthy)	212	(71.6)
Grade 1 (presence of erythema on the insertion of the catheter with or without pain; at risk for complication)	64	(21.6)
Grade 2 (pain at the site of insertion of the catheter with erythema and/or edema; slight phlebitis).	20	(6.8)
Total	296	(100)

Table 4: Association between grades of complication with quality of nursing care, inserted PIVC number, and child’s age

Variables		Grade 0	Grade 1	Grade 2	Total	P-Value
Quality of nursing care for the PIVC site	Good	36	7	2	45	0.04
	Fair	134	37	14	185	
	Poor	42	20	4	66	
	Total	212	64	20	296	
Inserted PIVC number	1 st	162	41	7	210	0.24
	2 nd	32	16	6	54	
	3 rd &>	18	7	7	32	
	Total	212	64	20	296	
Child age /month	< 1	6	4	3	13	0.183
	1-<12	62	22	7	91	
	12-<36	86	20	3	109	
	36- 60	58	18	7	83	
	Total	212	64	20	296	

Figure 1 : shows levels of nursing care for PIVC site care. The highest percentage (62.5%) of participants were received fair care at the site of PIVC dressing, and 22.3% received poor care.

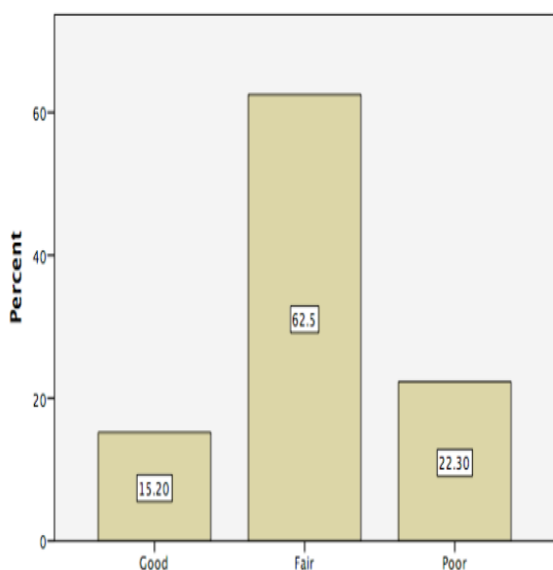


Figure 1: Levels of nursing care for the PIVC site dressing care

DISCUSSION

The current study was designed to explore peripheral intravenous catheter-related complications through assessment of the signs and symptoms related to PIVC complications among purposive sample of 296 children with PIVCs at Riparian Teaching Hospital for Children in Erbil city. The current study found that majority of participating children were hospitalized in the emergency unit, and the highest percentage of them were toddlers. The mean age was 23.08 ± 19.25 weeks and 58.4% were male. Another researcher conducted a study with 98 children and found, the mean age was 5.2 ± 4.7 years and the 50% of them were of the male gender [3]. In recent study most of patients were assessed within the first PIVC insertion, and lowest percentage of them were within third or more inserted PIVCs. Unluckily, after the PIVC inserted more than 50% of these will fail before finishing the treatment [16].The Infusion Nursing Society has abolished the practice of replacing catheters after every 72 hours and suggests that catheters should only be removed or replaced when they are no more required or

have impaired function [15]. The incidence of PIVC failure in pediatric patients is still high, despite the global and vital role in health care. A systematic review of 32 studies confirmed that an average of 34% of PIVC in pediatric patients fail before the completion of the therapies, with infiltration as the most frequent complication [14]. Moreover, in the current study, the majority of participants have the PIVC insertion for receiving medication or fluid, as mentioned in another study where 67.8% of PIVC insertions were used for drug administration [3]. Regarding the signs and symptoms of PIVC complications, the current study found more than a quarter of the monitored children were complaining of pain and redness at the site of PIVC site. This finding agrees with a study done by Zempsky who found that PIVC is a primary cause of procedure related pain in the hospital [18]. The current study revealed that two-thirds of the participants had a hard vein beyond the IV tip when palpated. Monreal et al., listed the criteria of phlebitis which includes symptoms of pain, erythema, swelling, and palpable thrombosis of the cannulated vein [23]. Regarding IV dressing and connection assessment, the current study reveals that more than two-thirds of PIVC had loose or lifting edges of the tape. In addition, many participants have no PIVC insertion date documented on the dressing, and most of them lack documentation of the date of PIVC insertion in the patient's chart. Similarly, another study found that the most dominant overall problem was lack of documentation of PIVC (26.8%) [17]. Concerning the levels of PIVC complication which explored the grades of phlebitis using the Phlebitis Scale developed by the Infusion Nursing Society [15], the results reveal that most of the participants were free from complications (grade zero). At the same time, less than a quarter of

observed children were within first grade having erythema on the catheter insertion site with or without pain indicating they were at risk for complication. This finding is similar with another studying showing the most frequent symptom at the insertion site was pain and tenderness [18]. The minority of children was within second grade having pain at the catheter insertion site with erythema and/or edema indicating slight phlebitis. One study reports complications among 111(51.9%) of PIVC subjects [3] and another stated the reported rates of phlebitis at 13%, extravasation at 28%, and bacterial colonization at 11% [19]. Regarding nursing care for the PIVC site, the current study finding shows that about a quarter of patients were suffering from poor nursing care for the PIVC dressing site. This finding is consistent with another study which found that PIVC complications were common in pediatric departments and are often associated with misuse of device [3]. There was a statistically significant association between grades of PIVC complication and levels of nursing care for the PIVC site and inserted PIVC number. There was no statistically significant association between grades of PIVC complication and children's age and site of PIVC insertion. In contrast, another stated that age, hospitalization in surgery unit, insertion in antecubital vein have role in development of phlebitis study [20]. Results from another study revealed that younger ages are risk factors for PIVC complications in children [21].

CONCLUSION

A quarter of observed children were at risk for having phlebitis and less than ten percent had slight phlebitis. About a quarter of patients received poor nursing care for the PIVC insertion site, which leads to PIVC complications. Most participants did not have the PIVC insertion date documented

on the dressing and in their medical chart. Nurses should give more importance to the PIVC site dressing and documentation. Further, studies need in this field for exploring the quality of post-PIVC insertion care, and the risk factors of PIVC complication among pediatric patients.

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CONFLICT OF INTEREST

Nothing to declare.

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