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Original Research Article

Trailblazing exploration: Unraveling phlebitis and its enigmas in children

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ABSTRACT

Aim: The present study was aimed to assess the incidence of phlebitis and identify the factors that cause phlebitis in children with a peripheral intravenous cannula.

Materials and Me thods: A prospective observational study was conducted between 15 July 2022 to 30 November 2022 in pediatrics wards of a tertiary care hospital. 225 children with PIVC were included in the study. PIVC was observed till phlebitis developed or maximum for seven consecutive days after enrollment. Phlebitis was defined by using the Jackson VIP scale.

Result: The incidence of phlebitis was 54.22% at 95% confidence interval. There was a significant association between phlebitis and the use of crystalloids, frequency of PIVC handling per day, use of cancer drugs, and use of a three-way, method of drug administration. The mean life span of PIVC was 69.86 ±32.88 hours, and the range was 19-180 hours.

Conclusion : The incidence of phlebitis is much higher than the acceptable limit as per Infusion Therapy Standards of Practice which should be reduced. Crystalloids, the Method of drug administration, and cancer drugs are the risk factor for phlebitis. The study suggests that most likely phlebitis occurs after three days.

1. Introduction

Hospitalized children are given various drugs, fluids, blood, nutritional product, and many other things to treat them. Medicines are given through various routes of drug administration e.g. oral, intradermal, subcutaneous, intravenous and intraosseous, etc. The intravenous route is the most common, effective, and essential method of drug administration in children to manage emergency conditions as well as stable conditions.

There are various devices to administer drugs via the intravenous route e.g. Peripheral intravenous cannula (PIVC), Central Intravenous Catheter (CIVC) peripherally inserted central catheter (PICC), subcutaneously implanted devices, etc. Among all these devices PIVC is the most common device which is used to give medicine to sick children. It is used in any small health center as well as tertiary hospitals. It is cheaper and more convenient to establish compared to other devices which are used for the same purpose.

The whole procedure of PIVC insertion takes a few minutes that's why it is most commonly used in all emergency conditions. Although insertion of PIVC is easier, it also requires enough skill for its placement and maintenance. Especially in children insertion of PIVC is more difficult, because their veins are so fragile and narrow bore.[1] Maintenance of PIVCs in children is challenging also because of various factors such as the inability to do proper dressing or fixation because of the small size of extremities or site of PIVC insertion, less cooperation from child and parents, etc.[2]

PIVCs are having many advantages, like being easy to insert low cost, requiring less time to establish,

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convenient to handle, make less discomfort to the patient whereas these are having some disadvantages also as phlebitis, infiltration, extravasation, accidental removal, etc.[3,4] Predisposing factors for PIVC associated phlebitis are puncture failure, previous complications related to the blood vessel, drugs administration and solutions with pH extremes and osmolarity,[5] history of the previous infiltration, PIVC readjustment during insertion, use of infusion pump for giving medicine, intermittent drug administrations, shorter dwell time,[4] joint involvement, indwelling time[1] size of catheter, location and length of infusion[6] use of antibiotics and potassium chloride[7] neonatal age,[8] etc.

2. Back ground of the study

More than 80% of hospitalized children require intravenous access at some stage during their admission, and worldwide more than one billion PIVCs are used annually.[9] PIVC allows fluids, medications, etc to be introduced directly into the cardiovascular system and reach most target organs very quickly. Once established, a well-functioning PIVC can remain in use for many days.[9]

Phlebitis is the commonest complication of PIVCs. Phlebitis is defined as an inflammation of tunica intima which is the innermost layer of the blood vessel,[8] Common types of phlebitis are- chemical phlebitis, caused due to the administration of various medications and solutions or fluids, mechanical phlebitis occurs because of trauma caused by the catheter in the tunica intima and infectious phlebitis is called when it resulted after infusion of contaminated solution or infection at the catheter insertion site or handled with aseptic techniques.[8] Phlebitis that occurs after the removal of PIVC is called post-infusion phlebitis. It may occur between 48 to 96 hours after PIVC removal.[8] Sign and Symptoms of phlebitis are pain, erythema, edema, induration, local heat, palpable venous cord in the path of the vessel, and purulent exudates at the puncture site.[1,5]

The pathophysiology of phlebitis is that when a child gets punctured for PIVC insertion, the risk of infection occurs. Piercing the skin allows bacteria and pathogens enter to the bloodstream. Therefore, the risk of bacteremia increases.[10] Common pathogen which is responsible for infectious phlebitis is coagulase-negative staphylococcus which is found over children's skin as a normal flora.[8]

Neonates and infants compared to older children have five times more chances of developing phlebitis. Children who are administered IV medication have double the risk of developing PIVC-associated phlebitis. Longer duration of PIVC in situ is also considered a risk factor for developing phlebitis.[8]

2.1. Need of the study

Many studies have been done on adult patients related to phlebitis but limited studies are available that were done on children. Studies that were done on children showed the incidence of PIVC associated phlebitis from 2.7 %[5] to 71 %.[3] There is a huge gap between these findings. One study showed that age, size of cannula, site of the cannula, joint involvement, and duration of the cannula in situ had no significant association with PIVC-associated phlebitis where as another study had considered all these as risk factors for phlebitis. The findings of these studies are contradictory so more studies are required to discover the fact.

3. Materials and Methods

It was a quantitative, prospective and observational study which was conducted in two pediatrics wards at the All India Institute of Medical Sciences (AIIMS) in New Delhi. Hospitalized children with PIVC were enrolled in the study who met inclusion criteria. Sampling technique was purposive sampling. This study included children who were having only one PIVC at a time, up to 12 years of age, willing to participate in the study. This study excluded children who were on continuous sedation, on continuous analgesics infusion, previously enrolled in the study, PIVC inserted more than 12 hours before enrolment.

3.1. Sample size

We calculated sample size by using Cochran's formula. Where we took level of precision 5% and Confidence level 90% because at 95% confidence interval sample size was coming very high which was not possible to achieve in avail period of data collection. Prevalence was considered 71% which was derived from previous study. Sample size was came 222.86 which was rounded of to 225.

4. Ethical Consideration

Ethical approval was obtained from the institute ethics committee, AIIMS, New Delhi. Informed consent from parents and assent from children were taken before the study. The confidentiality and anonymity of the participants were maintained throughout the study period. Information collected from participants was used only for research purposes. This study was registered in CTRI and registration number was CTRI/2022/06/043603.

4.1. Tool for data collection

We used three tools to collect the data. Tool one was used to collect demographic details and clinical profile of participants which was developed by the researcher. This tool consists of eight items related to demography that includes name, age, gender, height, weight, education of

child's mother, education of child's father, and 2 items related to clinical profile including the history of previous hospitalization and primary diagnosis. Content validity of tool-1 was obtained from seven experts. There was 100 % agreement among the expert. Tool-2 was a semi-structured tool to assess predisposing factors which was also developed by the researcher to assess predisposing factors of phlebitis. It consists of 15 items including Extremity and Site of PIVC, Size of PIVC, Fixation of PIVC, Use of Splint and three ways Extensions, PIVC inserted by, Number of injection per day, Method of drugs administration, name of antibiotics, name of other drugs crystalloid, colloid, Electrolytes correction fluid and cancer drugs, Frequency of PIVC handling. Content validity of tool was obtained from seven experts. There was 100 % agreement among the experts. Tool-3 was Jackson's visual infusion phlebitis (VIP) scale which was a standard tool to identify phlebitis. Permission was taken from the developer of the tool.

4.2. Pilot study

The pilot study was conducted on twenty children for assessing the feasibility of the study. Children who were enrolled in pilot study were excluded from final study.

4.3. Data collection procedure

Total 679 children were screened, out of which 454 were excluded on the basis of various exclusion criteria and 225 were enrolled for study. Data was collected from 15 July 2022 to 30 November 2022. Demographic data was collected by interviewing the care giver. Information on predisposing factors was obtained from medical records and by observation. The PIVC site was assessed at the same time each day till phlebitis developed or maximum for seven consecutive days.The findings of the assessment were recorded as per the VIP Scale criteria of phlebitis.

5. Data analysis

Data were analyzed using SPSS 26.0 version. The demographic and clinical variables were described using frequency, percentage, mean, standard deviation, median, and range. As part of inferential statistics, the Chi-square test was used for inference at a 0.05 level of significance.

6. Result

Majority of children (50.7%) were from the 6-12 year age group, the mean age was 6.16±1.09 years, and children were aged from 25 days to 12 years. The majority of children (64.44%) were male. Mean height of children was 104.47±25.30 cm and the range was 44 - 159 cm. The mean weight was 17.52±8.87 kg and the range was 1.94-56 kg. The majority of children (63.66%) had a history of previous hospitalization. The majority of children (25.77%) were diagnosed with malignancies. Characteristics of children given in Table 1.

Table 1: Demographic and clinical characteristics of children with PIVC. n-225

S. No.	Socio-demographic characteristics	Frequency (%)
1.	**Age (years)**	
	0- 1	21 (9.3)
	1-3	36 (16)
	3-6	54 (24)
	6-12	114 (50.7)
	Mean ±SD	6.16±1.09
	Range	25 days- 12 year
2.	**Gender**	
	Male	145 (64.44)
	Female	80 (35.56)
3	Height	104.47±25.30*, 44 -159#cm
4	Weight	17.52±8.87*, 1.94 -56# kg
5	**History of the Previous hospitalization**	
	No	82(36.34)
	Yes	143 (63.66)
6	**Primary Diagnosis**	
	Malignancies	58 (25.77)
	Renal Disorders	56 (24.88)
	Gastroenterological Disorders	31 (13.75)
	Neurological Disorders	24 (10.90)
	Respiratory Disorders	38 (16.7)
	Autoimmune Disorders	6 (3.7)
	Others Disorders	11(4.3)

* is Mean±SD, # is Range

Majority of PIVC (45%) were inserted in the left upper extremity. The majority of PIVCs (43.2%) were inserted in the dorsum of the hand. Joint was involved with most of the PIVCs (79.55%). Most of the PIVCs (63.11%) were of 24 gauge size. More than half (59.11%) of PIVC were fixed with the use of transparent and non-transparent adhesives together. The splint was not used in the majority of PIVCs (89.44%) Three-way was not used in most of the PIVCs (74.33%). Most of the PIVCs (77.33%) were inserted by junior resident doctors. Dressing of most of the PIVCs (91.55%) was clean. Accessories (IV set, Syringe, and Pressure line) were changed every day in all of the children. In the majority of children (37.77%) PIVC was handled thrice a day. In more than half (54.22%) of children reason for PIVC removal was phlebitis. In more than half of children (57.8%), medicines were given by using more than one method of drug administration e.g. bolus, syringe pump, and IV drip set. More than half of the children (56.9%) received a maximum of two injections per day. Crystalloid fluids were not given to most of the children (47.55%). Majority of children (85.77%) did not receive colloid fluids.

Table 2: PIVC and medicine profile among children with PIVC n-225

S No.	PIVC and medicine related characteristics	Frequency (%)
1	Extremity in which PIVC has inserted	
	Right Upper Extremity	91 (40.5)
	Left Upper Extremity	103 (45)
	Right Lower Extremity	10 (4.8)
	Left Lower Extremity	21 (9.7)
2	Site of PIVC	
	Dorsum of Hand	99 (43.2)
	Forearm	66 (29.3)
	Antecubital Fossa	28 (12.2)
	Dorsum of Foot	23 (11.4)
	Leg	9 (3.9)
3	Joint involvement with the PIVC site	
	Yes	179 (79.55)
	No	46 (20.45)
4	Size of PIVC	
	26 Gauge	31 (13.8)
	24 Gauge	142 (63.11)
	22 Gauge	43 (19.10)
	20 Gauge	8 (3.59)
	18 Gauge	1(0.4)
5	Fixation of PIVC done	
	Transparent Adhesive	91 (40.45)
	Non Transparent Adhesive	1 (0.44)
	With Both	133(59.11)
6	Splint used in PIVC Fixation.	
	Yes	24 (10.56)
	No	201 (89.44)
7	Three ways Extensions (10 cm length) connected with PIVC	
	Yes	58(25.67)
	No	167 (74.33)
8	PIVC inserted by	
	Nursing Officer	28 (12.44)
	JR	174 (77.33)
	SR	23 (10.23)
9	Dressing of PIVC	
	Clean	206 (91.55)
	Dirty	19 (8.45)
10	Accessories changed /day Yes	225 (100)
11	Frequency of PIVC handling	
	Once in A Day	65 (28.89)
	Twice In A Day	30 (13.33)
	Thrice in A day Four Times in day	85 (37.78) 45 (20.0)
12	Reason for PIVC removal	
	Phlebitis	122 (54.22)
	Discharged	78 (34.7)
	Blocked	8 (3.6)
	Leaking	5 (2.2)
	Accidental Removal	4 (1.8)
	Two PIVCs were inserted after enrollment	8 (3.48)
13	Administration of medicine	

Continued on next page

Table 2 continued

	By Bolus	19 (8.4)
	By using a syringe pump	45 (20.0)
	By using the IV Drip set	31 (13.8)
	By more than one	130 (57.8)
14	No. of injections per day	
	No injection	20 (8.9)
	Less than 2	128 (56.9)
	3-4	51 (22.7)
	5-6	15 (6.7)
	> 6	11 (4.9)
15	Administration of Crystalloid fluid	
	No crystalloid	107 (47.55)
	N/2 with5% Dx	30 (13.3)
	N/5 with5% Dx	4 (1.8)
	DNS	80 (35.55)
	NS	4 (1.8)
16	Administration of Colloid fluid	
	No Colloid	193 (85.77)
	Albumin	26 (11.53)
	IVIG	4 (1.8)
	Blood	2 (0.9)
17	Electrolytes correction	
	No Correction	203 (90.22)
	Kcl	3 (1.33)
	NaHCo3	10 (4.45)
	Calcium	9 (4)
18	Antibiotics	
	No	80 (35.45)
	Yes	145 (64.55)
19	Other drugs	
	No	85 (37.78)
	Yes	140 (62.22)
20	Cancer Drug	
	No	199 (88.44)
	Yes	26 (11.56)

No electrolyte correction fluid was given to most of the children (90.22%). Majority of the children (64.55%) received antibiotics. Many other drugs (analgesics, PPI, anticonvulsants, antiemetics, steroids, etc) are also used in the majority of children (62.22%). Cancer drugs were not received by majority of the children (88.44%).(Table 2).

In this study we found the incidence of phlebitis 54.22% at 95% confidence interval. 122 out of 225 children devolved PIVC-associated phlebitis. There was no statistically significant association between age, gender, history of previous hospitalization, primary diagnosis, extremity of PIVC, site of PIVC, joint involvement, size of PIVC, fixation of PIVC, and use of splint with the incidence of phlebitis. Use of three way found statistically significant association with phlebitis. Condition of PIVC dressing and person who inserted PIVC found no significant association with phlebitis. (Table 3)

There was a statistically significant association between method of drug administration and phlebitis. No association was found between the number of injections and phlebitis. A statistically significant association was found between crystalloid fluids and phlebitis. Electrolytes correction fluids, colloid fluids, and antibiotics found no association with phlebitis. Frequency of PIVC and cancer drugs was found statistically significant association with phlebitis.(Table 4).There was no statistically significant association between the duration of PIVC in situ and phlebitis.(Table 5).

Children who got medicine via a syringe pump are having 3.6 times more chance to develop phlebitis and it is statistically significant. Crystalloid is a risk factor for phlebitis but it is not statistically significant. Children, who got medicine OD, have less chance to develop phlebitis. It is statistically significant. Children who got cancer drugs have a 3.47 times more chance to develop phlebitis. It is statistically significant. Children, in whom three-way was not used, have less chance to develop phlebitis but it was not statistically significant.(Table 6). The Mean±SD life span was 69.86 ±32.88 hours, the minimum life span was 19 hours and the maximum was 180 hours. We categorized whole life span in four categories. The majority of PIVCs (41.34%) remained in situ for 48-72 hours only 3.55 % of PIVCs were removed within 24 hours.(Figure 1).

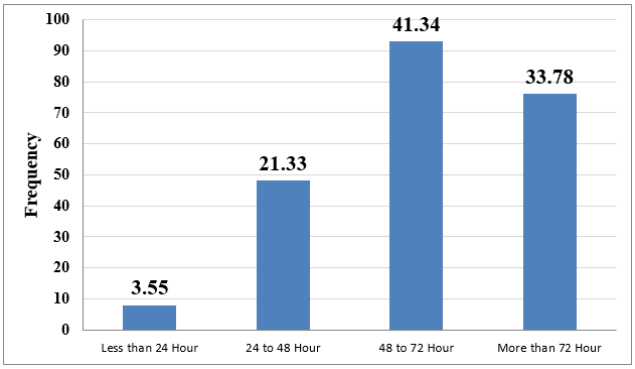

Fig. 1: Duration of PIVC among hospitalized children.

7. Discussion

In the present study incidence of phlebitis was 54.22% which is contrary to the findings of Urbanetto et al (2016)[11] reported 1.25%, Jacinto et al(2014)[5] reported 2.7%, Foster et al (2002)[8] reported 6.6%, Salma U et al (2019)[7] reported18.09 % whereas these findings are similar as reported by Sijabat et al (2021)[12] 64 % and Nagpal et al (2015)[13]71.25%. This gap between the findings might be due to sampling size, population, setting, methodology, and PIVC care. According to Infusion Therapy Standards of Practice, 5%[14] incidence of phlebitis is acceptable but in the present study, the incidence of phlebitis was more than 10 times.

In this present study, 62.3 % of phlebitis has occurred in males and 37.7 % in females but no significant association was found between gender and phlebitis. The findings of the present study were in accordance with the study finding of Jacinto et al (2014)[5] which showed no association between gender and phlebitis, these findings are also in line with the findings of Tefera et al (2020)[1] which showed no association between gender and phlebitis but the findings of the present study were in contrast with the study findings of Sijabat M et al. (2021)[12] which showed that male gender is a risk factor for phlebitis and the study done by Luyu et al(2020)[15] in which author found an association between gender and phlebitis.

The present study found that the majority of phlebitis (58.19%) occurred in 6-12 years of age children and the minimum (9.01%) in 0-1 year of age. No significant association was found between age and phlebitis. This finding is in contrast with the findings reported by Foster L et al.(2002)[8] in their study that the smaller age of children is a risk factor for developing phlebitis.

Children with a history of hospitalization may have some knowledge regarding PIVC and its care which may have an impact on phlebitis. In the present study, the majority of phlebitis (65.57%) occurred in children who had a history of previous hospitalization but it was not statistically significant. No other study reported about association between phlebitis and a history of previous hospitalization.

The present study findings suggest that more than half of children with an incidence of phlebitis were diagnosed with various malignancies and renal disorders. In this present study, no association was found between primary diagnosis and phlebitis and this finding is in contrast with the study finding of Abdelaziz RB et al (2017),[16] who suggested that respiratory disorder and infections are the risk factors for phlebitis.

Table 3: Association between phlebitis and demographic and clinical characteristics and PIVC Profile of children. n-225

S. No	Variable	Phlebitis 122 (54.4)	No Phlebitis 103(45.6)	X^2 Value	P Value
1	**Gender**			.537	.277
	Male	76 (62.3)	69 (67)		
	Female	46 (37.7)	34(33)		
2	**Age**			4.224	.065
	0- 1 year	11 (9.01)	10 (9.70)		
	1-3 year	14 (11.47)	22 (21.35)		
	3-6 year	26 (21.31)	28 (27.18)		
	6-12 year	71 (58.19)	43 (41.74)		
3	**Previous Hospitalization**			9.636	.239
	No	42(34.4)	40(38.80)		
	Yes	80(65.57)	63(61.16)		
4	**Primary Diagnosis**			9.948	.169
	Malignancy	33(27)	24(23.3)		
	Renal Disorder	24(19.7)	33(32)		
	Gastroenterological disorder	19(15.6)	12(11.7)		
	Neurological Disorder	16(13.1)	8(7.8)		
	Reparatory Disorders	22(18.8)	16(15.5)		
	Autoimmune Disorders	1(0.8) 6(4.9)	5(4.9)		
	Others Disorders		5(4.9)		
5	**Extremity of PIVC**			3.673	.291
	Right Upper	49(40.2)	42(40.8)		
	Left Upper	56(45.9)	47(45.6)		
	Right Lower	8(6.6)	2(1.9)		
	Left Lower	9(7.4)	12(11.7)		
6	**Site of PIVC**				
	Dorsum of Hand	50(41)	49(47.6)		
	Forearm	38(30.4)	28(27.2)		
	Antecubital Fossa Dorsum of Foot	18(14.8) 9(7.4)	10(9.7) 14(13.6)		
	Leg	7(5.7)	2(1.9)	6.227	.266
7	**Joint Involvement**			2.816	.100
	Yes	92(75.4)	87(84.5)		
	No	30(24.6)	16(15.5)		
8	**Size of PIVC**			5.963	.169
	Gauge 26	12(9.8)	19(18.4)		
	Gauge.24	77(63.1)	65(63.1)		
	Gauge 22	28(23)	15(14.6)		
	Gauge.20	4(3.3)	4(3.9)		
	Gauge 18	1(0.8)	0(0)		
9	**Fixation of PIVC**			1.041	.828
	Transparent Adhesive	51(41.8)	40(38.8)		
	Non Transparent Adhesive	1(0.8)	0(0)		
	With Both	70(57.4)	63(61.2)		
10	**Use of Splint**			1.0	.581
	Yes	12(10.7)	11(10.7)		
	No	109(89.3)	92(89.3)		
11	**Use of Three-way**			5.705	.037
	Yes	38(31.1)	19(18.4)		
	No	84(68.9)	83(80.6)		
12	**Condition of PIVC Dressing**			2.423	.485
	Dry and Clean	109(89.3)	97(94.2)		
	Dry and Dirty	13(10.65)	6(5.8)		
13	**Person who put PIVC**			3.494	.481
	Nursing Officer	19(15.6)	9(8.7)		
	JR	89(72.95)	85(82.52)		
	SR	14(11.5)	9(8.7)		

Value is<0 05

Table 4: Association between phlebitis and medicine and IV fluid Profile of children. n-225

S. No	Variable	Phlebitis 122 (54.4)	No Phlebitis 103(45.6)	X^2 Value	P Value
1	Method of drug administration			8.807	.031
	By Bolus	5(4.1)	14(13.6)		
	By using a syringe pump	22(18)	23(22.3)		
	By using IV Drip set	16(13.1)	15(14.6)		
	By more than one	79(64.8)	51(49.5)		
2	Number of Injection			8.854	.062
	No injection	7(5.7)	13(12.6)		
	Less than 2	66(54.1)	62(60.2)		
	3 -4	29(23.8)	22(21.4)		
	5-6	12(9.8)	3(2.9)		
	>6	8(6.6)	3(2.9)		
3	Crystalloid fluid			12.647	.016
	Yes	74(60.65)	44(42.70)		
	No	48(39.35)	59(57.30)		
4	Electrolyte correction fluid			2.763	0.96
	Yes	15(12.3)	6(5.8)		
	No	107(87.7)	97(94.2)		
5	Colloid Fluid			.671	.371
	Yes	16(13.11)	87(84.5)		
	No	106(86.9)	16(15.53)		
6	Antibiotics			.162	.086
	Yes	84 (68.9)	42(40.8)		
	No	38 (31.1)	61(59.2)		
7	Frequency of PIVC handling			14.364	.004
	OD	25(20.5)	39(37.9)		
	BD	15(12.3)	15(14.6)		
	TDS	49(40.2)	36(35)		
	QID	33(27)	12(11.7)		
8	Cancer Drugs			14.593	.001
	NO	103(84.4)	96(93.2)		
	Yes	19(15.6)	7(6.8)		

Value is <0 05

Table 5: Association between phlebitis and duration of PIVC in situ. n-225

S. No	Variable	Phlebitis 122 (54.4)	No Phlebitis 103(45.6)	X^2 Value	P Value
	Duration of PIVC in situ				
	Less than 24 Hours	6 (4.9)	2 (1.9)		
1	24 - 48 Hours	33 (27.0)	15 (14.7)	7.405	.060
	48 -72 Hours	44 (36.1)	43 (41.7)		
	More than 72Hours	39 (32.0)	43 (41.7)		

Value is<0 05

The present study shows that there is no association between extremities, site of PIVC, and phlebitis. These findings are similar to those published by Tefera et al (2020)[1] in their study but these findings are also in contrast with the findings published in a meta-analysis done by Luyu et al (2020)[15] in which the forearm was considered as a risk factor for phlebitis.

The present study demonstrates that 75.4 % incidence of phlebitis occurred in those children in whom the joint was involved at the PIVC site. In the present study, no significant association was found between phlebitis and joint involvement at the PIVC site. These findings are in contrast with the study findings conducted by Tefera et al (2020)[1] which described that involvement of joint at PIVC site is a risk factor for phlebitis.

The present study depicts that there is no significant association between phlebitis and the size of PIVC. These findings are contrary to the findings of Abdelaziz et al

Table 6: Predisposing factors of phlebitis n-225

S. No	Variables	AOR	P-value	95 % Confidence Interval	
1	Method of drug administration	1			
	Bolus	3.633087	0.045	1.031514	12.79607
	Syringe pump		0.357	.4813347	7.585859
	IV set	1.910847	0.205	.6567154	7.077204
	More than one method	2.155855			
2	Crystalloid Fluids				
	No	1			
	Yes	1.867679	.080	.9284017	3.757235
3	Frequency of PIVC handling				
	OD	.1586308	.000	.0613259	.4103279
	BD		.134	.161316	1.275465
	TDS	.4535999	.088	.2136735	1.113918
	QID	.48786751			
4	Use of cancer drug				
	No	1			
	Yes	3.478134	.018	1.235366	9.792583
5	Use of three-way extension				
	Yes	1			
	No	.8706736	0.771	.4188998	1.809675

(2017),[16] which showed that 24 size cannula is a risk factor for phlebitis.

The present study found that more than half (57.4) PIVCs were fixed with transparent adhesive, then non-transparent adhesive was also applied over the transparent adhesive to resecure that. The fixation of PIVC found no association with phlebitis and similar findings were reported by Salma et al (2019)[7] in their study.

Most of the incidence of phlebitis (89.3%) occurred in those children in whom a splint was not used to stabilize the PIVC. The use of a splint found no association with phlebitis and a similar finding was published in a study, done by Abdelaziz et al (2017).[16]

This study found that majority of PIVC dressing (89.3%) was dry and clean. No significant association was found between the condition of PIVC dressing and phlebitis while Abdelaziz et al (2017)[16] found that dressing plays a vital role in PIVC complications.

Most of the PIVC (72.95%) was inserted by a junior resident doctor. No association was found between phlebitis and the person who inserted phlebitis. No study reported the association between phlebitis and the person who inserted the PIVC.

The present study found that there is a significant association between the use of three-way extension and phlebitis. Regression analysis showed that the use of three-way is a protective factor for phlebitis. No study has reported any findings about three-way use.

In the majority of children (64.8%) drugs were given by using multiple methods of drug administration at a time including bolus, syringe pump, and IV drip set. Method of drug administration found a significant association with phlebitis. These findings are in line with findings reported by Abdelaziz et al (2017)[16] in their study that the use of a syringe pump is a risk factor. But the findings of the present study are also in contrast with a study done by Jacinto et al (2014)[5] found no association between the method of drug administration and phlebitis.

The finding of the present study depicts that more than half of the children (56.88%) were administered less than two injections per day. No significant association was found between the number of injections per day and phlebitis. There is no study which reported similar findings.

The present study revealed that 60.65% of children who developed phlebitis got crystalloid fluids. The association between phlebitis and the use of crystalloids was significant. These findings are consistent with the study conducted by Jacinto et al(2014)[5] in which fluids are a risk factor. The findings are also consistent with the study done by Parul et al (2015)[3] on the clinical pattern of phlebitis among children showed crystalloids increase the risk of phlebitis.

In the present study, 14.23 % of children received colloids. Three colloids were given to patients including IVIG, Albumin, and Blood. The present study found no association between phlebitis and colloid. These findings are similar to the findings of the study conducted by Mandal et al (2019)[17] where they reported that no significant association between blood transfusion and phlebitis. No study has reported the association between IVIG or Albumin with phlebitis.

The present study depicts there is no association between phlebitis and electrolyte correction fluid including kcl, calcium gluconate, and sodium bicarbonate. In the present study analysis of each electrolyte was impossible as more than one electrolyte was administered to the children. These findings are in contrast with the study done by

Bitencourt et al (2018)[2] which showed an association between kcl and phlebitis. No study has reported any findings about the association between calcium gluconate or sodium bicarbonate, and phlebitis.

This present study found no association between the use of antibiotics and phlebitis. These findings are contrary to the study conducted by Bitencourt et al (2018)[2] which found a significant association between antibiotics and phlebitis.

The present study reveals that there is a significant association between number of PIVC handling and phlebitis. Regression analysis showed that once in a day PIVC handling is a protective factor for phlebitis. No study has reported the association between the frequency of PIVC handling and phlebitis.

The present study describes that the use of cancer drugs and phlebitis has a significant association. Cancer drugs are also a risk factor for phlebitis. Similar findings were not reported in other studies.

This present study revealed that the mean life span of PIVC was 69.86 ±32.88 hours (range 19- 180 hours). These findings are similar to the findings of Abdelaziz et al (2017)[16] showed a lifespan of 68.82±35.71 hours (range1-168).

This study reveals that out of the 54.22 % (122) incidence of phlebitis, 36.1% occurred between 48-72 and 32% after 72 hours of placement of PIVC. No significant association was found between the duration of PIVC in situ and phlebitis. These findings are in contrast with the findings of the meta-analysis done by Luyu et al (2020)[15] in which the long duration of PIVC was considered as a risk factor and also with the study conducted by Tefera et al (2020)[1] which described a significant association between phlebitis and 48-72 hour and 72-96 hour of PIVC in situ.

8. Conclusion

The incidence of phlebitis is much higher than the acceptable limit as per Infusion Therapy Standards of Practice which is to be reduced. Crystalloids, the Method of drug administration, and cancer drugs are the risk factors for phlebitis. The frequency of PIVC handling and use of three-way extension is a protective factor for phlebitis the study suggests that most likely phlebitis occurs after three days.

8.1. Strength of study

We have studied 24 possible predisposing factors of phlebitis in this present study. This large number of factors has not been assessed in a single study so far. It is an observational study in which data was collected by a single person hence the risk of bias is the least. Standardized tool was used.

8.2. Limitations

Limitations of this study were that this study was limited to only two pediatric wards. Multiple antibiotics were given at a time so individual analysis of antibiotics was not possible. There were more than 80 disease conditions that were diagnosed in enrolled children so individual analysis was not possible. More than 40 drugs were given apart from colloids, crystalloids, and antibiotics so individual analysis could not possible.

9. Recommendation

We recommend that a similar study can be done with a large sample size. A comparative study also can be done between adult and pediatric populations to find out the incidence of phlebitis. A study can be done to assess the incidence of phlebitis with different classes of drugs like antibiotics, PPI, anticonvulsants, electrolyte connection fluids, colloids, etc.

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None.

11. Conflict of Interest

None.

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