Frequency of Peripheral Intravenous Catheter Related Phlebitis and Related Risk Factors: A Prospective Study

Umma Salma,[1] Mohammad Abdus Sattar Sarker,[2] Nahida Zafrin,[3] Kazi Shamin Ahamed[4]

Abstract:

Background: *Peripheral Intravenous Catheterization (PIVC) related complication is a common and significant problem in clinical practices. The aim of the study was to see the pattern of complication developed by PIVC and to find out the associated risk factors.*

Materials & methods: *A prospective study was conducted amongst 300 patients and 420 PIVCs were observed.*

Results: *76 (18.09%) patients developed phlebitis and among the phlebitis patients 55.26% were grade 2 and 22.37% grade 3. Hypertonic fluid infusion and some antibiotics were found as risk factors for phlebitis. Amongst the antibiotics flucloxacilin (60%), amikacin (50%), meropenem (50%), amoxicillin + clavulanic acid (34.78%) were most common antibiotics responsible for development of phlebitis.*

Conclusions: *Catheterization site and use of antibiotics and potassium chloride with associated co-morbidities are predisposing factors for phlebitis. Better insertion technique may be sought to lower the incidence of PIVC related complications.*

Keywords: *Peripheral Intravenous Catheterization (PIVC); phlebitis; risk factors.*

Introduction:

Peripheral Intravenous Catheterization (PIVC) is a common invasive procedure performed in hospitals to administer medications, fluids, and bio-products. PIVC complications are classified into minor and major categories based on the severity of symptoms. Minor complications include catheter occlusions accidental removals, fear of sharp catheter (needle phobia) and pain. On the other hand, major complications tend to be more severe such as phlebitis, injections, extravasation and even skin injuries.[1]

1. Associate Professor of Medicine, Dhaka National Medical College and Hospital.
2. Associate Professor of Medicine, Sir Salilmullah Medical College and Mitford Hospital.
3. Assistant Professor of Medicine, Sylhet MAG Osmani Medical College and Hospital.
4. Assistant Professor of Medicine, Dhaka National Medical College and Hospital.

Corresponding author: Dr. Umma Salma, Associate Professor of Medicine, Dhaka National Medical College and Hospital. Email: dr.salma19@gmail.com.

The most common complication associated with it is thrombophlebitis ç incidence varying according to different settings (3.7% - 67.24%).[2]

Phlebitis is the inflammation of the veins which is manifested by warmth, tenderness, redness and/or swelling at the insertion site. In severe case, inflammation can track along the length of vein resulting indurations and palpable venous cord.[3]

Over the last two decades, studies about phlebitis have divided the risk factors into four main groups: patient characteristics, therapy administered, health professional practices and cannula characteristics.

The complications associated with peripheral I/V cannula and I/V therapy can have a devastating effect on patient's health and quality of life and also increase the cost of health case through prolong hospital stay and treatment. The study was conducted in Dhaka National Medical College with an aim to identify the incidence and associated risk factors in our hospitalized patients.

Materials and Materials:

This prospective observational study was conducted at Dhaka National Medical College Institute Hospital, in medicine department among 300 hospitalized patients from 15th March to 20th June 2018. 420 I/V catheter was observed from 1st to last day of hospitalization with a range of 1-7 days. Unconscious, disoriented patients, and patients ç previously inserted PIVC from outside were excluded. Each patient was visited daily and catheter sites were examined for signs of thrombophlebitis. When the signs of thrombophlebitis were noticed, the visual infusion phlebitis and care (VIPS) was used to grade it. The data was analyzed using SPSS version 21 and result were tabulated.

Results:

Patient Characteristics:

420 PIVC sites from 300 patients (195 males and 105 females) were followed up. As we observed the PIVC from patients admitted under medicine unit, 100% of patient were suffering from medical diseases. Mostly suffering from infection diseases like Enteric fever, pneumonia, Urinary Tract Infection (UTI), acute gastro enteritis. Some patients were admitted for blood transfusion, electrolyte imbalance. Among the total patients, 149 patients (49.67%) were less than 45 years old and 151 (51.33%) patients were 45 years or older.

Catheter related characteristics:

Adhesive tape was applied for 100% catheter. Most commonly used catheter size was 20G (68.10%) followed by 22G (26.67%) and 18G (5.24%). PIVC were frequently inserted in wrist (60.59%), hand (24.29%), forearm (10.24%), leg (1.90%) and foot (0.48%). 84.33% PIVC were inserted in ward and 15.67% inserted in emergency. Average dwell time was 4 days. Maximum observed time was 7 days (Table II).

Table I: *Visual Infusion Phlebitis Score*

Grade 0	Site appears healthy	No sign of phlebitis	
Grade 1	One of the following is evident • Slight pain near IV side • Slight redness near IV side	possible sign of phlebitis	observe cannula
Grade 2	Two of the following is evident • Pain near IV side • Erythema • Swelling	early stage of phlebitis	resite cannula
Grade 3	All of the following are evident • Pain along the path of cannula • Erythema • Induration	medium stage of phlebitis	resite cannula, consider treatment
Grade 4	All of the following are evident and extensive • Pain along the path of cannula • Erythema • Induration • Palpable venous blood		resite cannula, consider treatment
Grade 5	All of the following are evident and extensive • Pain along the path of cannula • Erythema • Induration • Palpable venous cord • Pyrexia	late stage of phlebitis	resite cannula, initiate treatment

Frequency and types of PIVC - related complications:

Out of 420 observed PIVC, 120 (28.57%) developed complication. Phlebitis ranked first among complications (18.09%) followed by extravasation (9%), cannula obstruction (7.86%) and dislodge (2%) subsequently. Among the 76 phlebitis cases 42 (55.26%) develop grade II, 17 (22.37%) patient developed grade III phlebitis (Table II).

Table II: *Characterization of the puncture.*

Catheter insertion setting	n = 300	%
• Ward	253	84.33%
• Emergency	47	15.67%
• Total	300	100%
Catheterized limb	n = 420	
• Upper limb	412	98.10%
• Lower limb	8	1.90%
Catheterization site	n = 420	
• Wrist	256	60.95%
• Hand	102	24.29%
• Forearm	43	10.24%
• Antecubital area	9	2.14%
• Leg	8	1.90%
• Arm	2	0.48%
• Foot		
Catheter gauge	n = 420	
• 18G	22	5.24%
• 20G	286	68.10%
• 22G	112	26.67%
Catheter material	n = 420	
• 100% Polyurethane	420	
Catheter stabilization material	n = 420	
• 100% Adhesive tape	420	
Catheter dwell time (in days)		
• Average-	3.2	
• Medium-	4	
• Min- 1; Max-7		
Reason for catheter removal	n = 420	
• Phlebitis	76	18.09%
• Loss of function/ obstruction	33	7.86%
• Extravasation	9	2.14%
• Dislodged	2	0.48%
Grades of phlebitis	n = 76	
• Grade 1	6	7.89%
• Grade 2	42	55.26%
• Grade 3	17	22.37%
• Grade 4	11	14.47%
• Grade 5	0	0%

Risk factor for phlebitis:

Frequency of phlebitis is higher among the patients received hypertonic fluid 11.4% than those received isotonic fluid 5.19% (pvalue < 0.05). Phlebitis is observed more in patient group received KCI injection 26.31% than those not received the KCI. Among the patients received antibiotics injection frequency of phlebitis more with Flucloxacillin (60%), Amikacin (50%), Meropenem (50%), Amoxicillin + clavulanic acid (34.78%). Less frequently with Ceftazidime (16.67%), Cefuroxime (11.86%) and Ceftriaxone (11.25%) (Table III).

Table III: *Type of I/V fluid/Medication: (n=420).*

Type of fluid	n = 420	%
• Isotonic	385	91.67%
• Hypertonic	35	8.33%
• Hypotonic	00	0%
KCL n = 420		
• Yes	38	9.05%
• No	382	90.95%
Antibiotics	n =420	
• Ceftriaxone	160	38.09%
• Cefuroxime	59	14.04%
• Flucloxacillin	5	1.19%
• Amikacin	2	0.48%
• Amoxicillin+clavulanic acid	23	5.48%
• Ceftazidime	12	2.86%
• Meropenem	6	1.43%

Table IV: *Age, sex distribution and comorbidity in thrombophlebitis patients*

	Patients with thrombophlebitis n=76 [Number (%)]	Patients without thrombophlebitis n=224 [Number (%)]
Age		
• <45 years	35 (45.05%)	114 (50.89%)
• >45 years	41 (53.95%)	110 (49.11%)
Gender		
• Male	47 (61.84%)	117 (52.23%)
• Female	29 (38.16%)	107 (47.77%)
Comorbidities		
• DM	19 (25%)	6 (2.68%)
• HTN	25 (32.89%)	17 (7.59%)
• Hyperlipidaemia	13 (17.11%)	11 (4.91%)

Table V: *Risk factors for phlebitis:*

	Total patients	Phlebitis	%
KCL			
Yes	38	10	26.31
No	382	44	11.52
Antibiotics			
Cefriaxon	160	18	11.25
Cefuroxime	59	7	11.86
Flucloxacillin	5	3	60
Amikacin	2	1	50
Amoxicillin+clavulanic acid	23	8	34.78
Ceftazidime	12	2	16.67
Meropenem	6	3	50
Catheter Insertion Setting			
Ward	253	64	25.29
Emergency	47	14	29.76
Types of I/V fluid			
Isotonic	385	20	5.19
Hypertonic	35	4	11.4

Discussion:

For hospitalized patients intravenous therapy most commonly prescribed and PIVC is commonly performed procedure. It remains susceptible to infectious and non infectious complications.[1] In our study, 28.57% patients developed PIVC related complications this rate is lower than the rate of 35% observed in a study conducted in comparable patient population.[4] However, the rate of phlebitis in this study was 18.09%. This is more than the rate observed in other studies.[4] Many factors contributed in development of complications like size of catheter, insertion site preparation, type of infusion, insertion technique, catheter dwell time, dressing type and insertion site.[5,6] In present study, PIVCs were inserted frequently in the wrist 60.95%, hand 24.29% and forearm 10.24%.

Dressing regiments and methods of securing catheters may contribute to the occurrence of infection contributing to the complications including infiltration extravasation and catheter displacement.[2] However, in our study incidence of complications was not associated with the type of dressing because 100% PIVC were fixed by adhesive tape. This finding was in agreement with the conclusion of a systematic review and meta analysis that demonstrated the absence of any relationship between the type of dressing used in PIVC insertion sites and the recurrence of phlebitis, infiltration or skin dwelling bacteria in adult patients.[7]

The use of smaller caliber catheter is related to reducing the occurrence of phlebitis. Since they prevent mechanical irritation to the interior walls of small diameter veins .[5,8] In our study G20 and G22 were the main catheter sizes used (68.10% and 26.67% respectively), only 5.24% cannula was 18G

In literature review there is no specific rate of phlebitis and risk when antibiotics were infused using a peripheral catheter.[8] In our study, 100% of patient got I/V fluid of which 91.67% got isotonic fluid and 8.33% got hypertonic fluid. Phlebitis were more common (11.4%) among those received hypertonic solution and 5.19% those received isotonic solution. This difference is statistically significant ($p<0.05$). Patients on I/V medication where 1.41 times more likely to develop complications than those on hydration. These medications were mainly antibiotics and higher complications might be attributed to some antibiotics low pH level which are like to increase the incidence of these complications.[9] In our study, among all the injectable antibiotics phlebitis rate is highest in patient received injectable Flucloxaciline (60%) subsequently Amikacin and Meropenem both 50%, Amoxicillin and clavulanic acid 34.78%. Phlebitis rate is relatively lower among patient received Ceftriaxone and Cefuroxime (11.1%). According to CDC guideline[10] adult patients catheter should be replaced within 72-96 hour period in order to reduce complications.[11] However, the findings of our study detected no difference between patients with PIVCs catheterized for variable time periods. This coincides with the statement that routine replacement of PIVCs has no effect on the incidence of catheter failures.[4,12] It can be recommended that I/V line should be changed according to clinical signs and symptoms rather than adopting predetermined time frame.[13] Nurses society recommendation to remove PIVCs based on clinical indication rather than standard interval.[14,15]

In our study, phlebitis is more common in patient group 45 years or older (53.95%) than patient group less than 45 years (45.05%). This result is not coincide with the result of other studies.[16,17] As the inflammatory response in the elderly is often impaired, signs and symptoms of phlebitis may be stable. But in our study phlebitis rate is higher in elderly most likely due to higher requirement of antibiotics and higher hypertonic fluid than relatively young age group. In hypertensive, diabetic and dyslipidaemic group phlebitis rate is significantly higher (32.89%, 25%, 17.11% respectively) than normotensive, non diabetic and patient with normal lipid profile (7.59%, 2.68%, 4.91% respectively). The higher rate of phlebitis in these patients may be due to the endothelial damage induced by diabetes that predispose patient to phlebitis.[18]

Our study findings is supported of some other studies.[16,19,20] Infectious disease increase risks of phlebitis. One of the reason is related to use of I/V antibiotics which causes endothelial irritation resulting phlebitis. Grade II and grade III phlebitis is most common grade among the phlebitis patients in our study.

Conclusions:

PIVC induced complications are one of the most important preventable problem in hospitalized patients which increase the morbidity and prolong the hospital stay. Predisposing factors for phlebitis are catheterization site and use of antibiotics and potassium chloride with associated co-morbidities. Better insertion techniques may be sought to lower the incidence of PIVC complication to further delay their onset. Changing catheter is recommended when clinically indicated rather than 72 hours of insertion.

Conflict of interest: None.

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