# Contributing Factors of Peripheral Intravenous Catheter Related Phlebitis among Patients at a Teaching Hospital, Chitwan

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**Abstract:** *Peripheral intravenous catheter-related phlebitis (PIVC) is a common procedure and significant problem in day to day clinical practice. The study aimed at finding out the incidence and contributing factors of PIVC related phlebitis among admitted patients. Prospective observational study design was used among 586 PIVC sites of 465 patients having at least one PIVC sites of general wards of Chitwan Medical College Teaching Hospital by using semi-structured interview schedule and a specific form was prepared and used to observe signs and symptoms of phlebitis. Data were statistically analyzed by using descriptive statistics and chi-square test. The study findings revealed that the overall incidence of phlebitis was at 33.44% and early stage phlebitis was 88.26%. The incidence of phlebitis was at its highest with in the first 49-72 hours. It is associated with hypertension, patient being admitted to a nephrology ward, patient received isotonic fluid and potassium chloride. Therefore, the staffs should consider these areas and the insertion site should be observed at each shift change by the care provider to prevent phlebitis as well as it is recommended to explore other factors especially infection prevention measures.*

**Keywords:** CMCTH, Incidence, PIVC, Phlebitis, Nepal

## 1. Introduction

Intravenous cannulation is the commonest invasive procedure among hospitalized patients. [1] However, the placement of an intravenous cannula can have undesirable effects, the most common of which is phlebitis. PIVC related phlebitis is referring to the inflammation of the vein at cannula site. [2] Depending on the populations studied, the occurrence of phlebitis varies. Thus, Webster cites that the phlebitis rate ranges from 2.3% - 67%. [3] One of the more serious complications of IV therapy is bacteraemia which occurs in about 0.8% of cases. [4] Recent large trials suggest that the incidence of phlebitis per catheter in tertiary hospitals is most likely to be around 4.6%. [5] The incidence of phlebitis in Dhulikhel hospital Nepal was relatively mild at around 59.1%. [6] The study conducted in Kathmandu Medical College Teaching Hospital, Kathmandu, Nepal, found that 79% developed thrombophlebitis highlighting the severity of the problem in that setting. [7]

Various different factors have been known to contribute to the genesis of phlebitis: such as namely chemical factors (low pH, KCl, hypertonic solutions, amino acids and certain antibiotics), physical factors (catheter's material, size of the cannula, site of insertion, duration of cannulation) etc. [8]

The complication of PIVC leads to a patient's discomfort and the need of an increased medical treatment, leading to a longer stay of the patients in hospital. All of this resulting in a rise of the overall cost of treatment, and is, additionally associated with an increase in morbidity and mortality. [9]

There are two phlebitis scoring systems, which should be used in routine practice to identify and treat early signs of the inflammation. [2] According to the Visual Infusion Phlebitis Score (VIP), phlebitis can be classified in different stages such as: no sign of phlebitis as 0, first sign as 1, early stage as 2, medium as 3, advanced stage or start of thrombophlebitis as 4 and advanced stage of thrombophlebitis as 5. [10] The introduction of the visual infusion phlebitis (VIP) score tool for assessment of the early signs of phlebitis, along with prompt removal of peripheral intravenous cannulas, has been very successful in reducing the incidence below the acceptable rate of 5%.[11] The findings of the study conducted by Morrison and Holt also showed the replacement of PIVC only when clinically indicated and does not increase patient risk of phlebitis when compared to the current practice of routine replacement between 72 and 96 hours in the adult patients.[12] The review found no evidence to support changing catheters every 72 to 96 hours. Catheters are changed only if there is a clinical indication like signs of infection, blockage or infiltration. To minimise PIVC-related complications, health personnel should observe the insertion site in each shift change and remove the catheter if signs of inflammation, infiltration, occlusion, infection or blockage are present, or if the catheter is not needed for further therapy. [13]

And, the appropriate choice of device and site can make a significant difference in preventing phlebitis. Good infection control techniques are also crucial when it comes to preventing the condition. [2]

## 2. Materials and Methods

Prospective observational study design was used. Enumerative sampling technique was used. A total of 586 PIVC sites of the 465 patients aged 18 and above having at least one PIVC were observed from October to December 2017 and were admitted to Tropical Medicine, ENT, Respiratory, Nephrology, Surgical and the Orthopedic wards of teaching hospital of Chitwan Nepal. We observed more than one PIVC sites of the patients which were inserted during observation period. In some patients up to 3 PIVC were inserted during that time in different attempts of different times. So, the PIVC sites were more than the number of patients. We did not count and observed the PIVC sites which were not successful for insertion. We excluded minors below the age of 18 (before the age of giving consent legally) and unable to give information especially difficult to speak while asking about history of habits, comorbidities and about pain and patients with previously inserted PIVC from outside these wards. A specific form was prepared and attached to the chart of each patient. The nurses were instructed about the form and any possible signs and stages of phlebitis. A separate form was used for each individual PIVC site. Each PIVC site was reassessed on a daily basis and the results were recorded on the form by the general nurses (irrespective of work experience) of the particular ward from the date of insertion until the removal.

Researchers used the Visual Infusion Phlebitis (VIP) Scale in order to assess the phlebitis. On the basis of the scale, phlebitis was considered if at least two out of 5 symptoms (pain at IV site, redness, swelling, pain along the path of canula and palpable venous cord) were evident. So, phlebitis was further categorized into 3 stages (early, medium and advanced stage). If two signs were evident out of pain at IV site, redness and swelling, it is categorized as early stage of phlebitis. Medium stage of phlebitis was diagnosed if all of the 3 symptoms such as pain along the path of canula, swelling and redness were present. And advanced stage of phlebitis was considered if all 4 of the symptoms such as pain along the path of canula, swelling, redness and palpable venous cord were present. Ethical approval was obtained from Chitwan Medical College Institutional Review Committee (CMC-IRC) and Chitwan Medical College Teaching Hospital. Verbal informed consent was obtained from each participant by explaining the purpose of the study to them. All collected data was reviewed and checked manually for completeness, consistency and accuracy. Subsequently the data was coded and entered into EPI data 3.1. The entered data was then exported into IBM SPSS version 20 for analysis. The data was analyzed by using descriptive statistics (frequency, percentage, mean and standard deviation). Inferential statistic, an odd ratio with a 95% confidence interval was calculated. A line graph and a ROC curve were used to illustrate the incidence of phlebitis.

## 3. Results

**Table 1:** Socio-demographic Characteristics of the Respondents, n=465

| Variables | Frequency | Percentage |
|---|---|---|
| **Age group (in years)** | | |
| ≤ 20 | 20 | 4.3 |
| 21 - 40 | 189 | 40.6 |
| 41 - 60 | 130 | 28.0 |
| >60 | 126 | 27.1 |
| **Sex** | | |
| Male | 276 | 69.4 |
| Female | 189 | 40.6 |
| **Patient admitted ward** | | |
| Ear Nose Throat (ENT) | 125 | 26.9 |
| Tropical | 108 | 23.2 |
| Orthopedic | 93 | 20 |
| Nephrology | 86 | 18.5 |
| Respiratory | 32 | 6.9 |
| Surgery | 21 | 4.5 |
| **Patients' Smoking Habit** | 65 | 14.0 |
| **Having Hypertension** | 87 | 18.7 |
| **Having Diabetes Mellitus** | 53 | 11.4 |

Table 1 shows that out of the 465 participants, the majority (40.6%) were between 21-40 years old. The mean age was 46.20±18.95 years. The group of patients consisted of 69.4% of males, 26.9% of the participants were admitted to the ENT ward, 14% had a smoking habit, 18.7% had a history involving high blood pressure and 11.4% suffered from diabetes mellitus. A hundred percent of the IV cannulas were inserted by nurses. The majority (44.19%) of the nurses involved had a work experience of 1-2 years. The majority (70.30%) of IV cannulas were 18 and 20 gauge. Almost all (99.65%) of the intravenous cannulas were inserted into one of the upper extremities and the majority (53.41%) of those were inserted into the patient's hand.

**Table 2:** Incidence and Stage of Phlebitis, n=586

| Variables | Number | Incidence Rate |
|---|---|---|
| **Incidence of Phlebitis** | | |
| Phlebitis Present | 196 | 33.44 |
| Phlebitis Absent | 390 | 66.55 |
| **Stages of Phlebitis (n=196)** | | |
| Early Stage of Phlebitis-Grade 2 (two of these signs evident- pain at IV site, redness, swelling) | 173 | 88.26 |
| Medium Stage of Phlebitis-Grade 3 (two of these signs evident-pain along path of cannula, redness around site, swelling) | 23 | 11.73 |

Table 2 shows the incidence and stages of PIVC related phlebitis. The incidence rate of phlebitis was at 33.44% (95% CI:29.15 % -37.73 %) and among these cases, the majority of the intravenous sites (88.26%) developed an early stage (grade 2) of phlebitis. The forearm was the body part that seem to be associated with the development of phlebitis the most as 40.3% of the PIVC that were performed on it led to phlebitis (not shown in table).
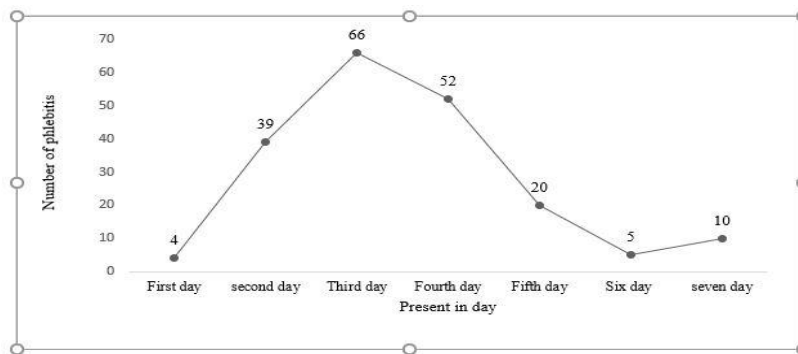
**Figure 1:** Incidence of Phlebitis related to Duration of Peripheral Intravenous Catheter

Figure 1 shows the incidence of phlebitis related to duration of PIVC. It was observed that, the incidence of phlebitis rose gradually rose from day one to day three and dropped after day four. The highest occurrence of phlebitis (11.26%) was between 49 and 72 hours of catheter placement. PIVC was kept in place from day 1 to day 9 of insertion. Phlebitis was developed 2.04%, 19.89%, 33.67%, 26.53%, 10.20%, 2.55% and 5.10% from day 1 to day 7 respectively. Then after the development of phlebitis was not observed.

**Table 3**: Association between Phlebitis Development and Patients' Characteristics

| Variables | Incidence of Phlebitis | | p-value | Odd Ratio | 95% CI |
|---|---|---|---|---|---|
| | Present (%) | Absent (%) | | | |
| **Age (in years)** | | | | | |
| ≤20 | 8(29.6) | 19(70.4) | | 1 | |
| 21-40 | 75(30.9) | 168(69.1) | 0.793 | 1.123 | 0.473-2.664 |
| 41-60 | 61(36.3) | 107(63.7) | 0.396 | 1.142 | 0.608-3.517 |
| >60 | 52(35.1) | 96(64.9) | 0.531 | 1.328 | 0.547-3.226 |
| **Sex** | | | | | |
| Male | 106(30.5) | 242(69.5) | | 1 | |
| Female | 90(37.8) | 148(62.2) | 0.064 | 1.388 | 0.981-1.965 |
| **Smoking** | | | | | |
| Yes | 28(35.0) | 52(65.0) | 0.892 | 1.035 | 0.638-1.708 |
| No | 168(33.2) | 338(66.8) | | **1** | |
| **Hypertension** | | | | | |
| Yes | 49(45.0) | 60(55.0) | 0.005* | 1.833 | 1.199-2.803 |
| No | 147(30.8) | 330(69.2) | | 1 | |
| **Diabetes** | | | | | |
| Yes | 26(44.8) | 32(55.2) | 0.084 | 1.631 | 0.937-2.838 |
| No | 170(32.2) | 358(67.8) | | 1 | |
| **Name of wards** | | | | | |
| Nephrology | 59(55.7) | 47(44.3) | 0.003 | 5.649 | 1.790-17.826 |
| Respiratory | 12(34.3) | 23(65.7) | 0.194 | 2.348 | 0.647-8.519 |
| Tropical | 43(32.8) | 88(67.2) | 0.177 | 2.199 | 0.701-6.897 |
| Ortho | 37(28.2) | 94(71.8) | 0.329 | 1.771 | 0.562-5.584 |
| ENT | 41(25.5) | 120(74.5) | 0.460 | 1.537 | 0.492-4.807 |
| Surgery | 4(18.2) | 18(81.8) | | 1 | |
| **Work Experience (months)** | | | | | |
| <6 | 27(33.8) | 53(66.2) | | | |
| 6-11 | 33(48.5) | 35(51.5) | 0.069 | 1.851 | 0.953-3.595 |
| 12-24 | 75(29.0) | 184(71.0) | 0.414 | 0.800 | 0.468-1.367 |
| >24 | 61(34.1) | 118(65.9) | 0.959 | 1.015 | 0.581-1.771 |
| **IV Fluid** | | | | | |
| Yes | 94(39.5) | 144(60.5) | 0.010* | 1.754 | 1.112-2.229 |
| No | 102(29.3) | 246(70.7) | | 1 | |
| **KCL** | | | | | |
| Yes | 14(58.3) | 10(41.7) | 0.008* | 2.923 | 1.274-6.707 |
| No | 182(32.4) | 380(67.6) | | 1 | |
| **Steroid** | 5(33.3) | 10(66.7) | 0.989 | | |
| **Metronidazole** | 20(26.3) | 56(73.7) | 0.592 | | |
| **Antibiotics** | 151(32.9) | 308(67.1) | 0.592 | | |
| **Blood Product** | 4(36.4) | 7(63.6) | 0.836 | | |

1-*Reference group* *Significant value, CI=confidence interval*

Table 3 shows that the patients who had hypertension were 1.833 (95% CI: 1.199-2.803) times more likely to have phlebitis as compared to those who did not have. Similarly, patients who were admitted to the nephrology ward were

5.649 (95% CI: 1.790-17.826) times more likely to have phlebitis compared to those who were admitted to the surgery ward. Furthermore, patients who received isotonic fluid were 1.754 (95% CI: 1.112-2.229) times and potassium chloride were 2.923 (95% CI: 1.274-6.707) times more likely to develop phlebitis compared to those who did not have. There could not be found a significant correlation between the development of phlebitis and certain features such as age, sex, smoking habit, work experience of the nurses, the administration of any drugs (Steroid, Metron and Antibiotics) or any blood products.

## 4. Discussion

Peripheral intravenous cannulation (PIC) is a common procedure carried out in hospitals to allow rapid and accurate administration of medication. However, it may lead to undesirable side effects such as phlebitis. The incidence of phlebitis in this study was at 33.44% which was actually lower than what other researchers found out in Nepal: 59.1% in Kathmandu University Teaching Hospital (KUTH), 79% in Kathmandu Medical College Teaching Hospital, 65% at Patan Hospital were results that came up in other studies. [6-7,14] The incidence is also lower (41.2%) than the study conducted in Istanbul Turkey. [15] Nevertheless, the figures reflecting the incidence of phlebitis in this study were still higher than the ones from other studies done in other countries. Since there was an incidence of 31.8%, 17.6%, 15.4% and 11.09%. [16-19] Regardless to the figures from other studies, the incidence of phlebitis that was shown in this study was much higher than the standard level established by the Infusion Nurses Society i.e. 5%. [20]

The incidence of phlebitis is related to different factors. The incidence of phlebitis in this study had its peak within the first 49-72 hours of catheter insertion, and the duration of placement of PIVC is 1- 9 days to different patients and development of phlebitis is only upto 7 days and then after none of the patients developed phlebitis. Webster, Osborne, Rickard and Marsh found no evidence to support changing catheters every 72 to 96 hours. So, catheters are changed only if there is a clinical indication present. [13]

In this study, an early stage (grade 2) of phlebitis was developed in 88.26% of all cases of phlebitis and 11.73% of infected sites showed a medium stage (grade 3) of phlebitis. In a study in Portugal, the most common grades of phlebitis were grade 1 and 2 (37.0% and 53.6%, respectively). [21] The study of Dhaka found that among the phlebitis cases, 55.26% developed grade II, and 22.37% developed grade III phlebitis. [22] A study in KUTH led to the observation of a high rate of very mild form of phlebitis (40.0%) followed by the mild (11.3%) and moderate and severe forms of phlebitis (both at 3.9%). [6]

No differences based on the patients' sex were found when it came to the development of phlebitis in this study, which is congruent with other studies. [21,23] In the study of Dhulkhel hospital Nepal, found that increased incidence rates of infusion related phlebitis were associated with male sex. [6] In this study, the patients' age seemed not to be significantly associated with the development of phlebitis which is congruent to findings in other studies. [21,23] Further studies show patients aged 60 and over to specifically be at risk for phlebitis. [24]

In this study, hypertension is statistically seen to be significantly connected to the development of phlebitis. A study found that the group of patients with at least one co-morbidity was associated with a slightly higher incidence of phlebitis [25] whereas, findings of another study did not show any significant association of co-morbidities with the development of phlebitis. [26] In this study, patients admitted to the nephrology ward seemed to be more at risk of developing phlebitis. Findings of a study indicate that PIVC insertion at an inpatient unit was more likely to be a trigger of phlebitis than PIC insertions at other services (emergency room and operating room). [23] On the other hand, inconsistent results were found where the setting of catheter insertion was not statistically significant for the development of phlebitis. [21]

In this study, catheter gauge seemed to have no statistical significance which is a finding congruent with the ones from other studies. [21,27-28] However, many authors have highlighted the advantages of using smaller gauge catheters. [23,29]

In this study, the major site of the incidence of phlebitis was the forearm as a PIVC in that site resulted into the relatively greatest development of phlebitis as 40.3% of the PIVC led to an infection. However, there could not be found a statistical significance which is congruent with findings from other studies. [21] Other studies show that the risk of phlebitis is lower when PIVCs are inserted in the hand/wrist rather than in the forearm. [30] Furthermore, it has been found that the veins on the dorsal side of the hand were supposedly promotive of a higher risk of thrombophlebitis. [29] Thus, it seems that the insertion of a catheter in areas of flexion or high mobility might contribute to the development of traumatic phlebitis and both veins of the upper limbs should be considered to be used, instead of veins of the lower limbs, due to the risk of embolisms and thrombophlebitis. [23,27,31]

In this study it was found that potassium chloride and the development of phlebitis showed a correlation of statistical significance. Similar results were found describing the administration of potassium chloride (KCL) as a leading cause of phlebitis. [21,23] In this study, antibiotics were not significantly associated with the development of phlebitis. Contradicting results were found where antibiotics seemed to be significantly associated with an increased incidence of phlebitis when compared to other drugs. [32] This study shows a significant association of administered isotonic fluid with the development of phlebitis. Contradicting results were found where isotonic fluids lowered the incidence of phlebitis, while hypertonic fluids increased the incidence of phlebitis by initiating the inflammatory response. [27]

## 5. Conclusion

One third of the patients receiving a PIVC at Chitwan Medical College Teaching Hospital, Nepal developed phlebitis. The majority of the intravenous sites led to the

development of an early stage of phlebitis. The incidence rate of phlebitis was at its highest with in the first 49-72 hours. PIVC was kept in place from day 1 to day 9 of insertion but phlebitis was developed up to 7 days of insertion. Patients who had hypertension, who were admitted to nephrology ward, who received isotonic fluid and potassium chloride were more likely to develop some sort of phlebitis.  The incidence is much higher than standard level. Therefore, the care providers should give more attention to these areas, insertion site should be observed at each shift change to prevent phlebitis and other factors mainly infection prevention measures need to be further explored to find out the contributing factors of peripheral intravenous catheter related phlebitis.

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