

## Peripheral intravenous catheter related phlebitis and its contributing factors among adult population at KU Teaching Hospital

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### Abstract

**Background:** Peripheral intravenous catheter-related phlebitis is a common and significant problem in clinical practice. This study was carried out to determine the occurrence of peripheral intravenous catheter related phlebitis and to define the possible factors associated to its development.

**Materials and methods:** Prospective observational study was carried out on 230 clients who were under first time peripheral infusion therapy during two months period: September–October, 2007. Peripheral infusion site was examined for signs of phlebitis once a day. Jackson Standard visual phlebitis scale was used to measure the severity of the phlebitis. SPSS software was used to enter, edit and analyze the data and t-test, chi-square test, binary logistic regression and ROC curve were used to draw the statistical inferences.

**Results:** Phlebitis developed in 136/230 clients (59.1%). It was very mild in most cases. Increased incidence rates of infusion related phlebitis were associated with male sex, small catheter size (20 gauge), insertion at the sites of forearm, IV drug administration and blood product transfusions. The incidence rate of phlebitis rose sharply after 36 hours of catheter insertion.

**Conclusion:** Peripheral Intravenous therapy related phlebitis at KUTH, Dhulikhel Hospital is a significant problem. Related risk factors as found in the present study were insertion site (forearm), size of catheter (20G) and dwell time ( $\geq$  36 hours). There were higher incident of phlebitis among the client with Intra venous drug administration and especially between ages 21 - 40 years. Therefore more attention and care are needed in these areas by the care provider.

**Key words:** Phlebitis, Intravenous Therapy, Catheter, Risk Factors, KUTH, Nepal.

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Intravascular devices are common and play very important role in modern day medical practice. One of the devices most used is the peripheral intravenous catheter (PIC) for IV fluids, IV medications, blood product administration, or blood sampling<sup>1</sup>. About 50% of hospital patients require intravenous (IV) access<sup>2</sup>. Although such catheter provides necessary intravascular access, their use puts client at risk for associated complications which may be local and systemic.

One of the most common complications of PIC is phlebitis that may occur in up to 75% of hospitalized patients<sup>3</sup>. It remains a significant problem in clinical practice and causes patient discomfort, catheter replacement, prolong hospital stay and health care cost. Many factors have been implicated in the genesis of phlebitis namely (1) chemical factors such as irritant drugs and fluids, (2) mechanical factors: such as catheter material, size of cannula, site of insertion, duration of cannulation (dwell time)<sup>4</sup> etc. Many cases of PICs related phlebitis has been noted at KUTH, Dhulikhel

Hospital, Kathmandu University Teaching Hospital. A prospective observational study was conducted to assess the magnitude of the problem as well as to shed some light on possible contributing factors. Awareness of such factors may help to reduce the incidence of PICs related phlebitis.

### Materials and methods

In this prospective observational study, we were able to include 230 clients who were admitted in the Intensive Care Unit (ICU), medical, surgical, obstetrics and gynecology (OBGYN or OBSGYN) of Dhulikhel Hospital over the month of September and October 2007. PIC site was examined daily from the initiation

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of the peripheral intravenous catheter to the time of discharge or up to two days after removal of catheter. Clients were visited daily for the assessment of the signs of phlebitis and was graded as absent (0), very mild (1), mild (2), moderate (3), severe (4) and very severe (5) depending on the degree of any pain, erythema, swelling, indurations, tenderness of vein and fever. To increase the accuracy of detection of signs of phlebitis and to measure the severity of phlebitis we used visual infusion phlebitis scale<sup>5,6</sup>. Variables recorded were age, gender, size of cannula, site and place of insertion, dwell time, use of antibiotics and blood products.

Only the first insertions of PICs to adult client were included. Clients who had skin diseases like skin rash and allergy to any medication and burn were excluded. Data entry and analysis were done using SPSS software. Descriptive statistics/ percentage were used to assess the incidence of phlebitis. Later, chi-square and t-test were used to draw statistical inferences whenever appropriate. Binary Logistic Regression was used to calculate odds ratio whereas Receiver Operating Characteristics (ROC) curve was used to find the cut-off value of dwell time related to the phlebitis.

## Results

Of 230 patients, 94 were male and 136 were female. Catheter was inserted for reasons such as administration of fluids, intravenous drugs and blood products. Catheter gage size was 18 or less in 77 patients and 20 gage in 153 patient. A 106 (46.8 %) catheters were inserted in the forearm, 64 (27.82%) in dorsum of hand and 60 (26.08%) in joint. Table 1 shows the incidence of various types of peripheral infusion related phlebitis in KUTH, Dhulikhel Hospital and we observed high rate of very mild form of phlebitis (40.0%) followed by mild (11.3%) and moderate and severe form of phlebitis (both at 3.9%).

Table 2 showed that only age groups and IV drug administration were statistically associated with the occurrence of phlebitis infection at KUTH, Dhulikhel Hospital.

According to Table 3, the incidence of phlebitis was found to be higher for age group 21-30 (81.8%),

followed by age group 41-50 (76.9%), slightly higher in male (59.6%) than female (58.8%). The phlebitis incidence was also found to be higher in catheter gage 20 (62.8%) than 18 or less gage (52.0%). Similarly, site of catheter insertion related incidence of phlebitis was higher if inserted at forearm (65.1%) followed by dorsum of hand (54.7%) and joint (53.3%). Regarding place of catheter insertion, incidence of phlebitis was found higher when inserted at medical ward 68.0% followed by surgical ward 66.7%, emergency room (59.3%), Operation Theater (53.9%) and OBSGYN (52.2%) respectively.

The odds ratio was found to be significant for age groups 21 – 30 (4.12 times higher) and 41 – 50 (3.06 times higher) than patients aged 60 years and over. Similarly, IV drug administration was also found to be statistically significant with 81 percent higher chance of having phlebitis infection than without IV drug administration. Though there were variations on odds ratios of other variables, they are not found statistically significant. However, a large and probabilistic study might be needed to confirm these findings rather than the observational study like ours, which is major limitation of this study.

Table 4 showed the descriptive statistics associated with the dwell time by the phlebitis infection status. It showed that patients without phlebitis were on a mean dwell time of 60.51 hours whereas patients with phlebitis were on a mean dwell time of 71.8 hours. It also revealed that these two groups are statistically different. This result; however, does not show the exact cut-off dwell time associated with the risk of having phlebitis infection.

Thus, Fig 1 showed the result from Receiver Operating Characteristics (ROC) curve for dwell time cut-off value associated with the risk for phlebitis infection at KUTH, Dhulikhel Hospital.

ROC curve analysis revealed that only 57.8% of the ROC curve area is covered for the probability of having phlebitis infection with a standard error of 0.038 and p-value less than 0.05.

**Table 1:** Incidence of Phlebitis in KUTH Dhulikhel Hospital

Results	Number	Percent
Very mild	92	40.0
Mild	26	11.3
Moderate	9	3.9
Severe	9	3.9
<b>With Phlebitis</b>	<b>136</b>	<b>59.1</b>
<b>Without Phlebitis</b>	<b>94</b>	<b>40.9</b>
<b>Total</b>	<b>230</b>	<b>100</b>

**Table 2:** Incidence of Phlebitis in KUTH Dhulikhel Hospital

Background Variables	Chi-Square	p-value
Age Groups	17.786	< <b>0.005</b>
Gender	0.013	> 0.05
Catheter Gage	2.471	> 0.05
Site of Catheter Insertion	2.917	> 0.05
Place of Catheter Insertion	1.024*	> 0.05
IV Drug Administration	4.368	< <b>0.05</b>
Blood Product Given	0.003*	> 0.05
Total	<b>230</b>	

\* Corrected Chi-square test.

**Table 3:** Incidence and Odds Ratio of Phlebitis by different background variables at Dhulikhel Hospital, Kathmandu University Teaching Hospital

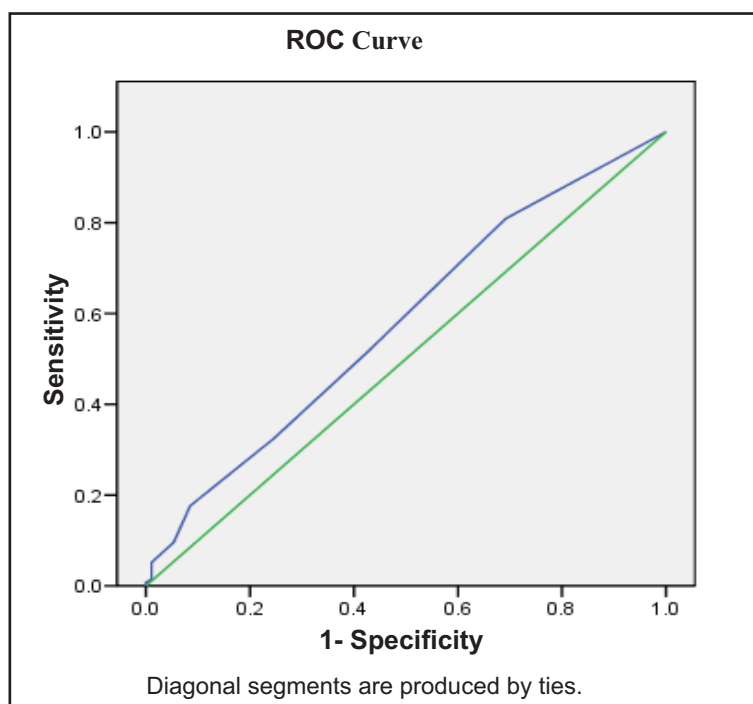
Background Variable	Number	Phlebitis	Incidence of Phlebitis (%)	Odds Ratio	95% CI for OR
Age					
15 – 20	46	24	52.2	0.71	0.33 – 1.53
21 – 30	64	28	43.8	4.12**	1.43 – 11.87
31 – 40	33	27	81.8	3.06*	1.04 – 9.00
41 – 50	26	20	76.9	1.59	0.59 – 4.12
51 – 60	27	17	63.0	1.31	0.54 – 3.21
> 60	34	20	58.8	--	--
Sex					
Male	94	56	59.6		
Female	136	80	58.8	1.03	0.60 – 1.76
Size of Catheter					
18 G	77	40	52.0	--	--
20 G	153	96	62.8	1.56	0.89 – 2.71
Site of Catheter					
Dorsum of hand	64	35	54.7	1.06	0.52 – 2.14
Forearm	106	69	65.1	1.63	0.86 – 3.11
Joint	60	32	53.3	--	--
Place of Insertion					
Medical Ward	25	17	68.0	1.34	0.55 – 3.23
Surgical Ward	6	4	66.7	1.95	0.60 – 6.29
OBGYN Ward	23	12	52.2	1.07	0.35 – 3.29
OT	26	14	53.8	1.83	0.28 – 12.1
ER	150	89	59.3	--	--
IV Drug Administration					
Yes	87	59	67.8	1.81*	1.03 – 3.15
No	143	77	53.9	--	--
Blood Product Given					
Yes	10	6	60.0	1.04	0.28 – 3.79
No	220	130	59.1	--	--
<b>Total</b>	<b>230</b>	<b>136</b>	<b>59.1</b>		

P-value: \* &lt; 0.05 and \*\* &lt; 0.001.

-- Reference category

**Table 4:** Descriptive Statistics of Dwell Time by Phlebitis Status

Phlebitis Infection	Mean	Std. Deviation	Standard Error of Mean	N	P – Value (t – test)
No	60.51	35.845	3.697	94	< 0.05
Yes	71.82	41.466	3.556	136	
<b>Total</b>	67.20	39.579		230	

**Fig 1:** Cut-off value of Dwell Time for Phlebitis Infection at KUTH/DH

### Discussion

Phlebitis is the most common complication of intravenous catheters and lead to many problems. It is now well established that the aetiology of phlebitis is multifactorial. In our study the incidence of phlebitis was 59.1%, and it was slightly lower than what other researcher found in Nepal: 65 % at Patan Hospital<sup>7</sup>. In some other studies done in western countries the incidence was lower than what we had found<sup>4, 8, 9, 10</sup> in our study.

The chance of having phlebitis was also found to be 4.13 and 3.06 times more for age 21-30 and 31-40 than age 60 and over. So, this study suggests to take special care if the patient is between these age, because it found statistical evidence (p-value < 0.05) that the phlebitis incidence is dependent to these age group as other study<sup>11, 12</sup>. The incidence of phlebitis in male was slightly higher than female (OR=1.03, CI 0.60-1.76). However, our data did not provide sufficient statistical evidence to prove and validate this result. This result differed from Maki & Ringer's study<sup>13</sup>, where they found an increased risk of 1.88 times for females rather than males.

Like other studies<sup>8, 14, 15, 16</sup> this study found that catheter of 20 gage have more chance of having phlebitis than 18 or above gage (OR=1.56, CI 0.89 - 2.71). It indicates that if we use large bore catheter (18or above) it reduces the incidence of phlebitis. But we had no statistical evidence (p-value > 0.05) to validate this argument. It also found that phlebitis incidence was highest for catheter inserted at forearm 65.1%, but as the chi-square test is not significant (p-value > 0.05), it can be concluded that catheter insertion site and occurrence of phlebitis are independent.

This study found the highest incidence of phlebitis in the ICU (81.82%), followed by Medical ward (61.48%), OBGYN wards (54.54%) and Surgical ward (52.83%). So the two wards have higher incidence and two wards have lower incidence than the total incidence rate of 59.1 %. Since the p-value is not significant, we conclude that admitted ward and occurrence of phlebitis infection are independent.

This study confirms the findings of some other studies as well<sup>5, 8, 11, 15</sup> that the administration of IV antibiotics

substantially increases the risk of phlebitis (OR=1.81, CI 1.03 -3.15, p-value < 0.05). One of the reasons may be related to the fact that the intravenous antibiotics cause chemical reaction of the endothelium with resultant phlebitis. Though we found slightly higher odds (1.04) for administration of blood products, it was not statistically significant and hence we can not conclude the higher risk of phlebitis infection due to blood product administration at KUTH, Dhulikhel Hospital.

Although the average administered dwell time is found to be 67.2 hours with 60.5 hours for non-phlebitis patients and 71.8 hours for phlebitis induced patients with a significant statistical result, the ROC curve analysis revealed that dwell time  $\geq$  36 hours is actually responsible for the phlebitis infection with 80.88% sensitivity and 30.5% of specificity in this study. Ideally, we expect high sensitivity and specificity which in turn gives a very high value of Area Under Curve (AUC) but as we have fairly high sensitivity but low specificity, and thus only about 57% of statistically significant AUC is covered during this analysis.

### Conclusion

Phlebitis is still an important and ongoing problem in medical practice. In addition to proper insertion and good nursing care, the avoidance of the above risk factors will lead to a lower incidence of infusion associated phlebitis in KUTH, Dhulikhel Hospital and, may be, in other Nepalese Hospitals too. In our context, special care is needed on the patient's age and during IV drug administration.

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