

# Peripheral Intravenous Catheter related Thrombophlebitis- Incidence and Risk Factors A Cross Sectional Study

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## Abstract

**Introduction:** Peripheral Intravenous Cannulation is indispensable in modern day clinical practice. Thrombophlebitis is a very common and consequential problem related to peripheral intravenous catheterization.

**Methods:** This descriptive cross sectional study was conducted in Allied Hospitals of Rawalpindi Medical University in three months on 170 patients. All the patients with peripheral venous catheter inserted for 72 hours were enrolled and those having skin rash or allergy to any medication or discharged from hospital or cannula removed before 72 hours were excluded from the study. The data was collected by using a predesigned pro forma, the variables included were age, gender, specific specialty, catheter insertion site, catheter gauge, underlying diseases such as diabetes mellitus, hypertension, hyperlipidemia and renal failure and smoking. Thrombophlebitis was graded using Visual Infusion Phlebitis Score suggested by Infusion Nurses Society. The data was entered and analysed using SPSS version 23 and Chi Square test was applied to check statistical significance.

**Results:** The incidence of thrombophlebitis found in this study was 53.5%. The most common grade found was Grade 2 (52.7%) followed by Grade 1 (35.1%) and 3(12.1%). Increased incidence of thrombophlebitis in this study was found in younger age group (16-40years), females admitted in medical units, large sized catheters inserted on hands, hypertensive and hyperlipidemic patients and significant associations were Diabetes Mellitus (P=0.004), Smoking (P=0.004) and Catheterization without Gloves(P= 0.003).

**Conclusion:** Peripheral intravenous catheterization is still on going and is a very significant problem in Allied Hospitals of Rawalpindi Medical University. Future studies should be made to improve the understanding of risk factors for thrombophlebitis

especially comorbidities like Diabetes Mellitus and to discover more effective preventive methods.

**Key words:** Intravenous cannula, Thrombophlebitis, Visual Infusion Phlebitis Score

## Introduction

IV Catheterization is a common procedure in modern day medical practice for the administration of fluids, IV medications, blood products and blood sampling.<sup>1</sup> A large variety of catheters are used clinically but the most routinely used are peripheral intravenous catheters since they provide a swift access to the vascular system, are less invasive and less complex. Almost 80% of the patients admitted require IV access sometime during their stay in the hospital.<sup>2</sup> This excessive use of catheters puts patients at the risk of many complications such as extravasation, ecchymosis, hematoma, infection and thrombophlebitis.

Thrombophlebitis is the most severe and common complication associated with IV catheterization with incidence varying from 7.14 % to 79% in different settings. In a study conducted in 2002 in Karachi the incidence came out to be 7.14 % and in a similar study conducted in Karachi in 2016 thrombophlebitis occurred in 16% of the study population.<sup>3,4</sup> In a research conducted in 2003 in Iran 26% of the catheters were removed due to thrombophlebitis and the incidence came out to be 41.2% in 2011 in a study conducted in turkey and similarly 79% of the patients suffered from thrombophlebitis in a research conducted in Nepal in 2011.<sup>5,6,7</sup> Thrombophlebitis is the inflammation of the vessel wall due to formation of a blood clot. Clinical signs of phlebitis are localized redness, warmth, swelling and palpable venous cord<sup>8</sup>. The studies conducted in the last two decades corroborate following four main groups as the risk factors for development of phlebitis are: patient characteristics, therapy administered, health professional practices and cannula characteristics.<sup>9</sup>

Thrombophlebitis may settle without causing any concern or it can lead to dreadful complications such as DVT, pulmonary embolism, cellulitis, hyperpigmentation of skin or nodule formation. It causes pain and discomfort and calls for the need of insertion of a new catheter at a new site, prolonged hospital stay, healthcare costs and thus adds to the morbidity and economic implications. Keeping in view the risks thrombophlebitis can put a patient to, this study aims to identify its incidence and associated risk factors in our set up.

## Materials And Methods

A descriptive cross sectional study was conducted at tertiary care hospitals of Rawalpindi Medical University after approval from the institutional research forum and review from ethical committee to assess the incidence of thrombophlebitis and associated risk factors in patients with peripheral intravenous catheterization. All the patients admitted in different wards of tertiary care hospitals in Rawalpindi with peripheral venous inserted for 72 hours were enrolled in this study. The patients having skin rash or allergy to any medication or discharged from hospital or cannula removed before 72 hours were excluded from the study. The data was collected by using a predesigned pro forma and the variables included were age, gender, specific specialty, catheter insertion site, catheter gauge, underlying diseases (diabetes mellitus, hypertension, hyperlipidemia and renal failure) and smoking. Keeping the level of confidence 95%, absolute precision 0.05 and the anticipated population proportion 0.11, the required sample size came out to be 151, but 170 patients were included in this study. All the patients enrolled in this study were visited daily for three consecutive days and the catheter sites were assessed, their functionality tested and any changes which could influence their removal were recorded. After the signs of thrombophlebitis were noticed, the grading was done using the Visual Infusion Phlebitis Score (VIPS)<sup>10</sup> as shown in Table I. The data was analysed using SPSS version 23. Descriptive statistics were calculated and Chi Square Test was applied to find out the statistical association of thrombophlebitis with different variables.

## Results

A total of 170 patients were taken into confidence for this study. 91 out of these 170 studied patients developed signs of thrombophlebitis making incidence for this study to be 53.5%. Among those who suffered

from thrombophlebitis, the most common grade to be found was Grade 2 (pain, erythema, swelling) with an incidence of 52.7%. Grade 1 (erythema and redness) and Grade 3 (pain, erythema, induration) thrombophlebitis developed in 35.1% and 12.1% of the subjects respectively. Almost 3/4<sup>th</sup> (73 %) of the smokers developed thrombophlebitis. Maximum cases of thrombophlebitis developed on the second day showing an incidence of 54.9%. Thrombophlebitis cases seen on the first and third day were 24.2% and 20.9% respectively. 37 out of 53 diabetic patients developed thrombophlebitis indicating that the risk is 70% in diabetic patients. Table II, Table III and Table IV show the relationship between risk factors and incidence of thrombophlebitis.

**Table I : Visual Infusion Phlebitis Score (VIPS)<sup>1</sup>**

<b>Grade 0</b>	Site Appears Healthy	No sign of phlebitis	
<b>Grade 1</b>	One of the Following is evident : > Slight Pain Near IV Site > Slight Redness Near IV Site	Possible sign of phlebitis	Observe cannula
<b>Grade 2</b>	Two of the following is evident: > Pain Near IV Site > Erythema > Swelling	early stage of phlebitis	Resite cannula
<b>Grade 3</b>	All of the following are evident > Pain along the path of cannula > Erythema > Induration	Medium stage of phlebitis	Resite cannula, Consider treatment
<b>Grade 4</b>	All of the following are evident and extensive > Pain along the path of cannula > Erythema > Induration > Palpable venous blood		Resite cannula, Consider treatment
<b>Grade 5</b>	All of the following are evident and extensive > Pain along the path of cannula > Erythema > Induration > Palpable venous blood > Pyrexia	Late stage of phlebitis	Resite cannula, Consider treatment

**Table II: Relationship of Demographic Data, Department and Smoking With Incidence of Thrombophlebitis**

Demographic	Total N=170	Thrombophlebitis Present N=91	P-value
Gender			
Males	83 (49%)	42 (51%)	0.455
Females	87 (51%)	49 (56%)	
Age			
16-40 Years	94 (55%)	57 (61%)	0.118
41-60 Years	56 (33%)	29 (52%)	
61 And Older	20 (12%)	9 (45%)	
Department			
Medicine	75 (44%)	33 (44%)	0.072
Surgery	55 (34%)	35 (64%)	
Gynae & Obs	40 (23%)	23 (58%)	
Smoker			
Smoker	41 (24%)	30 (73%)	0.004
Non Smoker	129 (76%)	61 (47%)	

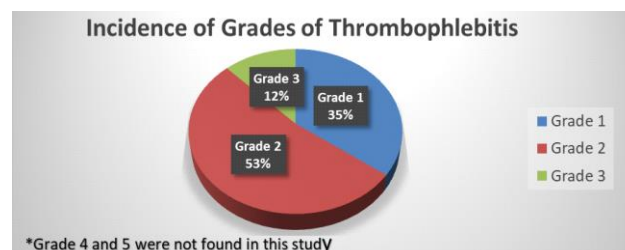
**Table III : Relationship of Catheter Characteristics, Infusion Type and Sterilized Gloves with Incidence of Thrombophlebitis**

Intervention Characteristic	Total N=170	Thrombophlebitis present N=91	P-Value
Catheter Size			0.272
16G	16 (09%)	08 (50%)	
18G	00 (00%)	00 (00%)	
20G	83 (49%)	42 (51%)	
22G	60 (35%)	32 (53%)	
24G	11 (06%)	09 (82%)	
Catheter Insertion			0.257
Hand	76 (45%)	46 (61%)	
Forearm	58 (34%)	28 (48%)	
Wrist	23 (14%)	10 (44%)	
Cubital Fossa	08 (05%)	03 (38%)	
Foot	05 (03%)	04 (80%)	
Infusion Type			0.482
Medications and Fluids	145 (85%)	76 (52%)	
Blood	25 (15%)	10 (40%)	
Gloves			0.003
Used	107 (56%)	48 (45%)	
Not Used	63 (44%)	43 (68%)	

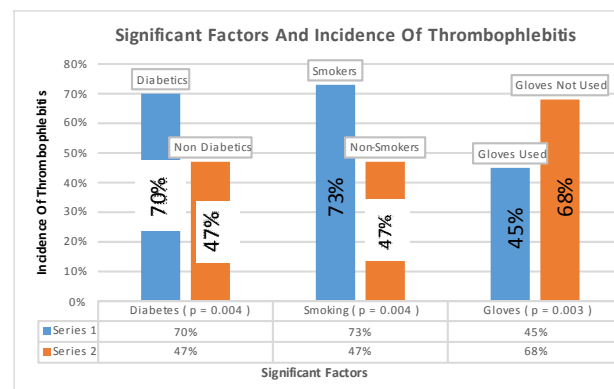
**Table IV. Relationship of Co Morbids With Incidence of Thrombophlebitis**

Characteristics	N = 170 (%)	Thrombophlebitis Present N=91 (%)	P Value

Diabetes			
Yes	53 (31%)	37 (70%)	0.004
No	117 (69%)	54 (46%)	
Hypertension			
Yes	52 (31%)	30 (58%)	0.470
No	118 (69%)	61 (52%)	
Hyperlipidemia			
Yes	09 (5%)	7 (78%)	0.134
No	161 (95%)	84 (52%)	



**Figure I: Pie Chart Showing Incidence of Various Grades of Thrombophlebitis according to Visual Infusion Phlebitis Score by 3rd Day Of Cannulation**



**Figure II: Graph Showing Incident of Thrombophlebitis in Significant Risk Factors**

## Discussion

Thrombophlebitis is the most common complication of intravenous catheterization and can lead to many problems. It has a multifactorial aetiology. Insertion of the intravenous catheter causes trauma to the intimal layer of the vein. This trauma along with many other factors (internal and external) triggers an inflammatory response which puts patient at the risk of thrombus formation and thus thrombophlebitis. The incidence of thrombophlebitis in this study came out to be 53.5% that is analogous to the incidence reported

in many researches around the world which varies from 7.14% to 79%.<sup>2,8</sup>

In this study, thrombophlebitis was graded using Visual Infusion Phlebitis Score after noticing its signs. Among the grades seen, the most commonly observed grade which kept on repeating time and again was grade 2 as compared to grade 1 & 3 whereas grade 4 and grade 5 were not detected at all. (Table IV)

A good explanation in this context can be the reason that once the signs of thrombophlebitis were noticed or patient complained of pain or slight erythema the cannula was immediately replaced as a preventive measure to avert it from causing severe grades or complications.

The patients were divided into three age groups as shown in table II. The comparison among these age groups showed that the incidence of thrombophlebitis is higher in group 1 than group 2 and groups 3 but the results were not significant. However this is in line with the higher incidence found in some other studies for this age group.<sup>10,11</sup>

Like some other studies this study also shows that females suffer more from thrombophlebitis as compared to their male counterparts but the results are not significant.<sup>12,13</sup> However, in another study conducted, specific gender had no role in the incidence of thrombophlebitis.<sup>14</sup> There is no seemingly explanation for this but a reasonable hypothesis may be that female hormones had contributed in playing some role in higher incidence of phlebitis in females.

This study found highest incidence of thrombophlebitis in Surgical Wards than Gynae & Obs and Medicine Wards but the results are not statistically significant. However, the results are congruent with other researches which also could not develop a significant relationship between catheter insertion setting and thrombophlebitis.<sup>15,16</sup>

This study regards smoking as a significant risk factor for the development of thrombophlebitis since the smokers developed 1.5 times thrombophlebitis more as compared to non-smokers P value 0.004, thus smoking should be discouraged at all levels. This risk factor has not been evaluated in any studies except one which does not consider it a significant risk factor.<sup>28</sup>

The highest incidence of thrombophlebitis with respect to catheter size in this study was found with 22 Gauge catheter and lowest with 16 Gauge but the results were not statistically significant and were not different from other catheter sizes. This is congruent with the results of many studies in which catheter size had no significant role in causing thrombophlebitis.<sup>17,18</sup> In

contrast to this, many other studies, however, highlight the advantages of using smaller size catheters.<sup>19-20</sup>

In this study, incidence of thrombophlebitis occurred more than in cases where catheter was used in lower extremities as compared to upper extremities which is in accordance with another research.<sup>21</sup> The highest incidence in relation to anatomical site was found in foot but no statistically noticeable differences were observed between the specific anatomical sites which are in line with the results of many other studies.<sup>22,23</sup> Since the Chi Square test applied gives a P value > 0.005 so it is deduced that catheter insertion site and development of phlebitis are independent.

The incidence of thrombophlebitis in patients who were infused with medications and fluids was higher as compared to those who were infused with blood. But this study could not establish a relationship between incidence of thrombophlebitis and type of infusion because the P value was > 0.05. However, the low pH and the high osmolarity of solutions, such as hypertonic solutions, can be linked to a high risk of phlebitis.<sup>15,23</sup>

In this study, intravenous catheterization procedures without gloves resulted in higher incidence as compared to usage of gloves thus regarding it a significant risk factor (P value 0.003). The usage of gloves has been recommended for the process of intravenous catheterization in many studies and it should be strictly followed to prevent thrombophlebitis.<sup>24</sup>

The most striking finding in our study was the association between thrombophlebitis and diabetes mellitus. The incidence of thrombophlebitis was found to be 8 times more in diabetic than non diabetic patients as mentioned in table 4 which is in congruence with the findings of other studies.<sup>5,25</sup> However in another study diabetes was not found to be a risk factor.<sup>28</sup> This higher incidence may be due to endothelial damage induced by diabetes which predisposes to development of thrombophlebitis. (Figure I) Hypertension and Hyperlipidemia were also evaluated in this study. Thrombophlebitis was higher in both hypertensive and hyperlipidemic patients but since the P value was greater than 0.05 so the results were insignificant and thus no correlation can be developed between these factors and thrombophlebitis.

## **Conclusion**

The incidence of thrombophlebitis in this study came out to be 53.5% which can be related to many other studies around the world. Only Grade 1, 2 and 3

according to VIPS could be detected in this study. In order to lessen the possible complications which can crop up, the risk factors identified serve as perfect and favourable targets to interlope with. The incidence rate established here makes the medical staff conscious of the care they have to take during intravenous cannulation. There is still a long road ahead of us and further studies are required to help us in understanding of the risk factors for phlebitis, especially diabetes mellitus, smoking and usage of gloves and to ascertain more hyper efficient safeguarding methods. Keeping in view our findings, we deem it fit if some specific variables influencing the risk of phlebitis (especially diabetes mellitus, gloves and smoking) are taken into consideration.

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