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Incidence of Thrombophlebitis Due to Venous Access: An Observational Study

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ABSTRACT

Background: Peripheral venous cannulation (PVC) is a critical procedure for delivering fluids, medications, and blood products to hospitalized patients. However, thrombophlebitis remains a common complication.

Aims: The aim of this study was to look at the effect of the cannula gauge, insertion site, and indwelling duration on thrombophlebitis incidence in order to enhance clinical practice and patient outcomes.

Settings and Design: This prospective observational study, conducted from May 2021 to September 2022, included 90 adult participants undergoing elective surgery at a tertiary care hospital.

Methods and Material: Following single-attempt cannulation with 18-gauge (18G) or 20-gauge (20G) PVCs in the median cubital, cephalic, or metacarpal veins, patients were monitored at 12 h, 24 h, 36 h, 48 h, and 72 h post-insertion with the use of the Visual Infusion Phlebitis (VIP) score. Chi-square tests were used to examine the data ($P < 0.05$ was considered significant).

Results: Thrombophlebitis incidence was significantly influenced by the insertion site ($\chi^2 = 7.271$, $P = 0.026$) and indwelling duration ($\chi^2 = 19.1498$, $P = 0.0039$), but not by gauge ($\chi^2 = 0.4$, $P = 0.527$). Cephalic veins had the lowest rate (33.3%), while metacarpal veins had the highest (70%). Incidence peaked at 24–36 h, with a mean duration of 3741.89 ± 1284.66 min (up to 6060 min). Age and gender showed no association.

Conclusion: Preferring cephalic or median cubital veins and monitoring indwelling duration can reduce thrombophlebitis, enhancing patient safety and care quality.

Keywords: *Peripheral venous cannulation, Thrombophlebitis, VIP score, Insertion site*

1. INTRODUCTION

Intravenous cannulation is a cornerstone of hospital care, with most patients requiring at least one peripheral venous cannula (PVC) for administering fluids, medications, nutritional supplements, or blood products. These short, color-coded catheters, available in various gauges, are commonly inserted into the metacarpal veins (dorsal hand), cephalic veins (forearm), or median cubital veins (cubital fossa). For adults undergoing elective surgery, 18-gauge (18G) or 20-gauge (20G) cannulas are preferred for blood transfusions, bolus drug administration, and rapid infusions. Despite their utility, PVCs are associated with complications such as phlebitis, cellulitis, and catheter-related bloodstream infections (CRBSI), which are particularly prevalent in developing countries where hospital-acquired infection rates exceed those in wealthier nations. Thrombophlebitis, an inflammatory condition of the vein wall triggered by cannula presence, manifests as pain, erythema, swelling, a palpable venous cord, or fever. Recognized since John Hunter's description, it remains a frequent yet preventable issue. Best practice guidelines advocate prompt removal or replacement of symptomatic PVCs to mitigate risks. The aim of this study was to determine the impact of cannula gauge, insertion site, and indwelling duration on thrombophlebitis occurrence, with the intention of providing evidence to improve PVC management and reduce patient morbidity and hospitalization.

2. METHODS

Study Design: The prospective observational research was carried out at K.S Hegde Charitable Hospital, a tertiary care center from May 1, 2021 to September 1, 2022, following institutional ethics committee approval (IEC Code INST.EC/EC/083/2021-22) and registration with the Clinical Trials Registry-India (CTRI/2021/07/034609).

Participants: The study adhered to the Declaration of Helsinki (2013) and good clinical practice standards. Exclusion criteria included failed cannulation attempts or pre-existing venous pathology; 90 consenting adult patients (≥18 years) planned for elective surgery under general anesthesia without preexisting in-situ PVCs were enrolled.

Cannulation was performed in a single attempt using an 18G or 20G Cathy®+ I.V. cannula at the median cubital, cephalic, or metacarpal veins, following standardized hospital protocols aligned with the CRBSI manual. Patients were allocated to six groups (15 each): Group A (18G, median cubital), Group B (20G, median cubital), Group C (18G, metacarpal), Group D (20G, metacarpal), Group E (18G, cephalic), and Group F (20G, cephalic). A single investigator monitored cannula sites at 12 h, 24 h, 36 h, 48 h, and 72 h post-insertion with the use of Visual Infusion Phlebitis (VIP) score: 0 (healthy), 1 (slight pain/redness), 2 (pain/redness/swelling), and 3–5 (progressive severity up to fever). PVCs with a VIP score ≥2 were removed. Participant flow was tracked using a STROBE chart (Figure 1).

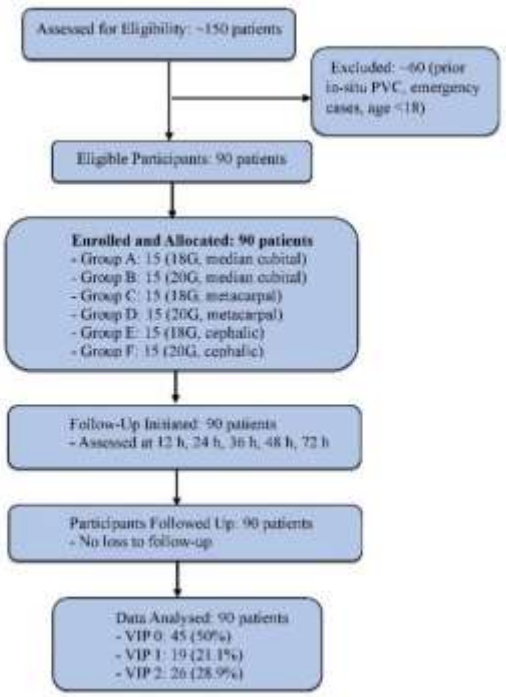

Figure 1: STROBE flow chart of participant selection and follow-up

Data Analysis

Microsoft Excel was utilized to record the data, while SPSS version 20 was used for analysis. Associations between thrombophlebitis and factors (gauge, site, duration, age, gender) were evaluated using descriptive statistics (means, standard deviations, percentages) and Chi-square tests; $P < 0.05$ was taken to be significant.

3. RESULTS

No scores ≥3 occurred because of early removal; among the 90 individuals (58 males, 64.4%; mean age 40.80 ± 16.32 years), 45 (50%) had no thrombophlebitis (VIP score 0), 19 (21.1%) had a VIP score of 1, and 26 (28.9%) had a VIP score of 2. Group D (20G, metacarpal) exhibited the highest incidence (11/15, 73.3%), followed by Group C (18G, metacarpal; 10/15, 66.7%), while Group F (20G, cephalic) had the lowest (5/15, 33.3%) (Figure 2). Site analysis showed metacarpal veins with the highest rate (21/30, 70%), followed by median cubital (14/30, 46.7%) and cephalic veins (10/30, 33.3%) ($\chi^2 = 7.271$, $P = 0.026$), indicating a significant association (Figure 3). The gauge had no effect: 24/45 (53.3%) with 18G and 21/45 (46.7%) with 20G developed thrombophlebitis ($\chi^2 = 0.4$, $P = 0.527$) (Figure 4).

The mean indwelling duration was 3741.89 ± 1284.66 min (62.36 ± 21.4 h), with a maximum of 6060 min (101 h) under institutional protocols. Thrombophlebitis peaked at 24–36 h (10/15 removals, 66.7%), but only 17/46 (37%) of PVCs in situ

≥72 h showed signs ($\chi^2 = 19.1498$, P = 0.0039), confirming duration's significant impact (Figure 5; Table 1). Age ($\chi^2 = 0.178$, P = 0.6732) and gender ($\chi^2 = 0.194$, P = 0.660) showed no association (Table 1).

Table 1: Factors Associated with Thrombophlebitis Incidence

Variable	Total, n (%)	With Thrombophlebitis (VIP 1 & 2), n (%)	Without Thrombophlebitis (VIP 0), n (%)	Chi-square (χ^2)	P Value
Overall	90 (100)	45 (50)	45 (50)	-	-
Gender					
Male	58 (64.4)	30 (51.7)	28 (48.3)	0.194	0.660
Female	32 (35.6)	15 (46.9)	17 (53.1)		
Age					
≤39 years	44 (48.9)	23 (52.3)	21 (47.7)	0.178	0.6732
≥40 years	46 (51.1)	22 (47.8)	24 (52.2)		
Gauge					
18G	45 (50)	24 (53.3)	21 (46.7)	0.4	0.527
20G	45 (50)	21 (46.7)	24 (53.3)		
Site					
Median cubital vein	30 (33.3)	14 (46.7)	16 (53.3)	7.271	0.026*
Cephalic vein	30 (33.3)	10 (33.3)	20 (66.7)		
Metacarpal vein	30 (33.3)	21 (70)	9 (30)		
Duration					
1440–2160 min	15 (16.7)	10 (66.7)	5 (33.3)	19.1498	0.0039*
2161–2880 min	5 (5.5)	3 (60)	2 (40)		
2881–4320 min	24 (26.7)	15 (62.5)	9 (37.5)		
≥4321 min	46 (51.1)	17 (37)	29 (63)		

*Statistically significant (P < 0.05).

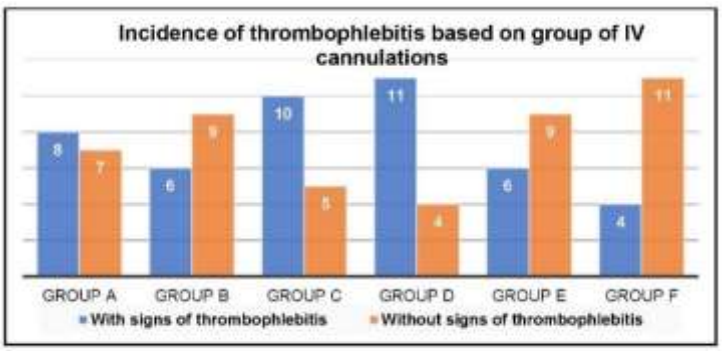

Figure 2: Bar graph showing the incidence of thrombophlebitis by group.

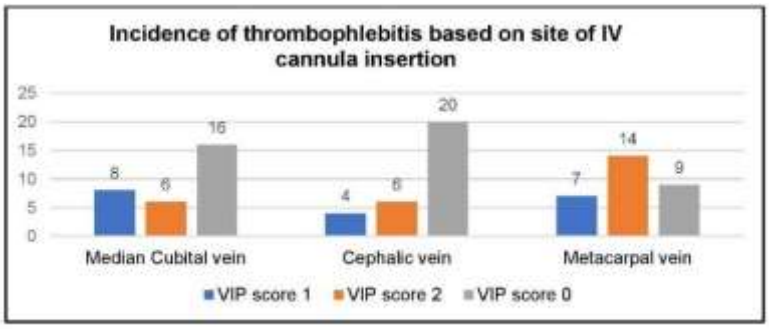

Figure 3: Bar graph showing the incidence of thrombophlebitis by site.

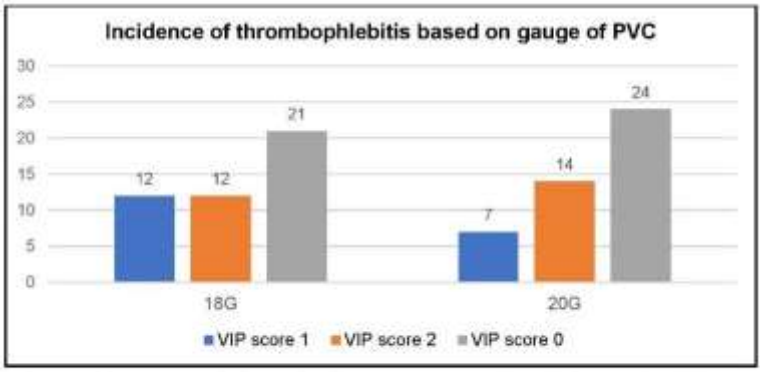

Figure 4: Bar graph showing the incidence and severity of thrombophlebitis by gauge.

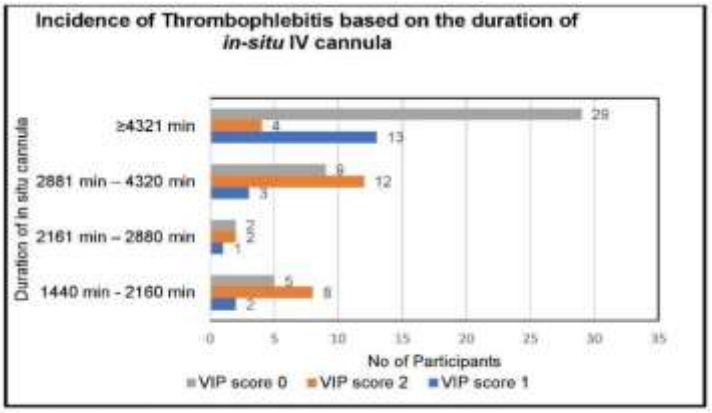

Figure 5: Bar graph showing the incidence of thrombophlebitis by duration.

4. DISCUSSION

This study identifies insertion site and indwelling duration as key determinants of thrombophlebitis incidence, while cannula gauge, age, and gender showed no significant influence. Cephalic veins exhibited the lowest rate (33.3%), likely due to their larger diameter and stability, consistent with Alexandrou et al. (2018), who reported fewer complications in forearm veins across 51 countries. Metacarpal veins, with a 70% incidence, may be more susceptible due to movement-induced irritation, according to Cicolini et al. (2009). The lack of gauge effect (P = 0.527) corroborates Gupta et al. (2023), who found no difference between 18G and 20G in surgical patients, though Cicolini et al. (2009) suggested smaller gauges may reduce risk.

Duration findings indicate a peak at 24–36 h, consistent with Maki et al. (1991), yet PVCs remained effective up to 101 h with proper care, as supported by Rai et al. (2023). This suggests that institutional protocols extending dwell time beyond 72

h may be safe with vigilant monitoring, challenging traditional 72–96 h replacement guidelines. Age and gender showed no correlation, mirroring Yasuda et al. (2021) and Becerra et al. (2016). Unassessed factors like smoking or IV medications, noted by Lee et al. (2019), could further influence outcomes and merit future investigation.

Strengths include the prospective design, standardized cannulation, and use of the validated VIP score. Limitations include the single-center setting, small sample size, and exclusion of additional risk factors (e.g., drug type, infusion rate). These findings add to the evidence base, suggesting that preferring cephalic or median cubital veins and monitoring duration can reduce thrombophlebitis, improving patient care and potentially lowering healthcare costs. Future multicenter studies with larger cohorts and broader variables could refine these recommendations.

5. CONCLUSION

Selecting cephalic or median cubital veins over metacarpal veins and closely tracking indwelling duration can minimize thrombophlebitis incidence. Early detection and management of complications are vital for enhancing patient satisfaction and reducing healthcare burdens.

Limitations: Out of all the variables examined in this study, only the site of PIVC and the duration of indwelling IV cannulas were found significant in the incidence of thrombophlebitis. Other factors like the gauge of PVC, participant's age, and gender were not statistically significant to the occurrence of thrombophlebitis probably due to the smaller sample size. As a result, we could have obtained more significance from other factors if the study had a larger sample size. As this study was performed among patients scheduled for elective surgical procedures, the outcomes might not always apply to patients in the EDs, wards, or ICUs. Moreover, since this data was collected in a tertiary care facility, the findings cannot be generalized in other settings.

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