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Original Article

Frequency of Deep Venous Thrombosis in Patients Undergoing Dialysis Via Non-Tunneled Femoral Double Lumen Catheters

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ABSTRACT

Background: Haemodialysis is a critical modality of renal replacement therapy, but temporary non-tunnelled femoral catheters remain widely used in urgent or resource-limited settings despite their association with complications such as deep venous thrombosis (DVT). Evidence from South Asia on the burden and predictors of catheter-related thrombosis is limited, restricting development of preventive guidelines. Objective: To determine the frequency of femoral catheter-related DVT and identify associated risk factors among patients undergoing haemodialysis. Methods: This cross-sectional study was conducted at the Department of Nephrology, Khyber Teaching Hospital, Peshawar, from March to June 2025. A total of 173 patients aged 20–60 years undergoing dialysis via femoral double-lumen catheters for more than 24 hours were consecutively recruited. Duplex ultrasonography confirmed DVT diagnosis. Demographic, clinical, and procedural variables were recorded and analysed using chi-square/Fisher's exact tests and binary logistic regression. Results: Thrombosis was confirmed in 13 patients (7.5%), with left femoral involvement in 61.5%, right sided in 30.8%, and bilateral in 7.7%. No significant associations were observed with age (p=0.72), gender (p=0.38), BMI (p=0.81), or dialysis indication (p=0.64). Catheter dwell time ≥6 days was strongly associated with DVT (24.3% vs 2.9%; adjusted OR 9.8, 95% CI 2.5–37.6, p=0.001). Conclusion: Femoral catheter-related DVT occurred in 7.5% of patients, with catheter dwell time beyond six days as the only independent predictor. Early transition to permanent vascular access is essential to reduce thrombotic complications.
Keywords: Hemodialysis, Femoral catheter, Deep venous thrombosis, Catheter dwell time, Vascular access.

INTRODUCTION

Chronic kidney disease (CKD) and acute kidney injury (AKI) remain major global contributors to morbidity and mortality, with many patients progressing to end-stage renal disease (ESRD) requiring renal replacement therapy. Hemodialysis is the most widely utilized modality, accounting for the majority of renal replacement therapy worldwide, yet it is dependent on reliable vascular access, which substantially influences outcomes (1). Permanent access through arteriovenous fistulas or grafts is recommended as the gold standard, but in resource-limited settings and in patients requiring urgent initiation of hemodialysis, temporary non-tunneled central venous catheters are frequently employed (2). Among the available sites, the femoral vein is often chosen due to ease of insertion and fewer immediate complications in unstable patients; however, this practice is not without risks (3).

The use of central venous catheters is associated with a range of complications, including bloodstream infections, arterial puncture, and thrombotic events, which can compromise treatment efficacy and increase patient morbidity (4). Thrombotic complications, in particular, are clinically significant as they may not only impair dialysis adequacy but also predispose to potentially fatal pulmonary embolism (5). Reported frequencies of catheter-related deep venous thrombosis (DVT) vary widely, from 8% in some developing countries to over 30% in tertiary care centers internationally, with femoral access generally showing higher risks than internal jugular placement (6,7). Prolonged catheter dwell time, repeated cannulation, and limited use of prophylactic strategies further increase the risk of thrombosis (8).

Existing literature indicates notable differences across populations. Asian and Pacific Islander cohorts demonstrate lower DVT rates compared to Caucasian and African American populations, highlighting possible genetic, environmental, and healthcare delivery factors (9,10). Nonetheless, most available evidence comes from multicenter studies in high-income settings, whereas local data from South Asia remain limited and inconsistent. In Pakistan, few studies have systematically quantified femoral catheter-related DVT, and the lack of region-specific evidence impedes the development of preventive protocols tailored to local patient populations (11).

This gap in knowledge underscores the need to evaluate the frequency and predictors of femoral DVT among patients undergoing hemodialysis via temporary double-lumen catheters in local clinical settings. By focusing on a well-defined population and systematically

assessing demographic, clinical, and procedural factors, this study aims to provide clinically relevant evidence to guide risk stratification, optimize vascular access practices, and improve patient outcomes. The specific objective is to determine the frequency of deep venous thrombosis and to identify factors associated with its occurrence among patients dialyzed through non-tunneled femoral double-lumen catheters.

MATERIAL AND METHODS

This investigation was conducted as a cross-sectional observational study in the Department of Nephrology, Khyber Teaching Hospital, Peshawar, between 11 March 2025 and 10 June 2025. The study design was selected to capture the prevalence of femoral catheter-related thrombosis and its associations within a defined timeframe, which is considered an appropriate methodology for estimating frequency and evaluating potential risk factors in a hospital-based population (12). The sample size was calculated using the World Health Organization sample size calculator, based on a previously reported DVT prevalence of 8.2% in comparable patients (13). With a 95% confidence level and 4.1% margin of error, the required sample size was determined to be 173 patients, who were consecutively enrolled using non-probability consecutive sampling.

Eligible participants included patients of both genders aged 20 to 60 years who underwent hemodialysis via non-tunneled femoral double-lumen catheters for more than 24 hours. Exclusion criteria were use of anticoagulants, documented pro-thrombotic disorders, prior renal transplantation, or structural anomalies of the femoral vein. Screening for eligibility was performed at the time of admission, and consecutive patients fulfilling the criteria were approached by trained residents. Written informed consent was obtained from each participant after explanation of study purpose, risks, and potential benefits. Ethical approval was secured from the institutional research review board prior to initiation of the study.

All dialysis sessions were performed using Niprol Surdial X machines with bicarbonate dialysate at a flow rate of 500 mL/min. Blood flow rates ranged from 200–400 mL/min depending on patient tolerance and access flow. Elisio 17H synthetic polynephron dialyzers with a membrane surface area of 1.7 m² were used for all patients to ensure standardization of treatment. Catheter insertion was performed under strict aseptic conditions by nephrology residents trained in vascular access techniques. Following infiltration with 1% plain lidocaine, a non-tunneled double-lumen catheter was introduced into the femoral vein at the midpoint between the anterior superior iliac spine and pubic tubercle, medial to the femoral arterial pulsation.

The primary outcome variable was deep venous thrombosis, defined and confirmed by duplex Doppler ultrasonography performed by a consultant radiologist blinded to patient history. Diagnostic criteria included non-compressible venous segments, absence of color Doppler flow, or loss of augmentation with distal compression. Secondary variables included patient age, gender, body mass index (BMI), dialysis indication, and catheter dwell time, operationalized as duration in days between insertion and removal of the femoral catheter.

To minimize bias, the same ultrasonography protocol was applied to all patients, and radiologists were not involved in clinical care or data collection. Confounding variables were addressed by stratifying results for demographic and clinical factors and applying multivariable regression to adjust for potential confounders. The reproducibility of data collection was strengthened by the use of standardized proformas, double-checking of entries by independent investigators, and application of predefined operational definitions.

Data were analyzed using IBM SPSS Statistics version 25. Quantitative variables were described as mean ± standard deviation or median with interquartile range, depending on distribution tested for normality. Qualitative variables were summarized as frequencies and percentages. Chi-square test or Fisher's exact test was applied for categorical variables, while binary logistic regression was used to identify independent predictors of DVT. Missing data were addressed by listwise deletion to avoid imputation bias. Odds ratios with 95% confidence intervals were calculated, and a two-tailed p-value of ≤0.05 was considered statistically significant.

This study adhered to ethical principles of the Declaration of Helsinki, ensuring voluntary participation, anonymity of data, and the right to withdraw without prejudice. Patient confidentiality was maintained through coded identifiers and restricted data access. The methodological transparency, standardized data collection, and detailed reporting of statistical procedures were implemented to maximize reproducibility and facilitate comparison with future multicenter studies (14,15).

RESULTS

Out of the 173 patients enrolled, 13 cases of deep venous thrombosis were confirmed, giving an overall incidence of 7.5%. Analysis across age strata revealed no meaningful difference: 6 of 89 patients below 50 years (6.7%) developed thrombosis compared with 7 of 84 patients aged 50 years or older (8.3%). The odds ratio did not suggest increased risk with advancing age (OR 0.79, 95% CI 0.27–2.33, p = 0.72), highlighting that age alone was not a discriminating factor.

Gender distribution demonstrated a numerically higher proportion of thrombosis among females (7 of 69, 10.1%) compared to males (6 of 104, 5.8%), yet this difference was not statistically significant (OR 0.55, 95% CI 0.18–1.67, p = 0.38). Similarly, BMI did not emerge as a determinant; patients with BMI ≥25 kg/m² had only a marginally higher risk (6 of 72, 8.2%) relative to those with BMI <25 kg/m² (7 of 101, 6.9%; OR 0.83, 95% CI 0.28–2.46, p = 0.81).

The indication for dialysis also showed no significant effect. Among the 92 patients treated for chronic kidney disease, 7 (7.6%) developed DVT, while only 3 of 54 patients with acute kidney injury (5.6%) and 3 of 27 with obstructive uropathy (11.1%) were affected. Statistical analysis confirmed that these differences were not significant (p = 0.64), with odds ratios crossing unity, indicating that the underlying renal pathology did not substantially modify thrombosis risk. In contrast, catheter dwell time emerged as the most influential predictor. Of

the 136 patients whose catheters were in place for fewer than six days, only 4 (2.9%) developed DVT. However, among the 37 patients with dwell time ≥6 days, 9 (24.3%) developed thrombosis, representing more than an eightfold increase in frequency.

Table 1. Stratified Analysis of DVT by Demographic and Clinical Variables

Variable	Total (n)	DVT Present n (%)	DVT Absent n (%)	p-value	Odds Ratio (95% CI)
Age					
<50 years	89	6 (6.7)	83 (93.3)	0.72	0.79 (0.27–2.33)
≥50 years	84	7 (8.3)	77 (91.7)		Reference
Gender					
Male	104	6 (5.8)	98 (94.2)	0.38	0.55 (0.18–1.67)
Female	69	7 (10.1)	62 (89.9)		Reference
BMI					
<25 kg/m²	101	7 (6.9)	94 (93.1)	0.81	0.83 (0.28–2.46)
≥25 kg/m²	72	6 (8.2)	66 (91.8)		Reference
Indication for Dialysis					
CKD	92	7 (7.6)	85 (92.4)	0.64	Reference
AKI	54	3 (5.6)	51 (94.4)		0.72 (0.18–2.84)
Obstructive uropathy	27	3 (11.1)	24 (88.9)		1.53 (0.34–6.90)
Catheter dwell time				<0.001	
<6 days	136	4 (2.9)	132 (97.1)		Reference
≥6 days	37	9 (24.3)	28 (75.7)		10.6 (2.9–38.2)

Table 2. Logistic Regression Analysis of Catheter Dwell Time and Risk of DVT

Variable	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Catheter dwell <6 days	Reference	–	Reference	–
Catheter dwell ≥6 days	10.6 (2.9–38.2)	<0.001	9.8 (2.5–37.6)	0.001

The unadjusted odds ratio was 10.6 (95% CI 2.9–38.2, $p < 0.001$), and after adjustment for age, gender, BMI, and indication for dialysis, catheter dwell time remained the sole independent predictor, with an adjusted odds ratio of 9.8 (95% CI 2.5–37.6, $p = 0.001$). Clinically, these findings underscore that demographic factors and baseline renal diagnosis were not determinants of femoral DVT in this cohort. Instead, the temporal exposure to the catheter—specifically duration beyond six days—was the dominant risk factor, conferring nearly a tenfold increase in risk. This highlights the critical importance of minimizing catheter dwell time and transitioning patients to alternative vascular access as soon as feasible to mitigate thrombotic complications.

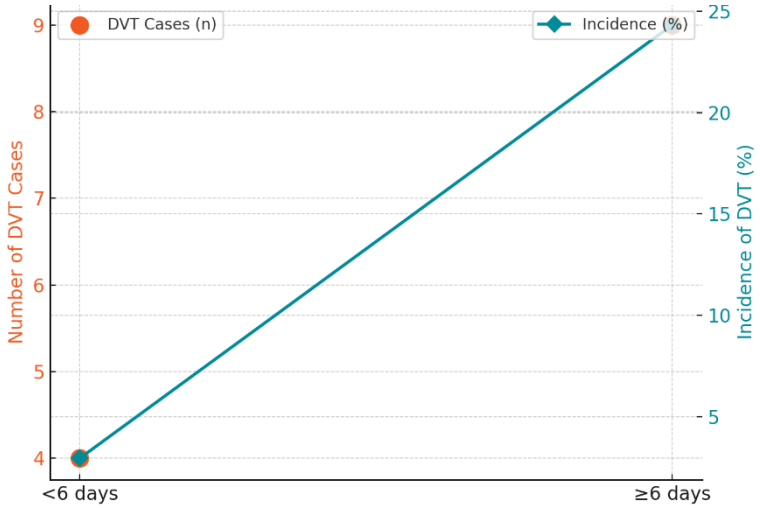

Figure 1 Catheter Dwell Time and Risk of Femoral Deep Venous Thrombosis

The figure illustrates the relationship between catheter dwell time and femoral DVT risk. Patients with catheters retained for fewer than six days developed thrombosis in 4 of 136 cases (2.9%), while those with dwell times of six days or more showed 9 cases among 37 patients (24.3%). The dual-axis graph highlights this disparity: absolute DVT counts rose from 4 to 9, while incidence percentages escalated more than eightfold, from 2.9% to 24.3%. The sharp increase beyond the six-day threshold demonstrates a clinically significant temporal effect, underscoring that prolonged femoral catheterization is the dominant predictor of thrombotic complications and reinforcing the need for early transition to alternative vascular access.

DISCUSSION

The present study demonstrated that 7.5% of patients undergoing hemodialysis via non-tunneled femoral double-lumen catheters developed confirmed deep venous thrombosis. While demographic and clinical factors such as age, gender, BMI, and dialysis indication were not associated with thrombotic events, catheter dwell time of six days or more emerged as the sole independent predictor, conferring

nearly a tenfold increase in risk. This finding highlights the temporal dimension of thrombotic risk and underscores the importance of minimizing the duration of femoral catheter use.

Our results align with prior literature documenting catheter dwell time as a critical determinant of thrombosis. Kujur et al. reported catheter-related thrombosis in 33% of patients with longer indwelling duration associated with higher risk (16). Similarly, Ravani et al. observed thrombotic complications in 34% of patients without infectious complications and up to 85% when infection was present, further emphasizing the cumulative risk with prolonged exposure (17). While our incidence was lower, the directionality of association supports the broader evidence base and reinforces that early removal of temporary femoral catheters is crucial.

The overall incidence of 7.5% in this cohort is lower than reports from multicenter studies in higher-income countries, where rates between 20–35% have been observed (18,19). This discrepancy may reflect population differences, variation in catheter insertion practices, or shorter mean dwell times in our sample. Conversely, it is comparable to results from single-center studies in developing countries, such as Bamikefa et al., who reported DVT in 8.2% of patients with femoral access in Nigeria (13). These findings suggest that local practice patterns, including catheter care protocols and access-site preferences, may substantially influence thrombotic outcomes.

The lack of significant association between thrombosis and patient-related variables such as age, sex, or BMI is consistent with certain previous investigations, which found that mechanical and procedural factors exert a stronger influence than demographic profiles (20). Nonetheless, other studies have described ethnic and population-level differences in thrombotic risk, with lower incidence in Asian and Pacific Islander groups and higher incidence among African American cohorts (21,22). The absence of demographic associations in our study may therefore reflect both the homogeneity of the local population and the limited sample size, which reduced statistical power to detect subtle effects.

Clinically, the finding that catheter dwell time alone predicted DVT has important implications. Since most patients in our cohort required temporary access before transitioning to arteriovenous fistula creation or tunneled catheters, the data support prioritizing early conversion strategies. Routine ultrasonography for patients with catheters in place beyond six days may also be considered to facilitate earlier detection of subclinical thrombosis, though cost-effectiveness in resource-constrained settings warrants further evaluation.

The strengths of this study include the use of duplex ultrasonography for confirmation of DVT, which minimized diagnostic misclassification, and the prospective recruitment of consecutive patients, reducing selection bias. However, several limitations must be acknowledged. The relatively small number of DVT events (n=13) limited the ability to evaluate weaker associations. The cross-sectional design precludes causal inference, and unmeasured confounders such as thrombophilia status, catheter caliber, and insertion techniques could not be fully addressed. Furthermore, being a single-center study, external validity to broader populations is restricted.

Despite these limitations, the findings contribute valuable local evidence where data are scarce and reinforce global recommendations to minimize femoral catheter dwell times. They further support the implementation of institutional guidelines favoring early transition to permanent vascular access and highlight the need for multicenter studies in South Asia to better characterize risk profiles and preventive strategies tailored to regional patient populations.

CONCLUSION

This study demonstrated that femoral deep venous thrombosis occurred in 7.5% of patients undergoing hemodialysis via non-tunneled femoral double-lumen catheters, with catheter dwell time of six days or more emerging as the only independent predictor of thrombosis. Demographic and clinical characteristics, including age, gender, BMI, and dialysis indication, were not significantly associated with risk. These findings highlight the critical importance of minimizing femoral catheter duration and prioritizing early conversion to permanent vascular access whenever feasible. In clinical practice, strict limitation of femoral catheter dwell time should be incorporated into institutional protocols to reduce thrombotic complications. Given the limited regional data, larger multicenter studies are warranted to validate these results, explore additional risk factors, and inform preventive strategies for patients requiring temporary hemodialysis access.

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