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Original Article

Comparison of Deep Venous Thrombosis Following Femoral Versus Internal Jugular Catheterization in Hemodialysis Patients

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ABSTRACT

Objective: To compare the frequency of deep venous thrombosis associated with femoral and internal jugular venous catheterization in patients undergoing hemodialysis.
Study Design: Prospective longitudinal study.
Place and Duration of Study: Department of Nephrology, Pak Emirates Military Hospital, Rawalpindi Pakistan, from Sep 2022 to Feb 2023.
Methodology: All patients undergoing hemodialysis, regardless of gender, who were 30-60 years old, were considered for inclusion. Patients were divided randomly. In Group-A, patients underwent hemodialysis through femoral vein catheterization. In Group-B, patients underwent hemodialysis through internal jugular vein catheterization. Following the insertion of the catheter, patients were monitored for any signs of deep vein thrombosis on each visit. Doppler ultrasound examination was conducted before the insertion of the dual-lumen central catheter, subsequent to its removal, and one week following catheter removal.
Results: The total of 60 patients were enrolled in the study. Patients who were enrolled in Group-A, had mean age 40.80±8.69 years. Patients who were enrolled in Group-B, had mean age 44.15±9.04 years. In Group-A, 8(26.7%) patients developed deep vein thrombosis. In Group-B, none of the patients developed DVT. The difference in the group was significant (p=0.002).
Conclusion: Hence, femoral vein catheterization is linked to a greater risk of DVT than internal jugular vein catheterization.

Keywords: Chronic Kidney Disease, Deep Venous Thrombosis, Femoral Catheterization, Hemodialysis, Internal Jugular Catheterization.

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INTRODUCTION

Hemodialysis requires access to the central veins that can provide rapid extracorporeal blood flow ranging from 300 to 400 mL/min for three to four hours three times a week with minimal complications.[1] Hemodialysis and peritoneal dialysis are performed using transcutaneous artificial indwelling catheters.[2] Peritoneal dialysis uses a trans-abdominal line, whereas hemodialysis, hemofiltration, and ultrafiltration need a wide-bore central venous line.[3] Hemodialysis, hemofiltration, and ultrafiltration catheter insertion are identical to other kinds of central venous access.[4,5]

Catheters used for extracorporeal RRT may cause thrombosis, infection, damage to nearby tissues, including the pleura (causing pneumothorax) or arteries, central vein stenosis, and device failure, which decreases blood flow and shortens functional lifespan.[6] Causes of dialysis catheter malfunction include blood stasis, hypercoagulability, and improper placement of catheter (like kinking the catheter at its point of entry). Many of these factors increase the likelihood that a fibrin sheath may develop around a catheter, severely limiting its usefulness.[7] A common complication is catheter-related vascular thrombosis, which leads to catheter malfunction. As a result, the afflicted vein may no longer be usable for vascular access, which significantly increases the morbidity of the affected limbs.[8] Catheter-related thrombosis and the need for central venous catheters are becoming more serious issues for hemodialysis patients. These patients with end-stage renal illness have diagnostic and therapeutic challenges linked to catheter-induced thrombosis, a subtype of deep venous thrombosis. The consequences of DVT associated with CVC can be serious, including permanent damage to a limb and, in severe cases, even death, especially if the affected outflow is necessary for future vascular access. Minimizing the use of central venous catheters and establishing autologous arteriovenous fistulae as soon

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as possible for permanent vascular access are the most effective methods for lowering the risk of catheter-related thrombosis.[9,10]

Hemodialysis frequently leads to deep vein thrombosis in patients. However, there is no evidence supporting this in the local context. Urgent studies are needed to improve hemodialysis practices and reduce the risk of deep vein thrombosis. This research was conducted to gather data for managing chronic renal disease. In the future, we might use this data to enhance our catheterization procedures, thereby lowering the risk of deep venous thrombosis, and improving both our success rates and patient satisfaction.

METHODOLOGY

This prospective longitudinal study was carried out at Pak Emirates Military Hospital, Rawalpindi, after approval of the Ethical Review Committee of hospital (ERC letter no. A/28/173(2)/EC/478/2022) over a period of six months from 1st September 2022 to 28 February 2023. Sample size was 60 cases (30 in each group), calculated by using WHO sample size calculator with 5% significance level, 90% power of study, and deep vein thrombosis, i.e. 0% with internal jugular vein catheterization and 25% with femoral vein catheterization.[11] Sampling technique was Non-probability, consecutive sampling.

Inclusion Criteria: Male and female patients aged 30-60 years with chronic renal disease requiring hemodialysis were included.

Exclusion Criteria: Individuals who had recently had a transplant, those who had undergone an implant, and those who had recently been treated for deep vein thrombosis were excluded from the research. Furthermore, patients with systemic lupus erythematosus (SLE), antiphospholipid syndrome, hematological malignancies and previously treated for deep venous thrombosis were also excluded from the research.

Patients who met the aforementioned criteria were enrolled. Consent was given voluntarily and in writing. A patient's demographic information was collected, including name, age, gender, body mass index (BMI), and duration of CKD. Patients were divided randomly into 02 groups by using a random number table. In Group-A, patients underwent hemodialysis through femoral vein catheterization. In Group-B, patients underwent hemodialysis through internal jugular vein catheterization. Following the insertion of the catheter, patients were monitored for any signs of deep vein thrombosis. Doppler ultrasound examination was conducted prior to the insertion of the dual-lumen central catheter, subsequent to its removal, and one week following catheter removal. A proforma tailored to this study served as the medium for all data collection.

All the data that was collected by using a proforma was later on entered and analyzed in Statistical Package for the Social Sciences (SPSS) version 23:00. Deep vein thrombosis was compared by applying chi-square test and the Fisher exact test, keeping p-value ≤0.05 as significant.

RESULTS

A total of 60 patients were enrolled in the study. Patients enrolled in femoral vein catheter group had a mean age of 40.80±8.69 years. Patients, enrolled in internal jugular vein catheter group, had a mean age of 44.50±9.04 years. In femoral vein catheter group, there were 21(70%) male patients and 9(30%) were females. In the internal jugular vein catheter group, there were 21(70%) male patients and 9(30%) females. In the femoral vein catheter group, the mean BMI of patients was 28.51±3.80 kg/m2. In the internal jugular vein catheter group, the mean BMI of patients was 29.39±4.59 kg/m2. In the femoral vein catheter group, out of 30 patients, 11(36.7%) cases were from rural areas, while 19(63.3%) cases were from urban areas. In internal jugular vein catheter group, out of 30 patients, 12(40.0%) cases were from rural areas, while 18(60.0%) cases were from urban areas. In the femoral vein catheter group, 22(73.3%) cases were diabetic, and 8(26.7%) cases were non-diabetic. In the internal jugular vein catheter group, 16(53.3%) cases had diabetes, and 14(46.7%) cases were non-diabetic. In femoral vein catheter group, 16(53.3%) cases were hypertensive, and 14(46.7%) cases were non-hypertensive. In the internal jugular vein catheter group, 11(36.7%) cases had hypertension, and 19(63.3%) cases were non-hypertensive. In femoral vein catheter group, 14(46.7%) cases had anemia, and 16(53.3%) cases were non-anemic. In the internal jugular vein catheter group, 13(43.3%) cases were anemic, and 17(56.7%) cases were non-anemic. In femoral vein catheter group, 6(20.0%) cases were smokers, and 24(80.0%) cases were non-smokers. In the internal jugular vein catheter group, 13(43.3%) cases were smokers, and 17(56.7%) cases were non-smokers. In the femoral vein catheter group, the mean duration of chronic kidney disease was 3.53±1.50

months. In the internal jugular vein catheter group, the mean duration of chronic kidney disease was 3.43±1.76 months. In the femoral vein catheter group, the mean serum creatinine level was 7.33±2.48 mg/dl. In the internal jugular vein catheter group, the mean serum creatinine level was 7.64±2.64 mg/dl, as shown in Table-I.

Table-I: Basic Demographics of Patients Enrolled In The Study (n=60)

Features	Femoral vein (n=30) Group-A	Internal jugular vein (n=30) Group-B
Age (Years)	40.80±8.69	44.50±9.04
Gender		
Male	21(70%)	21(70%)
Female	9(30%)	9(30%)
BMI (kg/m2)	28.51±3.80	29.39±4.59
Residence		
Rural	11(36.7%)	12(40.0%)
Urban	19(63.3%)	18(60.0%)
Comorbidities		
Diabetes	22(73.3%)	16(53.3%)
Hypertension	16(53.3%)	11(36.7%)
Anemia	14(46.7%)	13(43.3%)
Smoking	6(20.0%)	13(43.3%)
Duration of chronic kidney disease(years)	3.53±1.50	3.43±1.76
Serum creatinine level (mg/dl)	7.33±2.481	7.64±2.64

In the femoral vein catheter group, 8(26.7%) patients developed deep venous thrombosis. In the internal jugular vein catheter group, none of the patients developed deep venous thrombosis. The difference in the group was significant (p<0.05) as shown in Table-II. The presence of deep venous thrombosis was also compared with factors that could increase the risk of deep venous thrombosis. Among diabetics, deep venous thrombosis occurred in 7(18.4%), while among non-diabetics, deep venous thrombosis was noted in 1(4.5%) case only, although the difference was insignificant (p>0.05), but still diabetics are at high risk of developing deep venous thrombosis. Among hypertensive patients, deep venous thrombosis occurred in 4(14.8%), while among normotensive patients, deep venous thrombosis was noted in 4(12.1%) cases, and the difference was insignificant (p>0.05). Among anemic patients, deep venous thrombosis occurred in 3(11.1%), while among non-anemic patients, deep venous thrombosis was noted in 5(15.2%) cases (p>0.05). Also, among smokers, deep venous thrombosis occurred in 2(10.5%), while among non-smokers, deep venous thrombosis was noted in 6(14.6%) cases (p>0.05) as shown in Table-III.

Table-II: Comparison Of Outcomes In Both Groups (n=60)

Outcome		Site		*p*-value
		Femoral vein (n=30)	Internal jugular vein(n=30)	
Deep venous thrombosis	Yes	8(26.7%)	0(0%)	0.002
	No	22(73.3%)	30(100%)	

Table-III: Comparison of Deep Venous Thrombosis in Patients With Risk Factors (n=60)

Risk factor		Deep venous thrombosis		*p*-value
		Present	Absent	
Diabetes	Present	7(18.4%)	31(81.6%)	0.128
	Absent	1(4.5%)	21(95.5%)	
Hypertension	Present	4(14.8%)	23(85.2%)	0.760
	Absent	4(12.1%)	29(87.9%)	
Anemia	Present	3(11.1%)	24(88.9%)	0.647
	Absent	5(15.2%)	2(84.8%)	
Smoker	Yes	2(10.5%)	17(89.5%)	0.663
	No	6(14.6%)	35(85.4%)	

DISCUSSION

The findings of this study indicate that femoral vein catheterization is associated with a higher risk of deep venous thrombosis (DVT) compared with subclavian or internal jugular vein catheterization. In contrast, internal jugular vein access demonstrated better tolerance and fewer thrombotic complications. These observations suggest that, in the context of hemodialysis, prioritizing internal jugular vein catheterization may be a safer and more effective approach. Consequently, these results provide a rationale for recommending the internal jugular route over other catheterization methods in future clinical practice.

Current health care practices increasingly favor the application of peripherally inserted central venous catheters for transitional and prolonged access rather than the more traditional central venous catheters inserted percutaneously into the internal jugular, subclavian, or femoral veins, particularly in the inpatient setting.[12] The cost of caring for patients who need dialysis or a kidney transplant continues to be quite high. Abrantes *et al.,* evaluated that vascular problems, notably catheter-related thrombosis, are a major cause of increased morbidity and death in this patient population and account for a significant portion of their hospital bills.[13]

For urgent hemodialysis, a central venous catheter may be inserted; however, this procedure is

often linked with a higher risk of complications and death. Due to a lack of concrete evidence, decisions about this entity's management continue to be contentious.[8] While placing a temporary dialysis catheter in the internal jugular vein for hemodialysis is not particularly difficult, it does come with some risks, both immediate and long-term. A study by Regmi *et al.,* also described that catheter placement into a vein that already has a thrombus might cause potentially catastrophic results, such as pulmonary embolism, septic emboli, and brain edema.[14]

A systematic review conducted by Drakos *et al.,* found that the death rate from internal jugular vein thrombosis was 44%.[15] Similarly, a meta-analysis by Duffett et al., highlighted that comorbidities such as cancer, chronic renal disease, and infection all increase this rate dramatically in the elderly.[16] Catheterization of the femoral vein was associated with an increased risk of deep vein thrombosis (8 instances, 26.7%) compared to catheterization of the internal jugular vein (0%), as shown in our research (p<0.05). A prior study conducted by Siciliano *et al.,* found that the risk of developing DVT in the lower extremities was 25% higher in individuals who had femoral vein catheterization compared to those who had subclavian or internal jugular vein catheterization.[17]

A further investigation was carried out by Durbec, which was conducted on 31 patients who underwent femoral vein catheterization, and 30 patients had superior vena cava cannulation, through axillary (21 patients) or internal jugular vein (10 patients). The average number of days a single lumen polyurethane catheter was in place was shorter in the femoral vein group (7.1 +/- 4.6 days) than in the superior vena cava group (9.9 +/- 5.5 days; p>0.05). Throughout the course of the trial, no patients had symptoms consistent with deep vein thrombosis or pulmonary embolism. At the moment of catheter removal, bilateral phlebography of the lower extremities was conducted on each patient. Two (6.6%) of the participants in the femoral vein group had femoral vein thrombosis (two non-obstructive thromboses, adhering to the common femoral vein wall; p>0.05). Five patients (16.7%) in the femoral vein group experienced lower deep extremities thrombosis.[18]

Overall, the thrombotic complications were noted in a Bicentric Study conducted by Boccatonda *et al.,* that in 21.5% vs. 1.9% cases (p-value <0.001) and total thrombosis in 6% vs. 0% cases (p-value =0.01) were similarly more common with femoral catheterization, as were infectious problems, i.e., 19.8% vs. 4.5% (p-value <0.001; incidence density = 20 vs. 3.7 per 1,000 catheter--days). Femoral catheterization was the sole risk factor for infection (hazard ratio, 4.83; 95% CI, 1.96--11.93; p-value <0.001); however, the use of antibiotics delivered via the catheter reduced the likelihood of infection (hazard ratio, 0.41; 95% CI, 0.18--0.93; p-value =0.03). The sole predictor associated with an increased likelihood of thrombotic problems was femoral catheterization (odds ratio =14.42; 95% CI, 3.33--62.57; p-value <0.001).[19]

In addition, the time an indwelling catheter is left in place may have a role in the onset of thrombosis. After 10 days following catheterization, 25% of hemodialysis patients had internal jugular vein thrombosis, according to published research by Kitano *et al.,* and the incidence of this complication increased steadily thereafter. Many cases of deep vein thrombosis caused by a catheter go unreported. It was linked to 26% of central venous catheter insertions in a prospective trial. The risk of developing DVT after a catheterization procedure is higher in the internal jugular vein (up to 70%) than in the subclavian vein (30%).[20]

In the Saha *et al.,* study, identical results were seen in 46.7% of patients using a hemodialysis catheter.[21] Additionally, another incidence of 16.8% was reported by Scerratti *et al.,* in a one-year follow-up of dialysis patients using a central catheter in a research.[22]

In our study, the incidence of thrombosis contributing to catheter malfunction was notably higher than previously reported, although the predictive value of comorbidities could not be established. Despite ongoing advancements in catheter care, minimizing the frequency of central venous catheter use during hemodialysis remains the most effective strategy to reduce serious complications such as thrombosis. In alignment with the National Kidney Foundation's Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines,[23] the arteriovenous fistula continues to be the preferred vascular access for patients with chronic kidney disease. These findings reinforce the need to prioritize long-term, permanent access options whenever feasible to enhance patient safety and treatment outcomes.

LIMITATION OF STUDY

During the conduct of this study, a key limitation identified was the relatively small sample size. Owing to a

restricted timeframe and limited financial resources, it was not feasible to recruit a larger cohort of participants. These constraints may have reduced the statistical power of the study and restricted the generalizability of the findings. Future research with broader sampling and adequate funding is recommended to validate and strengthen these results.

CONCLUSION

The study concluded that femoral vein catheterization is linked to a greater risk of DVT than is the case with subclavian or internal jugular vein catheterization. Catheterization of the internal jugular vein was well tolerated. In the future, catheterization of the internal jugular vein might be recommended for hemodialysis instead of other methods.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

MIA & MY: Data acquisition, data analysis, critical review, approval of the final version to be published.

BR & AM: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

MWAQ & MSS: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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