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Research Article

SAFETY PROFILE OF TUNNELLED PERIPHERALLY INSERTED CENTRAL CATHETERS IN THE ARM: A PROSPECTIVE OBSERVATIONAL STUDY

Dr. Abhishek Gupta[1]*, Dr. Khushboo Gupta[2], Dr. Abhisek Saha[3], Dr. Praveen singhal[4], Dr. Manish Shaw[5], Dr. Mitesh Gupta[6], Dr. Hima Pendharkar[7]

[1]DM Resident, [7]Professor and HOD, Department of Interventional Radiology, National Institute of Medical Sciences and Research, Nims University, Rajasthan, Jaipur, India.
[2]Associate Professor, Department of Dermatology, National Institute of Medical Sciences and Research, Nims University, Rajasthan, Jaipur, India.
[3,6]DM Resident, National Institute of Medical Sciences and Research, Nims University, Rajasthan, Jaipur, India.
[4]Associate Professor, National Institute of Medical Sciences and Research, Nims University, Rajasthan, Jaipur, India.
[5]Professor, Department of Interventional Radiology, National Institute of Medical Sciences and Research, Nims University, Rajasthan, Jaipur, India.

Corresponding Author*: Dr.Abhishek Gupta, DM Resident, Department of Interventional Radiology, National Institute of Medical Sciences and Research, Nims University, Rajasthan, Jaipur, India.

Email ID: abhishek2785@gmail.com

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ABSTRACT

Background: Peripherally inserted central catheters (PICCs) provide central venous access through a peripheral vein, but use may be complicated by infection, thrombosis, migration, occlusion, and local tissue complications. Subcutaneous tunnelling is intended to improve catheter securement and separate the exit site from the venous entry point.

Objective: To assess complications and patient-related outcomes associated with tunnelled PICCs placed in the arm.

Methods: This prospective, observational, hospital-based study was conducted in the Department of Interventional Radiology at NIMS Hospital, Jaipur, from 15 March 2025 to 15 January 2026. Thirty eligible patients requiring PICC placement for chemotherapy, nutritional support, or medication administration were included. Ultrasound-guided venous access, subcutaneous tunnelling, and fluoroscopic/DSA confirmation were used. Outcomes included procedural findings, catheter complications, maintenance practices, pain, comfort, and catheter status.

Results: Mean age was 44.26 ± 17.80 years; 17 participants (56.7%) were female. Sarcoma was the most frequent diagnosis (33.3%), and FOLFOX was the most common chemotherapy regimen (36.7%). Right-arm placement was reported in 56.7%; basilic and brachial veins were each used in 43.3%. Mean insertion time was 24.20 ± 6.57 minutes, mean comfort score 18.96 ± 4.35, and mean pain score 4.73 ± 2.95. Immediate findings included pain (23.3%), hematoma (20.0%), bleeding (16.7%), and malposition (16.7%); 23.3% were recorded as having no immediate complication. Early complications were infection (26.7%), displacement (23.3%), thrombosis (16.7%), and hematoma (10.0%). Catheter-related bloodstream infection was reported in 10.0%.

Conclusion: Tunnelled PICC placement was undertaken in this small observational cohort, with a mean procedure time of approximately 24 minutes. Infectious, thrombotic, and mechanical events were nevertheless reported. Because follow-up summaries are inconsistent and there was no non-tunnelled comparison group, this study cannot establish comparative safety or demonstrate that tunnelling caused lower complication rates.

KEYWORDS: Peripherally Inserted Central Catheter, PICC, Tunnelling, Vascular Access, Catheter-related Infection, Thrombosis, Oncology.

Introduction

Reliable vascular access is essential for chemotherapy and other prolonged intravenous treatments. PICCs provide central access through a peripheral vein and are used when therapy requires more durable access than a short peripheral cannula. Their benefits must be balanced against complications such as catheter-related infection, upper-extremity thrombosis, malposition, occlusion, and dislodgement. Evidence from hospitalized populations demonstrates that PICC-associated complications are clinically important and that device selection should account for indication, duration of treatment, and patient-specific risk[1,2].

Tunnelled PICCs create a subcutaneous tract between the venous entry point and the skin exit site. The technique is intended to improve securement and permit selection of an exit site away from areas of flexion or repeated movement. A 2024 meta-analysis comparing tunnelled and non-tunnelled PICCs in patients receiving chemotherapy reported lower pooled odds of wound oozing, infection, thrombosis, phlebitis, and dislodgement with tunnelled devices, although comparative findings do not automatically predict outcomes in every local setting[3].

Safety assessment should include immediate procedural events, local infection and bloodstream infection, thrombosis, mechanical dysfunction, and patient-reported comfort and pain. Maintenance practices and follow-up surveillance are also relevant because catheter-related risks can emerge after insertion. Infection-prevention guidance emphasizes appropriate sterile dressing care, regular site assessment, and replacement of dressings when damp, loose, or soiled[4-7]. This study describes the clinical and procedural profile of patients receiving tunnelled PICCs at a tertiary hospital in Jaipur and summarizes reported complications and patient-related outcomes.

Aim and Objectives

Aim

To assess the safety of tunnelled peripherally inserted central catheters placed in the arm.

Primary Objective

To assess complication rates associated with tunnelled PICCs.

Secondary Objectives

To describe catheter-related phlebitis and infection, and to evaluate patient comfort and satisfaction during and after PICC placement.

Materials and Methods

Study Design, Setting, and Duration

This was a prospective, observational, hospital-based study conducted in the Department of Interventional Radiology at NIMS Hospital, Jaipur, Rajasthan, India, from 15 March 2025 to 15 January 2026.

Participants and Sampling

The study included patients aged 3 months to 75 years requiring PICC placement for chemotherapy, nutritional support, or medication administration. Eligible patients were receiving their first PICC/long-term central venous access device and could provide written consent, with parental or guardian consent for pediatric participants. Exclusion criteria included active infection or cellulitis at the proposed insertion site, pre-existing long-term vascular access, or a clinical contraindication to PICC placement. A consecutive complete-enumeration approach was reported; 30 participants were included.

Insertion Procedure

The source protocol describes ultrasound assessment of basilic, brachial, and cephalic veins; real-time ultrasound-guided venous puncture; guidewire and sheath placement; fluoroscopic/DSA assessment of venous anatomy; subcutaneous tunnelling with the exit site approximately 5 cm from the venous puncture and away from flexion areas; central catheter advancement; and fluoroscopic confirmation of the tip at the cavoatrial junction or lower superior vena cava. Catheter blood return and saline flushing were used to assess patency, followed by fixation, sterile dressing, and post-procedure monitoring.

Outcomes and Statistical Analysis

Recorded outcomes included demographic and clinical characteristics, insertion arm and vein, lumen number, immediate and early complications, infection, thrombosis, displacement, occlusion, breakage, maintenance practices, comfort and pain scores, insertion time, catheter status, and follow-up observations at one week, one month, and three months. The source reports descriptive analysis using means and standard deviations for continuous variables and counts and percentages for categorical variables. Descriptive results are presented; inferential comparisons are not reported because there was no comparator group and the available data did not support reliable comparative analysis.

Ethics

The source states that Institutional Ethical Committee approval was obtained and written informed consent was secured. The approval identifier and date were not available in the extracted study details and should be inserted by the authors before submission.

Results

Participant and Clinical Characteristics

Thirty participants were included. Mean age was 44.26 ± 17.80 years, mean weight 71.60 ± 11.74 kg, and mean height 166.63 ± 10.73 cm. Seventeen participants (56.7%) were female and 13 (43.3%) were male. Sarcoma was the most

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frequently recorded diagnosis (10/30, 33.3%); colon cancer and leukemia each accounted for 20.0%, breast cancer for 16.7%, and lymphoma for 10.0%. FOLFOX was the most common recorded chemotherapy regimen (36.7%).

Table 1: Baseline demographic and clinical characteristics

Characteristic	Result
Number of participants	30
Age, years, mean ± SD	44.26 ± 17.80
Female sex	17 (56.7%)
Male sex	13 (43.3%)
Weight, kg, mean ± SD	71.60 ± 11.74
Height, cm, mean ± SD	166.63 ± 10.73
Sarcoma	10 (33.3%)
Colon cancer	6 (20.0%)
Leukemia	6 (20.0%)
Breast cancer	5 (16.7%)
Lymphoma	3 (10.0%)
FOLFOX regimen	11 (36.7%)
Carboplatin regimen	6 (20.0%)
CHOP regimen	6 (20.0%)
Paclitaxel regimen	5 (16.7%)
AC-T regimen	2 (6.7%)

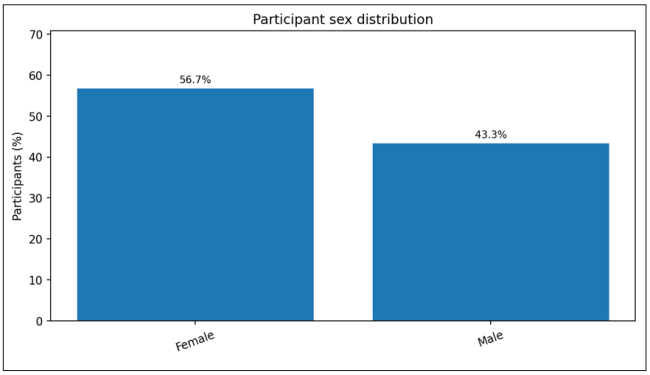


Figure 1.Sex distribution of the 30 study participants

Insertion Characteristics and Procedure-related Outcomes

Right-arm insertion was reported in 17 participants (56.7%), compared with 13 (43.3%) on the left. Basilic and brachial veins were each used in 13 participants (43.3%), while the cephalic vein was used in four (13.3%). Single- and double-lumen catheters were equally represented. Mean insertion time was 24.20 ± 6.57 minutes.

Immediate findings were recorded as pain in seven participants (23.3%), hematoma in six (20.0%), bleeding in five (16.7%), and malposition in five (16.7%); seven participants (23.3%) were recorded as having no immediate complication. These categories are presented as recorded in the source.

Table 2: Catheter insertion characteristics

Variable	n (%)
Right arm	17 (56.7%)
Left arm	13 (43.3%)
Basilic vein	13 (43.3%)
Brachial vein	13 (43.3%)
Cephalic vein	4 (13.3%)
Single lumen	15 (50.0%)
Double lumen	15 (50.0%)
Insertion difficulty: yes	11 (36.7%)
Insertion difficulty: no	19 (63.3%)
Insertion time, minutes, mean ± SD	24.20 ± 6.57

Table 3: Reported immediate and early complications

Outcome	n (%)
Immediate pain	7 (23.3%)
Immediate hematoma	6 (20.0%)
Immediate bleeding	5 (16.7%)
Immediate malposition	5 (16.7%)
No immediate complication recorded	7 (23.3%)
Early infection	8 (26.7%)
Early displacement	7 (23.3%)
Early thrombosis	5 (16.7%)
Early hematoma	3 (10.0%)
No early complication recorded	7 (23.3%)
Local infection: yes	8 (26.7%)
Catheter-related bloodstream infection	3 (10.0%)
Deep vein thrombosis, summary table	6 (20.0%)
Occlusion, summary table	5 (16.7%)
Breakage, summary table	5 (16.7%)

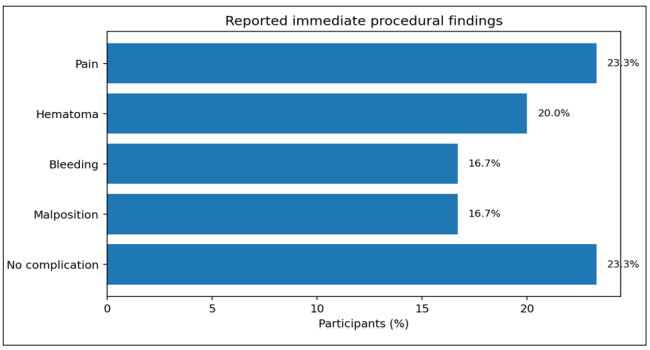


Figure 2.Distribution of reported immediate procedural findings

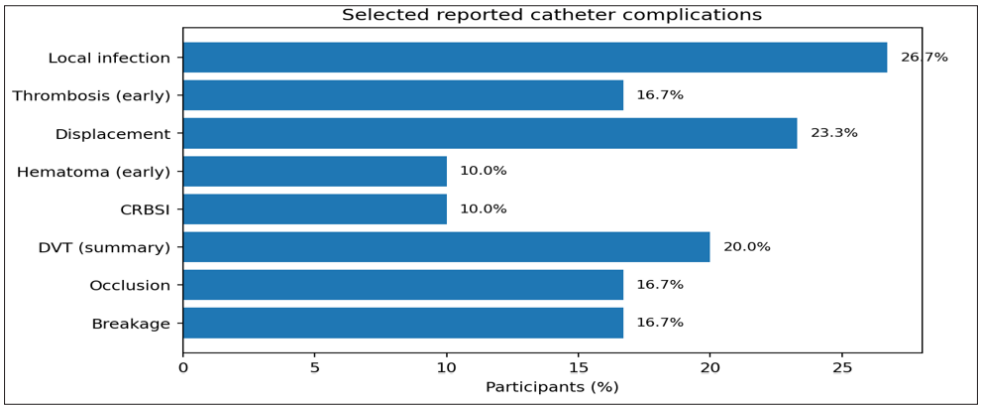


Figure 3.Selected catheter-related complications from separate source tables; categories may overlap

Patient-reported Outcomes, Catheter Status, and Maintenance

Mean comfort score was 18.96 ± 4.35 and mean pain score was 4.73 ± 2.95. Catheter status was recorded as completed in 13 participants (43.3%), still in use in six (20.0%), and removed in 11 (36.7%). Among the removal-reason records, dislodgement accounted for seven cases (reported as 41.2%), occlusion for four (23.5%), and infection and thrombosis for three each (17.6%).

Table 4: Patient-related outcomes, catheter status, and maintenance

Variable	Result
Comfort score, mean ± SD	18.96 ± 4.35
Pain score, mean ± SD	4.73 ± 2.95
Catheter status: completed	13 (43.3%)
Catheter status: in use	6 (20.0%)
Catheter status: removed	11 (36.7%)
Reported removal reason: dislodgement	7 (41.2% of reason records)
Reported removal reason: occlusion	4 (23.5% of reason records)
Reported removal reason: infection	3 (17.6% of reason records)
Reported removal reason: thrombosis	3 (17.6% of reason records)
Dressing change every 48 hours	14 (46.7%)
Dressing change weekly	8 (26.7%)
Dressing change as needed	8 (26.7%)
Flush practice: heparin	11 (36.7%)
Flush practice: saline	9 (30.0%)
Flush practice: both	10 (33.3%)
Locking technique: saline	16 (53.3%)
Locking technique: heparin	14 (46.7%)
Final safety assessment: high risk	13 (43.3%)
Final safety assessment: needs further assessment	9 (30.0%)
Final safety assessment: safe	8 (26.7%)

Follow-up observations

The source includes one-week, one-month, and three-month follow-up tables for phlebitis, thrombosis, displacement, infection, and wound oozing. Several headings are duplicated or ambiguous, and some values are reported only as positive counts without corresponding negative counts or clear definitions. The narrative describes a progressive increase in complications, while some tabulated percentages do not show a monotonic increase. These values have not been combined into a trend estimate; the original records should be checked before a definitive longitudinal interpretation.

Discussion

This prospective observational study describes tunnelled PICC placement and complications in 30 patients at a single tertiary-care centre. The cohort was heterogeneous in age and malignancy type, with sarcoma the most frequent diagnosis. Right-arm access was more common, and basilic and brachial veins were the most frequently selected veins. The mean insertion time of 24.2 minutes provides a local descriptive estimate, but a single-arm design cannot establish whether tunnelling changes procedure duration compared with conventional PICC insertion.

The most notable findings were early local and mechanical events, including pain, hematoma, bleeding, malposition, infection, and displacement. Local infection was reported in 26.7% and catheter-related bloodstream infection in 10.0%. These figures should be interpreted cautiously: the sample is small, complication definitions are not fully specified, and some summary tables report different values for related events. They should not be interpreted as stable incidence rates or compared directly with other studies without consistent outcome definitions.

A 2024 meta-analysis of studies in chemotherapy-treated cancer patients found lower pooled odds of several complications with tunnelled compared with non-tunnelled PICCs, including infection, thrombosis, phlebitis, wound oozing, and dislodgement[3]. That evidence provides context for the clinical interest in tunnelling, but it does not prove a benefit in this cohort because all participants received tunnelled PICCs and there was no concurrent comparison

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group. Infection-prevention guidance emphasizes aseptic insertion, appropriate dressing management, and regular site assessment; these practices remain important irrespective of catheter design[4-7].

The broader literature also supports treating thrombosis as a key safety outcome. A systematic review and meta-analysis found an increased risk of venous thromboembolism associated with PICCs, while a later meta-analysis estimated a pooled symptomatic venous thromboembolism incidence of 3.7% in non-comparative hospitalized cohorts; differences in populations and outcome definitions limit direct comparison with the present percentages[8,9]. Prospective observational studies further show that PICC complications vary by setting and may include occlusion, accidental withdrawal, infection, and thrombosis. In one cohort, overall complications were reported at 11.1 per 1,000 catheter-days, whereas a multicentre cancer cohort reported 1.59 complications per 1,000 catheter-days, illustrating why catheter-days and standardized definitions are useful when reporting incidence[10,11]. The insertion approach described in this study is consistent with recommendations supporting real-time ultrasound guidance for vascular access, including PICC placement[12]. A technical review of routine and tunnelled PICC placement also describes the role of imaging, tunnelling technique, and troubleshooting, but emphasizes that technique selection must be individualized to the clinical context[13]. Patient-reported surveillance may identify symptoms and functional problems not fully captured in routine clinical documentation, supporting the value of clearly defined and validated patient-reported measures in future studies[14]. Current guidance for catheter-related infection also underscores the importance of standardized diagnostic criteria and consistent prevention practices when interpreting infection outcomes[15].

Patient-reported scores indicated a mean comfort score of 18.96 and mean pain score of 4.73, but the scoring range and validated instrument were not specified in the available source text. Therefore, these values are reported without describing them as clinically “moderate” or “acceptable.”

The follow-up dataset is a major limitation. Several table labels are repeated or ambiguous, and the reported percentages do not consistently support the narrative claim that complications increased progressively over time. The reasons-for-removal counts also do not reconcile with the number of catheters listed as removed. It is therefore inappropriate to infer cumulative risk, calculate a reliable complication trajectory, or conclude that infection risk was reduced by tunnelling.

Overall, the findings are best regarded as a descriptive safety assessment of a small cohort. A larger prospective study should use standardized definitions, clear denominators at each follow-up time point, catheter-days where incidence rates are intended, validated patient-reported measures, and a non-tunnelled comparison group.

Strengths and Limitations

Strengths include prospective observational data collection, a defined study setting and period, a standardized image-guided insertion description, and assessment of procedural and patient-related outcomes. Limitations include the small single-centre sample, absence of a non-tunnelled comparator, lack of reported confidence intervals or inferential comparisons, unclear definitions and scales for some outcomes, incomplete follow-up denominators, inconsistent labels/counts across tables, and unavailable ethics approval identifier. The study cannot establish causality or comparative efficacy.

Conclusion

In this 30-patient prospective observational cohort, tunnelled PICC placement had a mean insertion time of 24.20 ± 6.57 minutes and reported comfort and pain scores of 18.96 ± 4.35 and 4.73 ± 2.95, respectively. Immediate and subsequent complications—including infection, thrombosis, displacement, occlusion, and local procedural events—were documented. The findings support structured monitoring of tunnelled PICCs but do not establish superiority over conventional PICCs. Before publication, the original dataset should be checked to reconcile follow-up tables, complication definitions, removal denominators, and patient-reported scoring instruments.

Conflict of Interest

None

References

1. Chopra V, O’Horo JC, Rogers MAM, Maki DG, Safdar N. The risk of bloodstream infection associated with peripherally inserted central catheters compared with central venous catheters in adults: a systematic review and meta-analysis. Infect Control Hosp Epidemiol. 2013;34(9):908-918. doi:10.1086/671737.
2. Chopra V, Flanders SA, Saint S, et al. The Michigan Appropriateness Guide for Intravenous Catheters (MAGIC): results from a multispecialty panel using the RAND/UCLA appropriateness method. Ann Intern Med. 2015;163(6 Suppl):S1-S40. doi:10.7326/M15-0744.
3. Wen J, et al. Complications of tunneled and non-tunneled peripherally inserted central catheter placement in chemotherapy-treated cancer patients: a meta-analysis. Front Surg. 2024;11:1469847. doi:10.3389/fsurg.2024.1469847.
4. O’Grady NP, Alexander M, Burns LA, et al. Guidelines for the prevention of intravascular catheter-related infections. Clin Infect Dis. 2011;52(9):e162-e193. doi:10.1093/cid/cir257.
5. Gorski LA, Hadaway L, Hagle ME, et al. Infusion Therapy Standards of Practice, 8th Edition. J Infus Nurs. 2021;44(1 Suppl 1):S1-S224.

6. Centers for Disease Control and Prevention. Summary of recommendations: prevention of intravascular catheter-related infections. Updated 2024. Available from: https://www.cdc.gov/infection-control/hcp/intravascular-catheter-related-infections/summary-recommendations.html.
7. Centers for Disease Control and Prevention. Strategies for prevention of catheter-related infections in adult and pediatric patients. Updated 2024. Available from: https://www.cdc.gov/infection-control/hcp/intravascular-catheter-related-infection/prevention-strategies.html.
8. Chopra V, Anand S, Hickner A, Buist M, Rogers MA, Saint S, et al. Risk of venous thromboembolism associated with peripherally inserted central catheters: a systematic review and meta-analysis. Lancet. 2013;382(9889):311-325. doi:10.1016/S0140-6736(13)60592-9.
9. Puri A, Dai H, Giri M, Wu C, Huang H, Zhao Q. The incidence and risk of venous thromboembolism associated with peripherally inserted central venous catheters in hospitalized patients: a systematic review and meta-analysis. Front Cardiovasc Med. 2022;9:917572. doi:10.3389/fcvm.2022.917572.
10. Grau D, Clarivet B, Lotthé A, Bommart S, Parer S. Complications with peripherally inserted central catheters (PICCs) used in hospitalized patients and outpatients: a prospective cohort study. Antimicrob Resist Infect Control. 2017;6:18. doi:10.1186/s13756-016-0161-0.
11. Kang J, Chen W, Sun W, Ge R, Li H, Ma E, et al. Peripherally inserted central catheter-related complications in cancer patients: a prospective study of over 50,000 catheter days. J Vasc Access. 2017;18(2):153-157. doi:10.5301/jva.5000670.
12. Franco-Sadud R, Schnobrich D, Mathews BK, Candotti C, Abdel-Ghani S, Perez MG, et al. Recommendations on the use of ultrasound guidance for central and peripheral vascular access in adults: a position statement of the Society of Hospital Medicine. J Hosp Med. 2019;14(9):E1-E22. doi:10.12788/jhm.3287.
13. Gupta N, Gandhi D, Sharma S, Goyal P, Choudhary G, Li S. Tunneled and routine peripherally inserted central catheters placement in adult and pediatric population: review, technical feasibility, and troubleshooting. Quant Imaging Med Surg. 2021;11(4):1619-1627. doi:10.21037/qims-20-694.
14. Krein SL, Saint S, Trautner BW, Kuhn L, Colozzi J, Ratz D, et al. Patient-reported complications related to peripherally inserted central catheters: a multicentre prospective cohort study. BMJ Qual Saf. 2019;28(7):574-581. doi:10.1136/bmjqs-2018-008726.
15. Mermel LA, Allon M, Bouza E, Craven DE, Flynn P, O'Grady NP, et al. Clinical practice guidelines for the diagnosis and management of intravascular catheter-related infection: 2009 update by the Infectious Diseases Society of America. Clin Infect Dis. 2009;49(1):1-45. doi:10.1086/599376.

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