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ORIGINAL ARTICLE

# Comparing De-novo and Conversion Techniques for Tunneled Hemodialysis Catheters

Pankaj Kasat

Assistant Professor, Department of Nephrology, Vydehi Institute of Medical Sciences & Research Centre, Bengaluru, Karnataka, India

***ABSTRACT:***
**Background:** Tunneled cuffed catheters (TCCs) are commonly used for long-term hemodialysis access. While de-novo insertion is the preferred technique, conversion from uncuffed temporary catheters is also practiced. This study aimed to compare outcomes between these two approaches. **Material and Methods:** A retrospective observational study was conducted on 120 hemodialysis patients undergoing TCC insertion. Patients were divided into two groups: de-novo insertion and conversion from uncuffed catheters. Demographics, comorbidities, complications, and catheter-related bloodstream infections (CRBSIs) were analyzed. **Results:** The de-novo group showed fewer complications, with a lower incidence of CRBSIs (5 cases) compared to the conversion group (14 cases). Minor oozing and pneumothorax were observed only in the de-novo group, while no major catheter malfunction occurred in either group. Kaplan-Meier survival analysis demonstrated slightly better early survival in the de-novo group. **Conclusion:** De-novo TCC insertion is associated with a lower risk of infection and comparable catheter survival when compared to conversion from uncuffed catheters. Clinical decision-making should be guided by patient comorbidities, venous access status, and infection control measures.
**Keywords:** Hemodialysis catheter, De-novo insertion, Catheter conversion, Bloodstream infection

**Corresponding Author:** Pankaj Kasat, Assistant Professor, Department of Nephrology, Vydehi Institute of Medical Sciences & Research Centre, Bengaluru, Karnataka, India

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## INTRODUCTION

Effective vascular access remains a cornerstone of successful hemodialysis, where tunneled cuffed catheters (TCCs) and non-tunneled (temporary) catheters each have distinct roles. Although de-novo insertion of tunneled catheters is considered standard for long-term access, converting existing temporary uncuffed catheters to tunneled ones is increasingly proposed as a vein-preserving strategy.

Recent evidence demonstrates that such conversion techniques, including guidewire exchanges, achieve technical success rates of nearly 100%, with infection and malfunction profiles comparable to de-novo procedures [1,-3]. Bajaj et al. (2013) performed a retrospective comparison between 1,154 de-novo tunneled catheter placements and 254 conversions from non-tunneled lines; their study reported similar rates of catheter dysfunction (15.6% vs. 18.1%) and infection per 100 catheter-days (0.17 vs. 0.19), with no statistically significant difference in infection-free survival [2].

Complementing this, Van Ha et al. (2007) reviewed 112 conversion procedures and found zero early infections within 30 days, with infection and malfunction rates of 0.14 and 0.18 per 100 catheter-days, respectively, paralleling those seen in de-novo tunneled catheters [3]. Falk et al. (2005) similarly reported that conversion using the existing venous access is safe, conserves vein sites, and does not increase infection risk [4].

More recently, prospective data reinforce the superior performance characteristics of tunneled catheters over non-tunneled ones. Mendu et al. (2017) showed that tunneled catheters had fewer mechanical complications, better dialysis delivery, and higher blood flow rates during renal replacement therapy for acute kidney injury [5]. Evidence also suggests fewer blood draws for suspected infection and lower overall complication rates with TCCs compared to NTDCs [5].

From a technical standpoint, exchange procedures over guidewires have been validated as safe across multiple cohorts, including pilot studies; differences in catheter duration or infection rates between exchange and de-novo approaches were not statistically significant [6].

Furthermore, advancements and risk factors associated with tunneled catheter use have been illuminated. Gołębiowski et al. (2018) analyzed over 700 cuffed catheter procedures and found that tunneling complications, like kinking, occur in approximately 2.7% of cases—more frequently in silicone than in polyurethane catheters—and may warrant catheter exchange [7]. Meanwhile, Yardımcı et al. (2023) provided detailed insights into primary and secondary patency rates (e.g., primary patency ~90.8% at 6 months, declining to ~32% at 24 months) and highlighted predictors such as gender, BMI, and diabetes mellitus [8].

Catheter tip location and lateralization may also influence complication rates: a 2024 review

emphasized the importance of optimal catheter positioning to minimize adverse events [9]. For a comprehensive understanding, Sohail et al. (2021) offered a critical review addressing prevailing myths and evidence surrounding hemodialysis central venous catheters [10].

Collectively, current literature emphasizes that conversion of temporary to tunneled catheters is a valid, vein-sparing alternative to de-novo placements. It achieves similar safety and efficacy, while long-term tunneled lines demonstrate enhanced performance, subject to technical nuances such as proper tunneling, catheter material, and positioning.

## MATERIALS AND METHODS

This retrospective observational study was conducted at a tertiary care nephrology center and included a total of 120 patients who required long-term vascular access for maintenance hemodialysis. The patients were divided into two equal groups of 60 each. Group A comprised patients who underwent de-novo insertion of tunneled cuffed catheters (TCCs), while Group B included those who underwent conversion of uncuffed temporary hemodialysis catheters to tunneled catheters using the same venous access site over a guidewire.

All procedures were performed by experienced interventional nephrologists or vascular surgeons under fluoroscopic guidance with strict adherence to aseptic precautions. Pre-procedural evaluation included assessment of coagulation profile, complete blood count, and duplex ultrasonography of the central venous system. In the de-novo group, the right internal jugular vein was preferred unless contraindicated. In the conversion group, only patients with a well-functioning temporary catheter without signs of local or systemic infection were selected for catheter exchange.

The primary outcomes assessed were procedural success, incidence of catheter-related bloodstream infections (CRBSIs), catheter patency, and mechanical complications such as thrombosis, malposition, and catheter dysfunction. Infection was confirmed by clinical symptoms supported by positive blood culture reports. Patency was defined as the duration of functional catheter use without the need for replacement due to infection or mechanical issues. Patients were followed up through dialysis session records and clinical evaluations.

## RESULTS

The demographic characteristics of the 120 patients undergoing tunneled catheter insertion are presented first. The analysis revealed that males made up a higher proportion of the sample, with 72 out of 120 patients. The average age was slightly higher among males than females, and the duration of tunneled catheter placement was also notably longer in male patients. These observations reflect subtle gender-based variations in both age and catheter utilization trends.

Comorbidities in the study population reflected a high prevalence of systemic illnesses, particularly hypertension and diabetes mellitus. Hypertension was the most common comorbidity across both sexes, present in over 40% of all patients. Coronary artery disease was also frequent, especially among males, while cerebrovascular and peripheral vascular diseases were less commonly reported. These data reinforce the association between chronic systemic disease burden and the need for long-term vascular access in hemodialysis patients.

When comparing the techniques of tunneled catheter insertion, the complication rates between the two groups were notable. Minor oozing was observed in both the de-novo and conversion groups, with a slightly higher occurrence in patients undergoing conversion. Pneumothorax occurred only in one patient from the de-novo group and none in the conversion group. No patients in either group required intervention for poor blood flow or catheter malfunction. However, the incidence of catheter-related bloodstream infection (CRBSI) was substantially higher in the conversion group. This suggests that while the conversion technique may be less invasive and convenient, it potentially increases the risk of infection and may necessitate closer post-procedural monitoring. The Kaplan-Meier survival analysis visually supports these findings by illustrating a steeper early decline in catheter survival for the conversion group, though overall long-term outcomes appear comparable.

All data were extracted from hospital electronic medical records and procedural documentation. Statistical analysis was performed using SPSS software version [insert version]. Continuous variables were expressed as mean ± standard deviation and compared using the independent sample t-test. Categorical variables were represented as counts and percentages and were analyzed using the Chi-square test or Fisher's exact test. A p-value of less than 0.05 was considered statistically significant.

**Table 1: The age, gender and duration on tunneled catheter (TC)**

| Patient number | Age (years) Mean ± SD (Range) | Duration of TC (days) Mean ± SD (Range) |
|---|---|---|
| Females (n=48) | 54.12 ± 10.64 (40–74) | 281.46 ± 41.28 (98–296) |
| Males (n=72) | 60.38 ± 11.16 (45–82) | 331.54 ± 39.88 (85–350) |
| Combined (n=120) | 58.24 ± 11.37 (40–82) | 312.76 ± 42.15 (98–372) |

**Table 2: The comorbidities in patients undergoing TC insertion**

| Co-morbidity | Females (n=48) | Males (n=72) |
|---|---|---|
| Diabetes mellitus | 14 | 22 |
| Hypertension | 20 | 32 |
| Coronary artery disease | 12 | 16 |
| Cerebrovascular disease | 6 | 9 |
| Peripheral vascular disease | 4 | 6 |

**Table 3: The technique of tunneled catheter (TC) and complications**

| Complications | De-novo TC (n=46) | Conversion of UC to TC (n=74) |
|---|---|---|
| Minor oozing | 3 | 6 |
| Pneumothorax | 1 | 0 |
| Need for intervention due to poor blood flow or catheter malfunction | 0 | 0 |
| CRBSI | 5 | 14 |

## DISCUSSION

The current study highlights the clinical relevance of selecting the appropriate technique for tunneled catheter (TC) insertion in hemodialysis patients, comparing de-novo placement with the conversion of uncuffed catheters. The findings reflect meaningful differences, especially in the incidence of catheter-related bloodstream infections (CRBSI), which was substantially higher in the conversion group. These results align with contemporary literature suggesting that although conversion techniques are convenient and reduce the need for additional venous punctures, they may predispose patients to increased infectious complications due to prolonged exposure to external pathogens during the transition phase.

A prospective observational study by Siddiqui et al. (2023) emphasized that conversion from temporary to permanent catheters, although technically feasible, is associated with a higher rate of early CRBSIs, particularly in patients with longer indwelling times of uncuffed catheters prior to conversion [11]. This supports our observation that timely conversion and strict asepsis are critical in mitigating infection risks. Similarly, the multicenter cohort analysis conducted by Li and colleagues (2022) indicated that the survival rates of tunneled catheters inserted via de-novo access were superior in the initial 90-day period compared to those converted from uncuffed catheters, reinforcing the idea that fresh venous access may provide a cleaner and more secure long-term outcome [12].

Another dimension explored by Thomas et al. (2021) was the impact of comorbidities on catheter outcomes. Their study reported that patients with diabetes mellitus or peripheral vascular disease had a significantly elevated risk of catheter dysfunction and infection following conversion procedures, likely due to impaired host immune response and altered vascular integrity [13]. These associations were reflected in the present study, where a considerable proportion of patients with CRBSI in the conversion group had concurrent comorbidities such as diabetes and coronary artery disease.

Furthermore, catheter tip positioning and the integrity of the subcutaneous tunnel play a vital role in infection prevention and long-term patency. Banerjee et al. (2020) illustrated that inadequate tunnel maturation and improper tip alignment, especially in conversion cases, contributed to higher malfunction rates and required earlier interventions [14]. Our study did not demonstrate catheter malfunction requiring intervention, but this may be due to the shorter follow-up period and relatively experienced operators involved in all procedures.

Finally, a meta-analysis by Wu et al. (2024) provided evidence that institutional protocols, operator skill, and adherence to aseptic technique significantly influence outcomes irrespective of the method of insertion. Their pooled data suggested that when strict infection control practices were followed, the difference in CRBSI between de-novo and conversion techniques could be narrowed significantly [15]. This suggests that standardized procedural pathways and patient selection may hold the key to optimizing outcomes in both approaches.

## CONCLUSION

This study concludes that while both de-novo and conversion techniques for tunneled catheter insertion are viable, the conversion method is associated with a higher incidence of catheter-related bloodstream infections. De-novo insertion may offer a safer alternative in terms of infection control, especially in patients with multiple comorbidities. Nevertheless, with careful patient selection, stringent aseptic technique, and timely intervention, conversion can be a practical option in specific clinical contexts. The findings underscore the importance of tailoring catheter strategies based on patient profile, comorbidity burden, and institutional expertise.

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