

Survival of tunneled femoral dialysis catheters: a single center retrospective study

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Abstract

Purpose

Tunneled femoral hemodialysis catheters are typically reserved for patients with exhausted conventional vascular access options, due to their reduced patency and higher complication rates. Data on their long-term performance in real-world settings remain limited. This study aimed to evaluate catheter survival and to describe the main causes of catheter failure.

Methods

We performed a retrospective, single-center observational study including all tunneled femoral hemodialysis catheters inserted between January 1, 2018, and December 31, 2025. Catheter survival was assessed using Kaplan–Meier analysis.

Results

A total of 126 catheters were inserted in 74 patients, of which 116 catheters in 65 patients were included in the survival analysis. The median catheter survival was 459 days. Estimated survival rates were 94.66%, 87.87%, 82.64%, 75.81%, and 57.20% at 30, 60, 90, 180, and 360 days, respectively. No statistically significant differences in catheter survival were observed according to sex, age, catheter length, diameter, design, or catheter sequence. Catheter-related infection and catheter dysfunction were the causes of catheter failure. The rate of catheter-related infections leading to catheter removal or death was 0.34 episodes per 1000 catheter-days.

Conclusion

In this cohort, tunneled femoral hemodialysis catheters demonstrated a median functional duration of 459 days, supporting their use as a viable option in patients with limited vascular access options.

Introduction

Vascular access plays a central role in the management of patients undergoing hemodialysis. Arteriovenous fistulas (AVFs) are recommended as the preferred vascular access because of their superior long-term patency and lower rates of infectious and thrombotic complications compared with central venous catheters (CVCs) [1, 2]. Nevertheless, CVCs remain an essential component of dialysis care, serving either as a bridge to arteriovenous access or kidney transplantation, or as the only feasible option in patients with exhausted vascular access [1, 3].

Despite guideline recommendations, CVCs remain widely used in routine clinical practice [3]. This can be explained by the fact that a functional AVF is not always available at dialysis initiation because of late referral, failed vascular access creation, or unfavorable vascular anatomy [3]. Recent data from the Romanian Renal Registry confirm this discrepancy between guideline recommendations and clinical practice, with only 20% of patients initiating hemodialysis with an AVF, compared with 55% and 25% using temporary and tunneled CVCs, respectively [4].

Tunneled CVCs are preferentially inserted into the right internal jugular vein, with other upper central venous sites considered according to current guideline recommendations [1]. Preservation of upper extremity vascular access is a key principle in the long-term management of patients receiving hemodialysis [1, 3]. Endovascular interventions may restore central venous patency and preserve upper extremity vascular access [5]. However, when these approaches are unsuccessful or unavailable, tunneled femoral CVCs become an important alternative for maintaining hemodialysis in patients with exhausted upper extremity vascular access [1, 3, 6].

Thus, tunneled femoral CVCs are typically used in patients with limited upper extremity vascular access options. However, published evidence on femoral hemodialysis catheters remains limited, with available studies reporting variable outcomes regarding catheter survival and catheter-related complications [7–14]. In this context, we conducted a retrospective cohort study to provide contemporary real-world data on the long-term outcomes of tunneled femoral hemodialysis catheters in a tertiary referral center.

Materials and methods

Study design and population

We conducted a retrospective, single-center observational study including all tunneled femoral hemodialysis catheters inserted in adult patients (≥ 18 years) at the Department of Nephrology, Emergency County Clinical Hospital Cluj-Napoca, Romania, between January 1, 2018 and December 31, 2025. Some patients required multiple catheter insertions during the study period. Catheters lost to follow-up were excluded from survival analyses.

Data collection

Clinical and procedural data were collected retrospectively from electronic medical records. Sex was recorded at the patient level, whereas age was recorded at the time of each catheter insertion. Procedural data included date of catheter insertion, catheter characteristics (side of insertion, tip-to-cuff length, tip design), date of catheter removal, and reason for catheter removal. Data completeness varied across variables due to the retrospective design of the study. The specific causes for catheter dysfunction (e.g., fibrin sheath, thrombosis, central vein stenosis, and catheter migration) were not systematically documented and therefore could not be reliably analyzed.

In our center, all patients received antivitamin K therapy (acenocoumarol) from the time of catheter insertion, as part of routine clinical practice for thrombosis prevention. However, data on catheter-related thrombosis were not systematically recorded and could not be evaluated in this retrospective analysis.

Endpoints and definitions

The primary endpoint of the study was catheter functional survival, defined as time (in days) from catheter insertion to catheter removal due to catheter-related complications including catheter-related infection or catheter dysfunction.

The secondary endpoint was the reasons for catheter removal.

Reasons for catheter removal were classified as catheter-related infection and catheter dysfunction, self-removal, elective removal, and patient death unrelated to the catheter. Self-removal included all unplanned catheter removals related to patient behavior (e.g., agitation, dementia, or accidental self-removal). Elective removal was defined as catheter removal when the device was no longer required, such as after successful AVF maturation or recovery of kidney function.

Catheters removed because of self-removal, elective removal, patient death unrelated to the catheter, or those still functional at the end of follow-up were treated as censored observations. Catheters lost to follow-up were excluded from survival analysis.

Follow-up and data availability

Information on catheter functional duration was available for 116 catheters. The reason for catheter removal was documented for 94 catheters, whereas the remaining catheters were still functional at the end of the follow-up. Catheter length was available for 111 catheters. Standard catheter lengths included 27 cm, 31 cm, 42 cm and 50 cm. The remaining nine catheters had non-standard lengths: one 19 cm catheter and eight 23 cm catheters.

Ethical approval

The study was conducted in accordance with the Declaration of Helsinki and was approved by the institutional ethics committee of the Emergency County Clinical Hospital Cluj-Napoca (21621/23.06.2026). Due to the retrospective nature of the study, the requirement for informed consent was waived.

Statistical analysis

Continuous variables are presented as median (interquartile range [IQR], and range). Categorical variables are reported as counts and percentages. Descriptive analyses were performed using Microsoft Excel (Microsoft Corp., Redmond, WA, USA). Missing data were not imputed, and analyses were performed using available data. Survival analyses were conducted using the Kaplan–Meier method, with comparisons between groups assessed using the log-rank test. To explore the potential impact of

repeated femoral catheter insertions, catheters were categorized according to insertion sequence (first vs subsequent). Cox proportional hazards regression were used to explore potential predictors of catheter failure. Survival analyses and Cox regression were performed using Python (version 3.10, Python Software Foundation, Wilmington, DE, USA). Given the exploratory nature of the study, no adjustment for multiple testing was applied. A two-sided p-value <0.05 was considered statistically significant. Incidence rates were expressed per 1000 catheter-days, with 95% confidence intervals calculated assuming a Poisson distribution.

Results

Patients and catheters characteristics

A total of 126 tunneled femoral hemodialysis catheters were inserted in 74 patients during the study period. Of these, 10 catheters in 9 patients were lost to follow-up and excluded from the analysis. The final analytical cohort comprised 116 catheters in 65 patients. Among the included patients, 49.2% were male. The median age at catheter insertion was 64 years (IQR, 49-72). Catheter characteristics are summarized in Table 1. Catheters were equally distributed between the left and right femoral veins (58 on each side). The most frequently used catheter lenght was 31 cm (n=55), followed by 42 cm (n=18) and 27 cm (n=13). Shorter (19 and 23 cm, n=9) and longer (50 cm, n=9) catheters were less frequent. Additional catheter characteristics, including tip design and diameter, are presented in Table 1.

Table 1 Baseline characteristics of patients and tunneled femoral dialysis catheters included in the analysis

Variable	N available	Missing	Values/Frequency (%) / Median (IQR)
Sex	65	0	Men 32 (49.23%) Female 33 (50.77%)
Age at insertion	116	0	Median: 64 (IQR 49-72) Min-Max: 24-88
Catheter side	116	0	Right side: N=58(50%) Left side: N=58(50%)
Catheter length "tip-to-cuff" (cm)	104	12	<27 cm: 9 (8.65%) 27 cm: 13 (12,5%) 31 cm: 55 (52.9%) 42 cm: 18 (17.3%) 50 cm: 9 (8.65%)
Diameter (F)	101	15	14.5 F: 28 (27.72%) 15 F: 73 (72.28%)
Tip design	94	22	Step: 88 (93,62%) Symmetrical: 6 (6,38%)

Footnote: Sex is reported at the patient level (N = 65), whereas age and all other catheter characteristics are reported at the catheter level. Due to the retrospective design, the number of available observations varies across variables. Missing data are reported for each variable; analyses of catheter survival included only catheters with available follow-up data.

Catheter survival

The median catheter survival was 459 days. Estimated survival rates at 30, 60, 90, and 180 days were 94.66%, 87.87%, 82.64%, and 75.81%, respectively. Survival at 1, 2, 3, and 4 years was 57.2%, 34.0%, 21.5%, and 10.7%, respectively (Figure 1).

Kaplan-Meier survival analysis stratified by sex showed no statistically significant difference in catheter survival between male and female patients (log-rank test, $p = 0.56$) (Figure 2). In univariable Cox proportional hazards regression, male sex was not significantly associated with catheter failure (HR 0.85, 95% CI 0.46–1.55; $p = 0.60$).

Kaplan-Meier survival analysis stratified by age (<65 vs ≥ 65 years) showed no statistically significant difference in catheter survival between groups (log-rank test, $p = 0.43$). No statistically significant differences in catheter survival were observed according to catheter length (<31 cm, 31 cm, and >31 cm),

tip design (step tip vs symmetrical tip), or diameter (14.5F vs 15F) (log-rank test, all $p > 0.05$). Survival analysis stratified by catheter sequence (first versus subsequent insertions) showed no statistically significant difference in catheter survival between groups (log-rank test, $p = 0.29$), although a separation of the Kaplan-Meier curves was observed (Figure 3).

Reason for catheter removal

The distribution of reasons for catheter removal is presented in Table 2.

Catheter dysfunction was the most frequent cause of catheter removal, accounting for 44 cases (37.93% of catheters). The incidence rate of catheter dysfunction leading to catheter removal was 1.26 events per 1000 catheter-days (95% CI 0.95-1.64).

Catheter-related infections were identified in 12 cases (10.34% of catheters), corresponding to a rate of 0.34 events per 1000 catheter-days (95% CI 0.18-0.56). Of these, 10 led to catheter removal, whereas 2 resulted in patient death. Information on infections managed conservatively with antibiotics were not available. Among the 12 cases, blood cultures were negative in five, while the remaining cases were associated with various pathogens, including *Staphylococcus aureus* (n = 3, including one MRSA case), *Staphylococcus haemolyticus*, *Klebsiella pneumoniae*, *Enterococcus* spp., *Proteus mirabilis*.

All remaining catheter outcomes were treated as censored observations, including elective removal, self-removal, patient death unrelated to catheter, and catheters still functional at the end of the follow-up.

Table 2 Reasons for catheter removal

Reason for removal	N (%)
Events (catheter failure)	
Catheter dysfunction	44 (37.93%)
Catheter-related infection	12 (10.34%)
Censored observations	
Self-removal	13 (11.20%)
Elective removal	8 (6.90%)
Death (unrelated to catheter)	17 (14,66%)
Still functional at the end of follow-up	22 (18.97%)

Discussions

In this retrospective single-center study, tunneled femoral hemodialysis catheters had a median functional survival of 459 days, with an estimated 1-year survival of 57.2%. Catheter failure was

attributed to catheter dysfunction and catheter-related infection. No significant associations between demographic or catheter-related variables and catheter survival were identified.

Given that tunneled femoral catheters are typically reserved for patients with exhausted upper extremity venous access, our findings suggest that femoral catheters may provide durable vascular access. This finding is consistent with several recent studies reporting more favorable outcomes than those described in earlier reports.

Reported outcomes of tunneled femoral hemodialysis catheters vary across studies (Table 3). Earlier studies, particularly that of Maya et al., suggested relatively poor catheter survival and high complication rates [7], contributing to the perception of femoral access as a last-resort option. However, subsequent studies reported more favorable outcomes. Burton et al. reported longer catheter patency than earlier studies [8], whereas Guillermo-Corpus et al. reported one of the longest catheter survival times published to date in a large prospective cohort [9], although survival was reported as mean rather than median duration, limiting direct comparison with our results. Similarly, Shindo et al. reported a 1-year primary patency rate of 66.7% for tunneled femoral catheters, comparable to the 57.2% observed in our cohort [13].

More recent studies by Sethi et al., Wu et al., and Pokala et al., have continued to report variable catheter survival and complication rates across different cohorts [10-12]. Consistent with our results, Pokala et al. found no significant association between catheter laterality, catheter tip position, or catheter length and premature catheter failure [12].

Table 3 Outcomes of tunneled femoral hemodialysis catheters reported in literature

Study	Year	Design	N (catheters)	Reported catheter survival (days)	1-year survival (%)	Infection rate (per 1000 catheter-days)
Maya et al ⁷	2005	Retrospective	27	59 (median)	NA	NA
Burton et al ⁸	2012	Retrospective	123	96.3 (mean)	NA	1.39
Guillermo-Corpus et al ⁹	2018	Prospective	144	694 (KM mean)	71	0.25
Pokala et al ¹²	2025	Retrospective	76	82.4 (mean)	0	0.40
Our study	2026	Retrospective	116	459 (median)	57.2	0.34

Footnote: Catheter survival is reported as provided in the original studies (median or mean duration); therefore, direct comparisons between studies should be interpreted with caution

No significant demographic or catheter-related predictors of catheter failure were identified in our analysis. Similarly, Restrepo-Valencia et al. found no significant differences in catheter patency, complications, or causes of catheter removal between tunneled femoral catheters of different lengths [14]. Likewise, Pokala et al. found no significant association between catheter laterality, catheter tip position or catheter length and premature catheter failure [12]. Moreover, Guillermo-Corpus et al. reported no effect of age, sex, diabetes, or previous catheter insertions on catheter survival [9]. In contrast, Burton et al. identified older age, diabetes, and left-sided catheter placement as independent predictors of catheter failure [8]. The absence of significant predictors in our study should be interpreted with caution, given the retrospective design and the limited availability of clinical variables. Potentially relevant factors, like comorbidities, vascular status, and dialysis-related characteristics, were not systematically recorded, and therefore were not included in the analysis.

A separation of Kaplan-Meier survival curves was observed between first and subsequent femoral catheter insertions, although this difference did not reach statistical significance. This observation should be interpreted cautiously given the limited sample size.

Catheter dysfunction and catheter-related infection were the causes of catheter failure in our cohort. Previous studies have likewise identified catheter dysfunction and catheter-related infection as the most frequent causes of tunneled femoral CVC failure [7-12]. The catheter-related infection rate observed in our study (0.34 episodes per 1,000 catheter-days) was within the range reported by Guillermo-Corpus et al. (0.25 episodes per 1,000 catheter-days) and Pokala et al. (0.40 episodes per 1,000 catheter-days) [9, 12]. However, only infections leading to catheter removal or death were captured in our database. Therefore, this estimate likely underrepresents the true incidence of catheter-related infections, as data on infections managed with antibiotics without catheter removal were not available. Furthermore, the relatively high proportion of culture-negative infections may have been related to prior antibiotic exposure, as several patients were referred from dialysis centers after antimicrobial therapy had already been initiated.

This study has several limitations. Its retrospective design limited the availability of several clinically relevant variables, including comorbidities and detailed vascular access history. Data on catheter-related thrombosis were limited because thrombotic events were not systematically recorded and all patients received anticoagulant therapy as part of routine clinical practice. In addition, infections not leading to catheter removal or death were not captured in this analysis.

Despite these limitations, this study provides real-world data on tunneled femoral hemodialysis catheters in a relatively large cohort. Given the limited data available in the literature on this type of vascular access, our findings contribute to a better understanding of their performance and clinical outcomes.

Conclusion

Tunneled femoral hemodialysis catheters remain an important option for patients with limited vascular access. In this study, catheter survival and complication rates were within the range reported in previous studies, although published outcomes remain heterogeneous. While earlier studies suggested relatively poor outcomes, more recent data, including our findings, suggest that tunneled femoral hemodialysis catheters can provide durable vascular access when upper extremity vascular access is no longer feasible. Further prospective studies are needed to better define factors associated with catheter outcomes in this patient population.

Declarations

The authors have no competing interests to declare that are relevant to the content of this article.

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Ethics approval: This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of County Clinical Hospital Cluj-Napoca (Date: 23.06.2026/No. 21621); retrospectively registered.

Author Contribution

Conceptualisation: D.T., I.R. and I.K. Statistics, tables and figures: D.T., I.R., A.F. Data collection: I.R., A.F., Y.M. and R.O. Methodology: D.T., I.R., I.K. and M.Ț. Writing and editing: D.T., I.R., C.R., D.M., A.P., M.Ț., Y.M. and I.K. All authors reviewed the manuscript.

Data Availability

All data supporting the findings of this study are available within the paper and its Supplementary Information.

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Figures

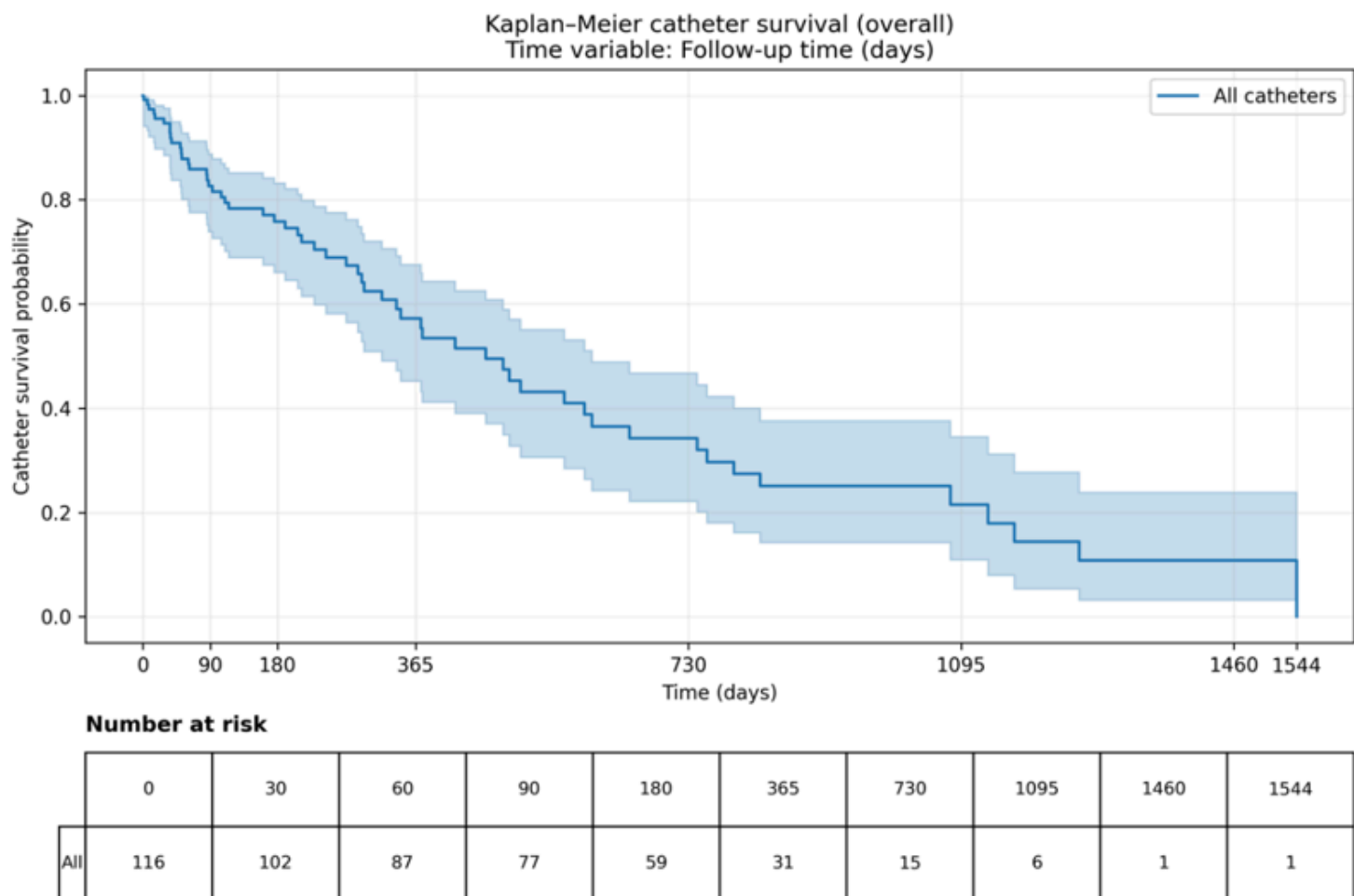


Figure 1

Kaplan-Meier curve of tunneled femoral catheter survival

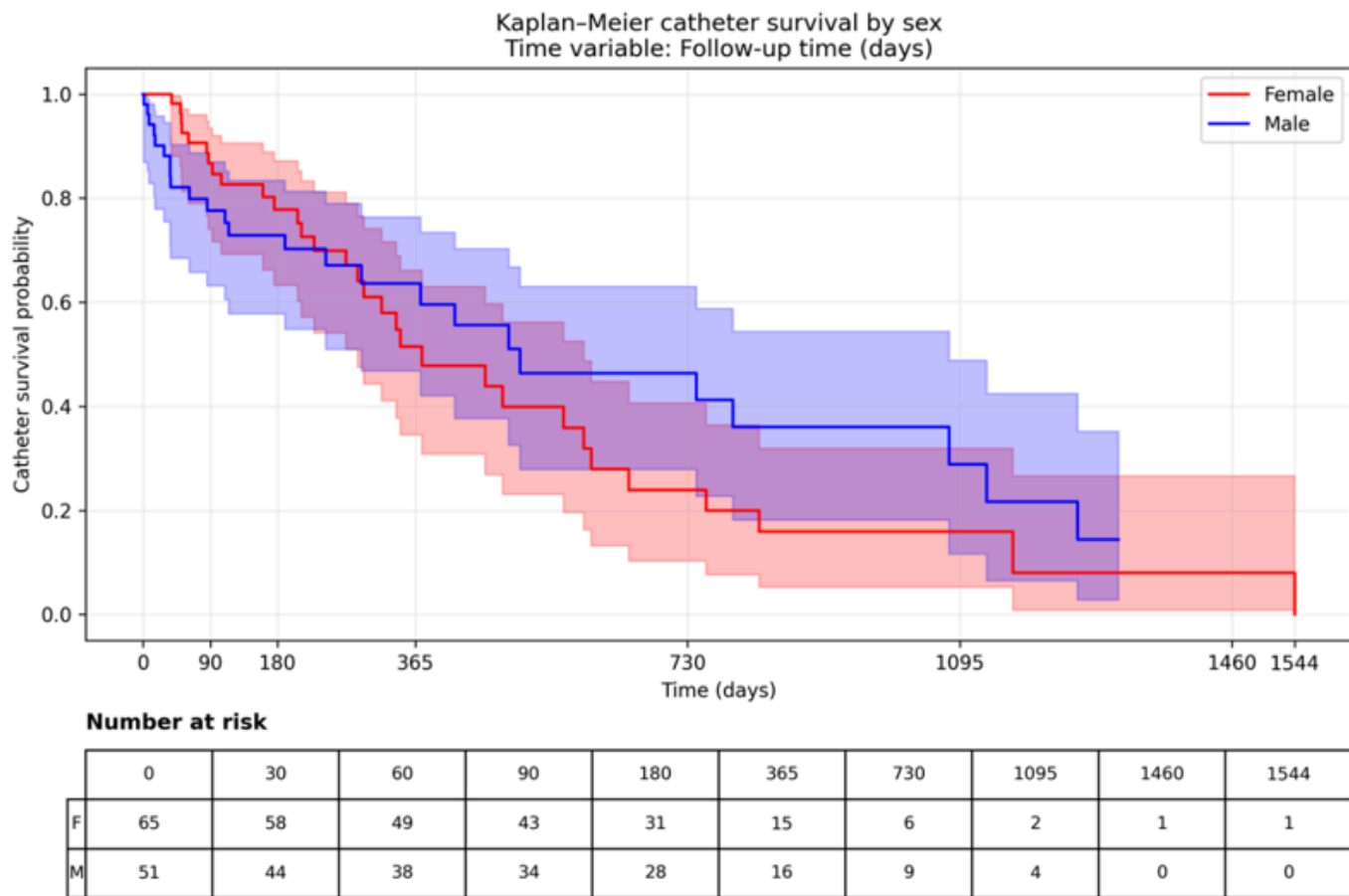
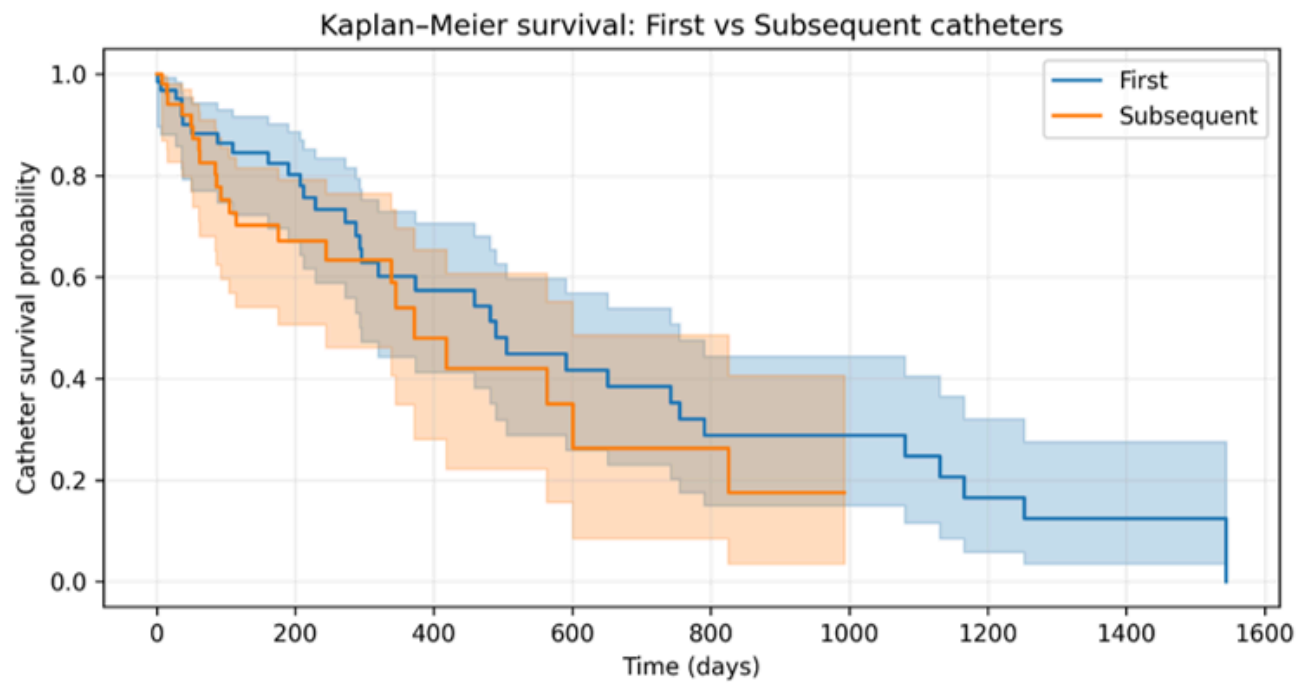


Figure 2

Kaplan-Meier curve of tunneled femoral catheter survival stratified by sex



	0	30	90	180	365	730	1095	1460	1544
First	65	56	46	38	21	12	6	1	1
Subsequent	51	46	31	21	10	3	0	0	0

Figure 3

Kaplan-Meier curve of tunneled femoral catheter survival stratified by sequence (first vs subsequent)