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Indications and Complications of Tunnelled Haemodialysis Catheters: A Single-Centre Retrospective Study of 114 Patients

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Lahcen Kaddouri [1], Yassine Bachar [1], Zakaria Elmejjati [2], Youssef Belchiti [1], Youssef Benhmammouche [1], Kenza Benzmane [1], Abdelkarim Kharroubi [1]

1. Vascular Surgery, Mohammed VI University Hospital, Faculty of Medicine and Pharmacy, Ibn Zohr University, Agadir, MAR 2. Emergency Department, Mohamed V Military Hospital, Rabat, MAR

Corresponding author: Lahcen Kaddouri, kaddourilahc@gmail.com

Abstract

Background: Tunnelled haemodialysis catheters provide vascular access when an arteriovenous fistula (AVF) is unavailable, immature, or temporarily unusable. We evaluated indications, insertion sites, complications, and access transition in a Moroccan tertiary vascular surgery centre.

Methods: This retrospective single-centre study included unique patients undergoing tunnelled haemodialysis catheter placement between January 2020 and August 2024. After data cleaning, one confirmed duplicate record was consolidated, yielding 114 unique patients. The patient was the unit of analysis. Categorical outcomes were reported as counts and percentages, with Wilson 95% confidence intervals (CIs) for complication proportions. Exploratory associations with delayed complications were assessed using two-sided Fisher exact and Mann-Whitney U tests; Holm correction was applied across six prespecified comparisons.

Results: The mean age was 50.7 ± 15.8 years and 68 patients (59.6%) were men. Diabetes was present in 49 (43.0%), hypertension in 42 (36.8%), and cardiovascular disease in 17 (14.9%). Awaiting AVF creation was the leading indication (61/114, 53.5%). The right internal jugular vein was used in 110 patients (96.5%). Immediate bleeding occurred in 6 patients (5.3%; 95% CI 2.4-11.0%). Delayed complications occurred in 20 (17.5%; 95% CI 11.7-25.6%): thrombosis in 11 (9.6%), infection in 6 (5.3%), and post-dialysis bleeding in 3 (2.6%). Patients with delayed complications were older than those without delayed complications (median 57.5 vs 48.0 years; p=0.007; Holm-adjusted p=0.043). AVF maturation was the recorded reason for ending catheter use in 93 patients (81.6%).

Conclusion: Tunnelled catheters were used predominantly as bridging access while patients awaited AVF creation or maturation. Thrombosis was the most frequent delayed complication. Older age was associated with delayed complications in this exploratory analysis, but the small number of events and retrospective design require cautious interpretation. Standardised event definitions and dated catheter follow-up would strengthen future surveillance.

Categories: Other, General Surgery, Nephrology
Keywords: catheter-related infection, haemodialysis, thrombosis, tunnelled dialysis catheter, vascular access

Introduction

Reliable vascular access is essential for maintenance haemodialysis. Contemporary National Kidney Foundation's Kidney Disease Outcomes Quality Initiative (KDOQI) guidance emphasises individualised end-stage kidney disease guidelines (ESKD Life Plan) rather than a single access strategy for every patient, with access selection adapted to clinical circumstances, vascular anatomy, prognosis and future kidney replacement therapy needs [1].

Tunnelled haemodialysis catheters remain necessary when an arteriovenous fistula (AVF) has not yet been created, has not matured, is temporarily unusable, or when other permanent access options are limited. Their immediate usability is offset by risks of infection, dysfunction, thrombosis, and central venous complications. In a Canadian cohort of 1,041 patients using tunnelled catheters, catheter-related complications remained clinically important during follow-up [2].

Published outcomes vary because populations, follow-up periods, denominators and complication definitions differ. Local patient-level data can describe access pathways and identify priorities for surveillance. The primary objective was to describe demographic and clinical characteristics, the recorded vascular access sequence, tunnelled catheter indications, insertion sites, duration of use, complications and reasons for discontinuation. The secondary objective was to explore associations between selected patient characteristics and delayed complications. This secondary analysis was hypothesis-generating.

Materials And Methods

Study design and setting

We conducted a retrospective, single-centre, descriptive and exploratory analytical study in the Department of Vascular Surgery of CHU Mohamed VI, Agadir, Morocco. The study period extended from January 2020 to August 2024.

Participants and patient flow

Patients who underwent tunnelled haemodialysis catheter placement during the study period were eligible. Medical records were excluded when they were unusable for extraction of the study outcomes or when the subsequent clinical course could not be established. Data were extracted from existing medical records into Microsoft Excel (Microsoft Corp., Redmond, WA). The final analytical sample comprised 114 patients.

Variables and unit of analysis

Collected variables included age, sex, diabetes mellitus, diabetes-related complications, hypertension, cardiovascular disease, smoking status, baseline haemoglobin, haemodialysis duration, number and sequence of vascular accesses, indication for tunnelled catheter placement, insertion site, immediate and delayed complications, duration of catheter use, reason for ending catheter use and mortality. In all patients, venous puncture was performed under real-time ultrasound guidance, and intraoperative fluoroscopy was used to verify catheter position. All patients received HemoSplit™ 14.5 F tunnelled haemodialysis catheters (Becton, Dickinson and Company, Franklin Lakes, NJ), and heparin was used systematically.

The patient was the unit of analysis. The total number of vascular accesses included AVFs, non-tunnelled catheters, and tunnelled catheters and was not interpreted as a count of tunnelled catheter procedures. The dataset did not support a separate procedure-level analysis of repeated tunnelled catheter placements. Available denominators are specified for variables with missing values.

Operational definitions of complications

Complications were abstracted as clinical diagnoses or categories recorded in the charts, rather than adjudicated using standardised research definitions. The infection category included records describing fever, tunnelitis, inflammation at the catheter exit site, bacteraemia or septicaemia attributed clinically to catheter infection. Fever and local inflammation were recorded as clinical findings, and catheter-related infections were confirmed by positive blood cultures. Associated clinical manifestations included fever, tunnel inflammation, or inflammation at the catheter exit site.

The thrombosis category included partial intraluminal thrombosis, complete catheter obstruction attributed to thrombosis, and superior vena cava thrombosis recorded in the clinical files.

Immediate complications were defined as events occurring during catheter insertion or on the day of the procedure (day 0, J0). Delayed complications were defined as events occurring from postoperative day 1 (J1) onwards. This classification was based on calendar days relative to insertion, rather than an elapsed 24-hour threshold. Immediate events consisted of bleeding associated with placement; delayed categories consisted of thrombosis, infection, and post-dialysis bleeding.

Catheter duration and outcome denominators

Catheter duration was calculated from the exact dates of insertion and removal, expressed in months, and was available for all 114 patients. In patients awaiting AVF maturation, the catheter was removed once the fistula was mature and usable for haemodialysis.

Complications were reported as the number and percentage of patients experiencing each complication among the 114 patients included in the study. Catheter duration was calculated using the exact insertion and removal dates. Complication frequencies were expressed as patient-level proportions.

Statistical analysis

Continuous variables were summarised as mean ± standard deviation (SD) and/or median with interquartile range (IQR) and range. Categorical variables were reported as counts and percentages. Wilson score 95% CIs were calculated for complication proportions. Two-sided Fisher exact tests were used for categorical exploratory comparisons, and Mann-Whitney U tests for continuous variables. Six comparisons formed one family for Holm correction: age, catheter duration, sex, diabetes, hypertension, and smoking in relation to any delayed complication. A two-sided p-value <0.05 was used as the nominal threshold; adjusted p-values were also reported. All comparisons were unadjusted for confounding and exploratory.

Ethics and data protection

Written informed consent for the use of clinical data in this study was obtained from the patients. This retrospective study used existing medical records and involved no prospective intervention. According to the institutional practice reported by the authors, signed institutional authorisation is not required for this type of retrospective record-based study. Patient data were anonymised, handled confidentially, and reported without identifying information.

Results

Patient characteristics

A total of 114 patients were analysed. There were 68 men (59.6%) and 46 women (40.4%). The mean age was 50.7 ± 15.8 years; the median age was 52 years (IQR 42-62.5; range 11-84). Diabetes mellitus was present in 49 patients (43.0%), hypertension in 42 (36.8%), cardiovascular disease in 17 (14.9%), and smoking in 35 (30.7%). Diabetes-related complications were recorded in 16 patients (14.0%). Haemodialysis duration was evaluable in 113 patients, with a median of 32 months (IQR 14-45; range 1-168). Patient characteristics and access data are summarised in Table *1*.

Characteristic	Value
Unique patients (n)	114
Gender, n (%)	
Male	68 (59.6)
Female	46 (40.4)
Age, mean ± SD, years	50.7 ± 15.8
Age, median (IQR), years	52 (42-62.5)
Diabetes, n (%)	49 (43.0)
Hypertension, n (%)	42 (36.8)
Cardiovascular disease, n (%)	17 (14.9)
Smoking, n (%)	35 (30.7)
Diabetes-related complications, n (%)	16 (14.0)
Haemodialysis duration, median (IQR), months*	32 (14-45)
All recorded vascular accesses, total	277
Mean number of accesses per patient	2.43
Tunnelled catheter as first recorded access, n (%)	75 (65.8)
Left radiocephalic AVF as second access, n/N (%)	49/113 (43.4)
Awaiting AVF creation, n (%)	61 (53.5)
Complicated AVF, n (%)	24 (21.1)
Awaiting AVF maturation, n (%)	19 (16.7)
Replacement of non-tunnelled catheter, n (%)	10 (8.8)
Right internal jugular insertion, n (%)	110 (96.5)
Left internal jugular insertion, n (%)	3 (2.6)
Right subclavian insertion, n (%)	1 (0.9)
Catheter duration, mean ± SD, months	5.68 ± 3.66
Catheter duration, median (IQR), months	5 (3-8)

TABLE 1: Patient characteristics and recorded vascular access data

*Haemodialysis durations were evaluable in 113 patients. SD, standard deviation; IQR, interquartile range; AVF, arteriovenous fistula.

Vascular access and catheter characteristics

A total of 277 vascular access processes were recorded among the 114 unique patients, corresponding to a mean of 2.43 accesses per patient. The tunnelled catheter was the first recorded vascular access in 75 patients (65.8%). A second access was documented in 113 patients; the most frequent second access was a left radiocephalic AVF in 49/113 patients (43.4%).

The indication for tunnelled catheter placement was awaiting AVF creation in 61 patients (53.5%), a complicated AVF in 24 (21.1%), awaiting AVF maturation in 19 (16.7%), and replacement of a non-tunnelled catheter in 10 (8.8%). Thus, awaiting AVF creation or maturation accounted for 80/114 indications (70.2%).

After harmonising one spelling variant, the right internal jugular vein was the insertion site in 110 patients (96.5%), the left internal jugular vein in 3 (2.6%) and the right subclavian vein in 1 (0.9%). Catheter duration was evaluable in 114 patients. The mean recorded duration was 5.68 ± 3.66 months, with a median of 5 months (IQR 3-8; range 0.5-24).

Complications

Immediate bleeding occurred in 6/114 patients (5.3%; 95% CI 2.4-11.0%). No other immediate complication category was recorded. Delayed complications occurred in 20/114 patients (17.5%; 95% CI 11.7-25.6%): chart-recorded thrombosis in 11 (9.6%; 95% CI 5.5-16.5%), chart-recorded infection in 6 (5.3%; 95% CI 2.4-11.0%) and post-dialysis bleeding in 3 (2.6%; 95% CI 0.9-7.5%). Immediate and delayed complications did not overlap in the verified dataset; therefore, 26 patients (22.8%) had at least one recorded complication. Complication proportions are presented in Table 2.

Outcome	n/N	%	95% CI (%)
Any recorded complication	26/114	22.8	16.0-31.3
Immediate bleeding	6/114	5.3	2.4-11.0
Any delayed complication	20/114	17.5	11.7-25.6
Delayed chart-recorded thrombosis	11/114	9.6	5.5-16.5
Delayed chart-recorded infection	6/114	5.3	2.4-11.0
Post-dialysis bleeding	3/114	2.6	0.9-7.5

TABLE 2: Patient-level proportions of chart-recorded complications

Wilson 95% confidence intervals. Immediate complications occurred during insertion or on the procedure day (J0); delayed complications occurred from postoperative day 1 (J1) onwards. Thrombosis and infection were not uniformly confirmed by imaging or microbiology. These proportions are not rates per 1,000 catheter-days.

Exploratory associations

Patients with delayed complications were older than patients without delayed complications: median age 57.5 versus 48.0 years (Mann-Whitney U, p=0.007). This association remained below the 0.05 threshold after Holm correction across the six exploratory comparisons (adjusted p=0.043). Catheter duration was also longer in patients with delayed complications (median 9 vs 5 months; p=0.017), but this did not remain significant after Holm correction (adjusted p=0.086).

Delayed complications occurred in 10/49 patients with diabetes (20.4%) and 10/65 without diabetes (15.4%; Fisher p=0.620); in 8/42 patients with hypertension (19.0%) and 12/72 without hypertension (16.7%; p=0.801); in 13/68 men (19.1%) and 7/46 women (15.2%; p=0.627); and in 9/35 smokers (25.7%) versus 11/79 non-smokers (13.9%; p=0.181). None of these categorical comparisons was statistically significant. These unadjusted comparisons are shown in Table 3 and do not identify independent predictors.

Comparison	Value or event proportion in group 1	Value or event proportion in group 2	p-value	Holm-adjusted p
Age, median years	57.5 (delayed, n=20)	48.0 (no delayed, n=94)	0.007	0.043
Catheter duration, median months	9 (delayed, n=20)	5 (no delayed, n=94)	0.017	0.086
Sex	Men, 13/68 (19.1%)	Women, 7/46 (15.2%)	0.627	1.000
Diabetes	Present, 10/49 (20.4%)	Absent, 10/65 (15.4%)	0.620	1.000
Hypertension	Present, 8/42 (19.0%)	Absent, 12/72 (16.7%)	0.801	1.000
Smoking	Yes, 9/35 (25.7%)	No, 11/79 (13.9%)	0.181	0.724

TABLE 3: Exploratory unadjusted comparisons in relation to delayed complications

*Continuous rows compare medians in patients with and without delayed complications (Mann-Whitney U tests). Categorical rows show the patient-level event proportion in each exposure group (Fisher exact tests). Holm correction covers all six comparisons.

Reasons for ending catheter use and mortality

The reason for ending tunnelled catheter use was recorded for all 114 unique patients. AVF maturation was the most frequent reason (93/114, 81.6%), followed by a catheter-related complication (17/114, 14.9%) and death (4/114, 3.5%). The separate mortality variable recorded 7 deaths (6.1%). These variables describe different concepts: death was the reason for catheter discontinuation in four patients, whereas overall mortality included deaths occurring irrespective of the previously recorded reason for ending catheter use. Results are shown in Table *4*.

Outcome	n/N	%
AVF maturation as reason for ending catheter use	93/114	81.6
Catheter-related complication as reason for ending catheter use	17/114	14.9
Death as reason for ending catheter use	4/114	3.5
Overall mortality from separate mortality field	7/114	6.1

TABLE 4: Recorded reasons for discontinuation and separate overall mortality

Overall mortality is a separate outcome and is not an additional category of the reasons for discontinuation. The discontinuation reason does not verify the date of physical removal.

Discussion

This series describes tunnelled haemodialysis catheter use in 114 unique patients at a Moroccan tertiary vascular surgery centre. Awaiting AVF creation or maturation accounted for 70.2% of indications; the right internal jugular vein was used in 96.5% of cases, and thrombosis was the most frequently recorded delayed complication.

The cohort was relatively young, with a mean age of 50.7 years, and diabetes and hypertension were frequent. Regional and single-centre reports provide useful context for catheter utilisation [3,4], but comparisons require attention to whether the denominator is patients or procedures and to differences in referral and case selection. Catheters have been used in several access scenarios, including unavailable or temporarily unusable arteriovenous access [5]. Their role in this cohort should therefore be interpreted within the local sequence of access care.

A tunnelled catheter was the first recorded vascular access in 75 patients (65.8%). This may indicate that many patients reached the catheter-placement pathway before a usable arteriovenous access was available. Possible explanations include late nephrology referral, emergency dialysis initiation, delayed access planning, waiting times for surgery, resource constraints or patient-specific clinical circumstances. None of these mechanisms was measured, and first recorded access cannot be assumed to mean first-ever access or emergency dialysis initiation. Earlier accesses may also have been incompletely documented, and a vascular surgery catheter cohort is selected rather than representative of all regional dialysis patients. Nonetheless, this finding identifies an access pathway that warrants evaluation using referral dates, dialysis-start circumstances and intervals to access creation and first successful cannulation.

The 70.2% of indications involving AVF creation or maturation should be considered within the KDOQI ESKD Life-Plan framework [1]. In that framework, access decisions form part of an individual plan that considers present and future kidney replacement therapy needs and goals of care. A catheter may provide necessary temporary access, while the appropriateness and timing of an AVF depend on the individual clinical situation. Our data record indications and subsequent transitions but do not document patient preferences, vascular suitability, transplantation or peritoneal dialysis plans, prognosis, or the reasons for the selected strategy. They therefore cannot establish whether every catheter episode or planned AVF was optimal within an individual Life-Plan.

The catheter duration reported in this series reflects the interval between insertion and removal, calculated from the exact dates available for all 114 patients. For patients awaiting AVF creation or maturation, this interval represents the period during which a catheter was needed before a usable fistula became available. The catheter was removed once the AVF was mature and usable for haemodialysis. AVF maturation accounted for 93 of the 114 recorded reasons for catheter removal (81.6%), highlighting the role of tunnelled catheters as bridging access in this cohort. The insertion-to-removal interval should nevertheless be distinguished from AVF maturation time, because it may also include the interval before fistula creation. These findings support examining the access pathway to identify opportunities to reduce catheter dependence while ensuring that the replacement access is suitable for dialysis.

The strong preference for the right internal jugular route is consistent with its frequent use in published catheter series [6]. Laterality and tip position have been evaluated in relation to catheter dysfunction and infection [7].

Catheter-related infections occurred in six patients (5.3%) and were confirmed by positive blood cultures. This finding underscores the importance of infection prevention and surveillance throughout catheter use. Published reports describe exit-site, tunnel and bloodstream infections as important complications of tunnelled haemodialysis catheters [8]. Thrombosis was the most frequent delayed complication in our cohort, occurring in 11 patients (9.6%). The recorded thrombotic complications included partial intraluminal thrombosis, complete catheter obstruction attributed to thrombosis and superior vena cava thrombosis. These events emphasise the need to monitor catheter function and maintain reliable dialysis access; noninfectious catheter complications are also discussed extensively in the literature [9].

The reported infection and thrombosis frequencies are patient-level proportions: they describe the percentage of patients experiencing each complication during catheter use. Exact insertion and removal dates were available for all 114 patients. Comparisons with other cohorts should therefore consider differences in outcome definitions, duration of exposure and whether the denominator represents patients, catheters or catheter-days. Published observational studies and reviews provide useful context [2,10,11], but a direct comparison of crude percentages should not be interpreted as evidence of superior or inferior catheter performance. The infection proportion observed here should be interpreted within the follow-up and reporting approach of this study.

Patients with delayed complications were older (median 57.5 versus 48 years), and the age comparison remained below the 0.05 threshold after Holm correction (adjusted p=0.043). With only 20 events and no multivariable adjustment, this remains a hypothesis-generating association. Age may be associated with comorbidity, duration of exposure or other unmeasured aspects of access care. Multiplicity correction does not control these confounders, and the result is not evidence that age independently predicts catheter complications. Studies of long-term catheter outcomes use different endpoints and analytical approaches [12], which should be considered when comparing their findings with the exploratory associations observed in our cohort.

Patients with delayed complications had a longer catheter duration in the reported exploratory analysis. This observation may reflect a longer period at risk, but the relationship can also operate in the opposite direction: a complication may alter the access pathway and prolong catheter dependence. Although exact insertion and removal dates were available, the comparison of total duration does not by itself establish when a complication occurred within that interval or demonstrate a causal relationship. The finding should therefore be interpreted as exploratory rather than as evidence that catheter duration independently predicts complications. Analyses incorporating the timing of individual events could further clarify this relationship, as illustrated by catheter survival studies [13].

The broader literature reports differences in outcomes between vascular access types, although observational comparisons remain susceptible to patient selection and confounding [14,15]. In this cohort, the predominance of AVF maturation as a reason for catheter removal supports the bridging role of tunnelled catheters. All patients received 14.5 F HemoSplit™ catheters, providing consistency in the device used, but the absence of a comparator prevents conclusions about the relative performance of this catheter model. The practical implications are to coordinate individualised access planning, monitor catheter function and infection, and remove the catheter once the AVF is mature and usable. Future analyses could use the available insertion and removal dates together with episode-level complication data to report exposure-adjusted outcomes.

Study limitations

The retrospective, single-centre design and selected catheter population limit generalisability. Unusable records and records with an unclear clinical course were excluded, but the initial screening count and exclusion totals were unavailable, preventing a complete patient flow and assessment of the extent of selection bias.

Conclusions

Tunnelled haemodialysis catheters were most commonly used while patients awaited AVF creation or maturation in this centre, and the right internal jugular vein was the predominant insertion site. Thrombosis was the most frequently recorded delayed complication. The exploratory association with older age does not establish age as an independent predictor. Non-standardised diagnoses, unavailable event dates and patient-level denominators restrict comparisons of complication burden. These findings support further evaluation of the local access pathway and prospective surveillance with standardised definitions and dated catheter follow-up.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Lahcen Kaddouri, Youssef Belchiti, Youssef Benhmammouche, Abdelkarim Kharroubi, Zakaria Elmejjati, Kenza Benzmane

Acquisition, analysis, or interpretation of data: Lahcen Kaddouri, Yassine Bachar, Youssef Belchiti, Youssef Benhmammouche, Abdelkarim Kharroubi, Zakaria Elmejjati, Kenza Benzmane

Drafting of the manuscript: Lahcen Kaddouri, Yassine Bachar, Youssef Belchiti, Youssef Benhmammouche, Abdelkarim Kharroubi, Zakaria Elmejjati, Kenza Benzmane

Critical review of the manuscript for important intellectual content: Lahcen Kaddouri, Yassine Bachar, Youssef Belchiti, Abdelkarim Kharroubi, Zakaria Elmejjati, Kenza Benzmane

Supervision: Lahcen Kaddouri, Abdelkarim Kharroubi

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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