Vascular accesses in chronic hemodialysis: Clinical implications and comparative survival between autologous fistulas and tunneled catheters

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Original Article

Vascular Surgery

OPEN ACCESS

Background: Vascular access is essential in replacement therapy through chronic hemodialysis, as it directly influences patient survival and the occurrence of complications. This retrospective study compared 12-month survival between autologous arteriovenous fistulas and tunneled venous catheters in patients with chronic kidney disease treated in a tertiary care hospital unit. The autologous fistula was the most commonly used access type and showed a significantly higher mean survival compared to catheters ($p < 0.05$). Late complications, such as dysfunction and bacteremia, were mainly associated with catheter use, while the presence of cardiometabolic comorbidities was linked to a shorter functional duration of the access. The findings support the recommendation to prioritize autologous arteriovenous fistulas when clinical and anatomical conditions allow, highlighting the importance of proper preoperative planning to improve outcomes in chronic hemodialysis patients.

Keywords: hemodialysis, vascular access, arteriovenous fistula, tunneled catheter, survival, comorbidities.

Chronic kidney disease (CKD) is a high-priority global public health issue, marked by its increasing prevalence, significant morbidity burden, and high associated costs, particularly in countries with a high incidence of metabolic and cardiovascular disorders such as Mexico (1). In this country, CKD ranks among the top ten causes of general mortality, often linked to late diagnoses and limited access to timely replacement therapies (2, 3). It is estimated that around 60% of patients who initiate renal replacement therapy remain on hemodialysis indefinitely due to limited transplant availability and structural barriers within the healthcare system (4).

The clinical success of hemodialysis largely depends on the presence of a functional, durable, and safe vascular access. International guidelines, such as those from the Kidney Disease Outcomes Quality Initiative (KDOQI) and the European Society for Vascular Surgery (ESVS), recommend autologous arteriovenous fistulas as the first choice, due to their superior patency, lower infection risk, and better long-term performance compared to tunneled venous catheters or prosthetic fistulas (5,6).

Despite these recommendations, daily clinical practice faces limitations that hinder the systematic implementation of autologous accesses. Factors such as unfavorable vascular anatomy, significant comorbidities, and insufficient preoperative planning often lead to the use of tunneled venous catheters, especially in urgent settings or as a temporary solution (7,8). However, catheters are associated with a higher incidence of mechanical and infectious complications, reduced durability, and increased hospitalization rates due to access dysfunction (9, 10).

Consequently, a systematic evaluation of the clinical performance of different vascular accesses is essential to guide therapeutic decisions that can positively impact the quality of life and survival of CKD patients. In this context, the present study aimed to compare 12-month survival and analyze the main complications associated with the use of autologous arteriovenous fistulas versus tunneled venous catheters in patients with CKD treated at Hospital Ángeles Metropolitano. Additionally, clinical and surgical variables potentially influencing outcomes were examined, with the purpose of generating evidence applicable to contemporary nephrology practice.

Methods

A retrospective, observational, and comparative study was conducted to evaluate 12-

From the Surgery Department at Hospital Angeles Metropolitano, Facultad Mexicana de Medicina. Mexico City, Mexico. Received on August 21, 2025. Accepted on August 26, 2025. Published on August 27, 2025.

DOI 10.5281/zenodo.16957350

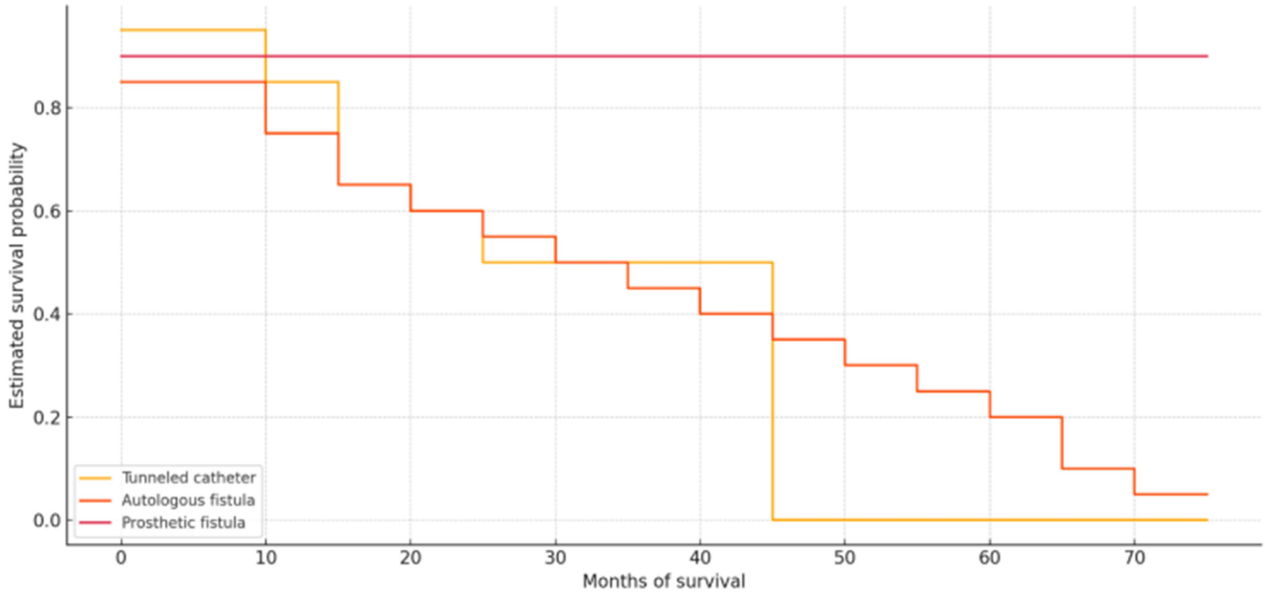

Figure 1. Kaplan-Meier curves comparing the estimated survival of vascular accesses in chronic hemodialysis according to access type. The autologous fistula shows a longer and more sustained survival trajectory. The tunneled catheter exhibits a faster decline, indicating shorter functional duration in most cases. The prosthetic fistula, represented by a single case, maintains a stable curve due to the absence of events during the observation period.

month survival and clinical complications associated with two types of vascular access used in patients with chronic kidney disease (CKD) undergoing maintenance hemodialysis: autologous arteriovenous fistulas and tunneled venous catheters.

The study population consisted of patients with confirmed stage V CKD treated at the hemodialysis unit of Hospital Ángeles Metropolitano in Mexico City, between June 2020 and May 2022. A convenience sampling method was used, resulting in a final sample of 29 patients who met the following inclusion criteria: age 18 years or older, chronic requirement for hemodialysis, and vascular access created or placed within the institution. Patients whose access was created in other centers, those receiving acute hemodialysis, or with incomplete medical records were excluded.

The primary outcome variable was vascular access survival, defined as the time interval between placement and documented functional loss or end of follow-up. Independent variables included type of access (autologous fistula or tunneled catheter), sociodemographic characteristics (age, sex, education, marital and employment status), clinical variables (comorbidities, duration of CKD, use of anticoagulants or antiplatelet agents), surgical variables (history of prior access, type of preoperative planning, anatomical location), and complications (immediate and late, including reasons for access withdrawal).

Statistical analysis included both descriptive and inferential procedures. Measures of central tendency and dispersion were calculated for quantitative variables, and absolute and relative frequencies for qualitative variables. Associations between categorical variables were assessed using the Chi-square test or Fisher's exact test, while comparisons of quantitative variables were performed using Student's t-test or the Mann-Whitney U test, depending on data distribution. Access survival was estimated using the Kaplan-Meier method, and group differences were analyzed with the Log-Rank test. A significance level of $p < 0.05$ was considered.

Results

Clinical and sociodemographic data from 29 patients with end-stage chronic kidney disease (CKD) who required vascular access for chronic hemodialysis were analyzed. The average age was 63.76 years (SD ±13.14), with a predominance of male patients (65.52%). Regarding educational level, 48.28% had completed university studies, and 58.62% were married. The majority of patients (68.97%) reported being employed at the time of care.

The mean duration since CKD diagnosis was 6.62 years (SD ±3.44). Cardiometabolic comorbidities—such as type 2 diabetes mellitus, systemic arterial hypertension, and dyslipidemia—were present in 75.86% of cases. In terms of vascular access history, 34.48% had a history of multiple temporary accesses, while an equal percentage had no prior surgeries. Regarding preoperative planning, 42.86% underwent two or more imaging studies, and the same proportion received only Doppler ultrasound. The most frequently used type of vascular access was the autologous arteriovenous fistula (75.86%), followed by tunneled venous catheters (20.69%) and, in one case, a prosthetic fistula (3.45%). Catheters were mainly placed in the internal jugular vein (13.79%) and the subclavian vein (10.34%). The

DOI 10.5281/zenodo.16957350

predominant surgical technique for fistulas was the brachiobasilic approach (72.41%).

Immediate complications (recorded within the first 30 days) occurred in 27.59% of patients, with bleeding and hematoma being the most common events (20.69%). Late complications (occurring after 30 days) were more frequent (55.17%), primarily access dysfunction (24.14%) and bacteremia (13.79%), mostly associated with the use of tunneled catheters.

The average vascular access survival was 33.86 months (SD ±19.08). Kaplan-Meier curves and the Log-Rank test showed that autologous fistulas had significantly longer survival compared to tunneled catheters ($p < 0.05$) (Figure 1). Additionally, patients with cardiometabolic comorbidities exhibited a notable reduction in access duration (mean of 29.18 months), in contrast with those having less compromised clinical conditions.

Finally, inferential analysis revealed statistically significant associations between the type of access and the occurrence of immediate complications ($p = 0.00038$), with a higher incidence in catheters. A strong association was also found between the type of late complication and the treatment applied ($p = 0.0011$), reflecting a consistent correlation between access etiology and the therapeutic approach adopted.

Discussion

The results of this study confirm the clinical superiority of autologous arteriovenous fistulas over tunneled venous catheters in patients undergoing chronic hemodialysis, in alignment with international guidelines and prior evidence highlighting their greater durability, lower complication rates, and better functional survival (3, 5, 11).

Late complications, such as bacteremia and access dysfunction, were significantly more frequent in patients with tunneled catheters, reaffirming their known susceptibility to infections and structural instability (9, 10). This finding reinforces the need to restrict their use to exceptional situations, such as emergency access or unfavorable vascular anatomy, and to implement strict clinical monitoring when their use is unavoidable.

One of the clinically relevant elements identified in this study was the influence of preoperative planning on the occurrence of early complications. Patients evaluated with two or more imaging studies exhibited a lower incidence of immediate adverse events, which aligns with research emphasizing the role of pre-surgical duplex mapping in optimal anatomical site selection and reduction of technical failures (12, 8).

Moreover, the presence of cardiometabolic comorbidities was significantly associated with lower vascular access survival. This result is consistent with studies identifying diabetes mellitus, arterial hypertension, and atherosclerosis as factors that impair endothelial integrity, reduce access patency, and increase the risk of thrombosis or infection (1, 13).

Although this study was not designed to assess therapeutic adherence or self-care, certain sociodemographic characteristics—such as higher education level and active employment—may have positively influenced the observed outcomes. Various studies have reported that these factors are associated with better understanding of treatment, higher adherence to medical recommendations, and lower risk of complications related to access management (14, 15).

Conclusion

Autologous arteriovenous fistulas demonstrated significantly greater survival and a lower incidence of both early and late complications compared to tunneled venous catheters in patients with chronic kidney disease undergoing hemodialysis. These findings support their selection as the first-line therapeutic option, in accordance with current international guidelines.

Adequate preoperative planning—particularly through the use of multiple imaging studies—and comprehensive evaluation of comorbidities, especially those of cardiometabolic origin, are crucial for optimizing vascular access functionality and reducing adverse events.

It is recommended to develop prospective, multicenter studies with larger sample sizes to confirm these results, more accurately assess the impact of clinical and social factors on access durability, and design preventive strategies to improve the quality of renal replacement therapy in hemodialysis.

Conflicts of interests

The authors have no conflicts of interests.

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 DOI 10.5281/zenodo.16957350