Tradeoffs in Vascular Access Selection in Elderly Patients Initiating Hemodialysis With a Catheter

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Rationale & Objective: National vascular access guidelines recommend placement of arteriovenous fistulas (AVFs) over grafts (AVGs) in hemodialysis patients, but have not been comprehensively assessed in the elderly. We evaluated clinically relevant vascular access outcomes in elderly patients receiving an AVF or AVG after hemodialysis therapy initiation.

Study Design: Retrospective cohort study using national administrative data.

Settings & Partcipants: Claims data from the US Renal Data System of 9,458 US patients 67 years and older who initiated hemodialysis therapy from July 1, 2010, to June 30, 2011, with a catheter and received an AVF (n = 7,433) or AVG (n = 2,025) within the ensuing 6 months.

Predictor: Arteriovenous access subtype, AVF or AVG.

Outcomes: Successful use of vascular access, interventions to make vascular access functional, duration of catheter dependence before successful use of vascular access, frequency of interventions, and abandonment after successful use of vascular access.

Analytical Approach: Multivariable logistic regression analysis was used to compare the need for intervention before successful use of AVFs and AVGs, and negative bionomial regression was used to calculate the frequency of intervention after successful use of vascular access.

Results: Unsuccessful use of vascular access within 6 months of creation was higher for AVFs versus AVGs (51% vs 45%; adjusted HR, 1.86; 95% CI, 1.73-1.99). Interventions to make vascular access functional were greater in AVFs versus AVGs (42% vs 23%; OR, 2.66; 95% CI, 2.26-3.12). AVFs had a lower 1-year abandonment rate after successful use compared with AVGs (OR, 0.71; 95% CI, 0.62-0.83) and required one-fourth fewer interventions after successful use (relative risk, 0.75; 95% CI, 0.69-0.81). Patients receiving an AVF had substantially longer catheter dependence before successful use than those receiving an AVG (median time, 3 vs 1 month; $P < 0.001$).

Limitations: Residual confounding due to vascular access choice, restriction to an elderly population, and 1-year follow-up period.

Conclusions: In elderly hemodialysis patients initiating hemodialysis therapy with a catheter, the optimal vascular access selection depends on tradeoffs between shorter catheter dependence and less frequent interventions to make the vascular access (AVG) functional versus longer access patency and fewer interventions after successful use of the vascular access (AVF).

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Vascular access is the "lifeline" for hemodialysis patients, providing a critical conduit for delivery of blood to the extracorporeal circuit. More than 80% of US hemodialysis patients initiate dialysis therapy with a central venous catheter (CVC),[1] with most subsequently undergoing placement of a permanent vascular access, either an arteriovenous fistula (AVF) or graft (AVG). Patients remain catheter dependent until their AVF or AVG can be successfully used for dialysis, and longer duration of CVC-dependence has been associated with increased risk for catheter-related bacteremia and death.[2-4] Surgical or endovascular interventions are frequently required to make vascular accesses functional for successful use on dialysis.[5-11] Even after successful use of a vascular access, a vascular access often requires additional interventions to maintain long-term patency for dialysis. Ultimately, many AVFs and AVGs are abandoned, usually due to irreversible thrombosis.

The Fistula First Initiative, launched by the Centers for Medicare & Medicaid Services (CMS) in 2002, urges providers to maximize AVF use in preference to an AVG.[12] The rationale is that AVFs have long-term survival superior to that of AVGs and require fewer interventions to maintain such patency.[13] Implementation of the Fistula First Initiative recommendations has resulted in AVF placement in many elderly patients who would have previously received an AVG.[14] Concurrently, there has been a substantial increase in percutaneous interventions in AVFs, both to salvage AVFs that are unable to be successfully used for dialysis and to maintain their long-term patency after maturation.[15] Such interventions delay successful AVF use, further prolonging catheter use. Two small observational studies reported that interventions to make the vascular access functional are also associated with subsequent shortening of vascular access patency and an increase in the frequency of interventions to maintain such patency.[16,17]

We previously compared clinical outcomes (deaths and hospitalizations) in a national cohort of elderly patients who initiated hemodialysis therapy with a CVC and subsequently had an AVF or AVG placed.[18] We found that placement of an AVF rather than an AVG is associated with greater patient survival despite longer CVC dependence.[18]

The present study comprehensively compared several clinically relevant vascular access–related outcomes in the same cohort of elderly hemodialysis patients to better understand the tradeoffs between AVF and AVG selection.

Methods

Data Sources and Study Population

We used standard analytic files derived from the US Renal Data System (USRDS) for July 1, 2010, to December 31, 2013. Two-year pre–end-stage renal disease (ESRD) Medicare data provided additional baseline information, including comorbid conditions, as previously published.[18,19] All incident hemodialysis patients 67 years and older who had their first ESRD service in the 1-year period between July 1, 2010, and June 30, 2011, were identified as our baseline population. To ensure that the catheter was the only vascular access present at the start of hemodialysis therapy, patients were excluded from the study cohort if they: (1) were using an AVF or AVG or had an AVF or AVG placed already but were awaiting successful use at hemodialysis therapy initiation, as reported in the 2728 Medical Evidence Form[20,21]; or (2) underwent AVF or AVG surgery in the 2-year pre-ESRD period, as assessed by *Current Procedural Terminology*-4 (CPT-4) procedure codes.

Because we used encrypted patient information and reported aggregate data, we did not require research ethics committee approval. Informed consent was also waived due to deidentified information.

Variables of Interest

The main study exposure was the vascular access type (AVG or AVF) inserted within 6 months of hemodialysis therapy initiation, identified by using CPT-4 codes of 36818, 36819, 36820, 36821, and 36825 for AVF insertion and 36800, 36810, and 36830 for AVG insertion.[22,23]

Optimal vascular access management requires a complex set of consecutive processes of care, each of which must be overcome to achieve the goal of a successful and durable access. First, a vascular access must be surgically created in patients with a catheter. Second, it must reach the point of successful use and be used repeatedly to deliver dialysis. Third, when successful use of the vascular access has been achieved, it needs to remain patent for a prolonged period, often requiring subsequent interventions. Using this spectrum of care processes, we identified key study vascular access outcomes as indicated next.

Unsuccessful use of vascular access occurred if an AVF or AVG was not used for dialysis within 6 months of its creation. Effective July 2010, all dialysis units were required by CMS to report monthly vascular access use for all active hemodialysis patients using vascular access modifiers: V5 (catheter), V6 (AVG), or V7 (AVF). A patient with a concurrent CVC and a maturing AVF or AVG is reported as dialyzing with a CVC. These reports were used to ascertain when an AVF or AVG was successfully used for hemodialysis. Successful use of vascular access was deemed to have occurred during the first month in which the patient was reported as using it.

Interventions to make a vascular access functional were defined based on whether an intervention(s) was required for the AVF or AVG before its successful use. Patients were considered to have an intervention to make the AVF or AVG functional for successful use for dialysis if they underwent a vascular access intervention before successful use of vascular access and to have no intervention to make vascular access functional if they did not undergo such an intervention.

Catheter dependence was defined as the duration of catheter use from AVF/AVG placement to its successful use.

Loss of primary access patency at 1 year denoted a requirement for any access intervention after successful use of vascular access.

For access abandonment at 1 year, the duration of secondary AVF or AVG survival was calculated from its first successful use to abandonment regardless of the need for interventions to maintain access patency. Abandonment was defined as 3 consecutive months of CVC use or new AVF or AVG placement.

The frequency of access interventions was calculated based on the interventions required to maintain AVF or AVG use in the 1-year period after it matured.

Codes used to identify intervention procedures are listed in Table S1. Interventions to make a vascular access functional, duration of catheter dependency, access abandonment, and frequency of interventions after successful vascular access use were examined among those who achieved successful vascular access use.

The Medical Evidence Form provided patient demographics at hemodialysis therapy initiation. Major comorbid conditions were identified using 1 inpatient or 2 outpatient Medicare claims during the 2-year pre-ESRD period. Liu's comorbidity index was used.[24] We used the same baseline for all outcomes, defined as hemodialysis therapy initiation. Start of follow-up was defined as the vascular access surgery date for both AVG and AVF patients.

Statistical Analysis

Baseline characteristics were summarized and compared between patients with AVF and AVG placement, respectively, using Pearson χ^2 tests for categorical variables and nonparametric Wilcoxon rank sum test for continuous variables. Duration of catheter dependency before successful use of vascular access was compared using Kruskal-Wallis test among 4 groups: intervention to make AVF functional, no intervention to make AVF functional, intervention to make AVG functional, and no intervention to make AVG functional. Because USRDS data report vascular access use for dialysis sessions on a monthly basis, we selected a discrete time-to-event framework and used complementary log-log models to estimate hazard ratios (HRs) for successful vascular access use, primary patency loss, and