Kidney Medicine

Hemodialysis Access Type and Access Patency Loss: An Observational Cohort Study

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Rationale & Objective: Access patency outcomes for arteriovenous fistulas (AVFs) as compared with arteriovenous grafts (AVGs) in patients receiving hemodialysis (HD) who have achieved a functioning permanent access are not fully explored.

Study Design: Observational cohort study.

Setting & Population: Fee-for-service Medicare beneficiaries aged ≥18 years with kidney failure who were newly using a permanent access for maintenance HD from the United States Renal Data System (2010-2015). Patients using an oral anticoagulant were excluded.

Exposure: AVG or AVF.

Outcomes: Loss of primary unassisted, primary assisted, and secondary patency.

Analytical Approach: Outcomes were characterized using cumulative incidence curves, and HRs adjusted for sociodemographic and clinical factors were estimated for the comparison of AVF versus AVG.

Results: The cohort included 60,329 and 17,763 patients newly using an AVF and AVG, respectively, for HD. Over 3 years of follow-up, AVG users, compared to AVF users, had a higher cumulative incidence of loss of primary unassisted patency (87% vs 69%; HR, 1.56; 95% CI, 1.52-1.60), loss of primary assisted patency (69% vs 25%; HR, 3.79; 95% CI, 3.67-3.92), and loss of secondary patency (22% vs 10%; HR, 2.03; 95% CI, 1.92-2.16). Stratified analyses revealed differences by subgroups; in particular, incidence of patency loss was higher among patients who underwent prior interventions to maintain prefunctional access patency and Black patients.

Limitations: This analysis focused on outcomes occurring after first successful use of a permanent access and thus does not inform about risk of patency loss during access maturation.

Conclusions: Among patients with kidney failure who successfully used a permanent access for HD, patency loss was consistently substantially higher in those using AVGs compared with AVFs. New interventions, such as prophylactic drugs, are needed to improve access longevity and reduce the need for invasive interventions, particularly among patients unable to receive a fistula.

Visual Abstract included

Complete author and article information provided before references.

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A well-functioning vascular access is essential for the provision of maintenance hemodialysis (HD) in patients with kidney failure. An ideal access provides reliable, complication-free access to the vascular system while suiting the clinical circumstances of a patient.[1] Due to considerably lower rates of complications—including infection, stenosis, and thrombosis—a permanent arteriovenous (AV) access such as an arteriovenous fistula (AVF) or arteriovenous graft (AVG) is much preferred over a tunneled central venous catheter for long-term use. Although the AVF has long been considered the optimal access because of its superior lifespan and lower complication rate, the AVG can be a suitable alternative with the benefits of shorter maturation times, higher primary success rates, and accessibility for some who lack adequate vasculature for a "native" access.[2]

Thrombosis is a major problem among patients with an AV access, particularly grafts, which are inherently thrombogenic. Nevertheless, a thrombosed AVG is often easier to declot than a thrombosed AVF.[2] If an AV access is not salvaged within approximately 48 hours of thrombosing, a catheter is often needed to restore temporary access. Thus, thrombosis initiates a "countdown" in which the health care system must marshal resources and work to quickly reopen the access.

Maintaining long-term AV access patency frequently requires interventions to overcome thrombosis and other complications (eg, anatomical problems, stenosis). These complications are often categorized into 3 types of access failure[3] by increasing order of severity. First, loss of *unassisted primary* patency constitutes complications that are often less severe than thrombosis and require relatively simple interventions (eg, angioplasty). Second, loss of *assisted primary* patency generally involves access thrombosis events that can be salvaged via prompt thrombectomy. Third, loss of *secondary* patency represents any complication requiring abandonment of the access (eg, irreversible thrombosis).

We sought to characterize the risk of access failure outcomes in AV access users by type and patient characteristics to help nephrologists and others predict the expected longevity of a permanent access from the time of its first use for HD. Using a nationwide end-stage kidney disease (ESKD) registry, we constructed a cohort of patients receiving maintenance HD with a newly functioning AV access and compared the rates of primary unassisted, primary assisted, and secondary patency loss between those using an AVF and AVG, both overall and in specific patient subgroups. Whereas other work in this area has often focused on patients who initiated HD using a

PLAIN-LANGUAGE SUMMARY

In patients with kidney failure receiving hemodialysis, vascular access complications such as stenosis and thrombosis are common and often require restorative interventions. In the event that a malfunctioning access cannot be remediated, it may be necessary to create a brand new access. We examined the risks of needing different types of treatment for access complications in a cohort of Medicare beneficiaries receiving hemodialysis who had successfully used an arteriovenous access. We found that the risks of needing an intervention to treat thrombosis and needing a brand new access placement were higher among graft users compared with fistula users. New interventions are needed to improve access outcomes in the hemodialysis population, especially among those not using a fistula.

catheter and later transitioned to an AV access or conditioned on the presence of pre-ESKD Medicare claims, this analysis includes all patients receiving HD with a newly functioning AV access, whether it was created preemptively or after reaching kidney failure and whether or not Medicare claims were available before the onset of kidney failure.[4-6]

METHODS

Data sources

This study used the following analysis files from the 2010 to 2015 United States Renal Data System (USRDS) ESKD registry database:[7] the End-Stage Renal Disease Medical Evidence Report (Form CMS 2728) and Death Notification (CMS 2746) forms, patients, treatment history, and Medicare Part A (institutional), Part B (physician/suppler), and Part D (prescription drug events) claims files. A waiver of informed consent was granted by Hennepin Healthcare's institutional review board, and data use agreements between the Hennepin Healthcare Research Institute and the National Institute of Diabetes and Digestive and Kidney Diseases were in place. Subject to the terms of a data use agreement with the USRDS, qualified individuals can freely obtain data used in this analysis from USRDS.

Study design

This study used a retrospective cohort design. Patients with kidney failure receiving HD who were newly using an AV vascular access were considered for inclusion. The date of first use of the AV access for outpatient HD, which could occur on or after the date of kidney failure incidence, was defined as the index date. Only patients with continuous Medicare fee-for-service and Part D coverage from the date of kidney failure incidence to the index date were included, which ensured that we could observe the full history of modality, vascular access, and medication use. Patients aged <18 years or who received an oral anticoagulant within 90 days before the index date were excluded. The latter patients were excluded to allow study of the background risks of patency failure independent of the therapeutic effects of anticoagulation.

Modality and Vascular Access

HD modality was identified using the treatment history files. The date of first use of an AV access for HD (ie, the index date) was identified using the CMS 2728 form or outpatient dialysis claims with a Healthcare Common Procedure Coding System modifier code of V6 (AVG) or V7 (AVF) but no V5 (catheter) modifier. The vascular access modifier codes are reported on at least 1 dialysis claim per month. Use of an AV access for HD throughout follow-up was then defined using outpatient dialysis claims occurring after the index date. Claims with Healthcare Common Procedure Coding System modifier V5 alone, or with modifier V5 in combination with V6 or V7, were considered HD sessions using a catheter. Patients were followed as long as they continued to use an AV access, allowing for periods of temporary catheter use of no more than 30 consecutive days (ie, patients were censored on reaching 31 consecutive days of catheter use). Throughout follow-up, patients were categorized as AVF or AVG users according to the access used on the index date.

Outcomes

The outcomes of interest (illustrated in Fig S1) included loss of primary unassisted patency, loss of primary assisted patency, and loss of secondary patency. Loss of primary unassisted patency constituted the first intervention during follow-up to maintain full function of the access, including angioplasty, surgery for anatomical or physical complications, thrombectomy or thrombolysis, new AV access creation, or access abandonment. Loss of primary assisted patency was the first intervention to treat access thrombosis, create a new AV access, or abandon the access. Finally, loss of secondary patency was defined (only) as creation of a new AV access or abandonment of the access. Since follow-up started from the date of first use of the AV access for HD, these outcomes could be considered as representing loss of *functional* access patency. The algorithms used to define each patency outcome are presented in Table S1. Relevant procedure codes were selected based on clinical expertise and recent USRDS publications.[5,8]

Patient Characteristics

Patient characteristics included age, sex, race, enrollment in Medicaid, body mass index (BMI), primary cause of kidney failure, catheter use at HD initiation, time since HD initiation, comorbid conditions, interventions to maintain prefunctional access patency, and prescription medications. Comorbid conditions were defined using the CMS 2728 form in combination with Medicare claims in the

Table 1. Baseline Characteristics in Patients Receiving Hemodialysis by Access Type

Characteristic	AVF (N = 60,329)	AVG (N = 17,763)
Age (y), n (%)		
18-44	2,838 (4.7%)	771 (4.3%)
45-64	15,987 (26.5%)	4,310 (24.3%)
65-74	22,032 (36.5%)	6,026 (33.9%)
75-84	15,521 (25.7%)	4,981 (28.0%)
≥85	3,951 (6.5%)	1,675 (9.4%)
Female, n (%)	26,734 (44.3%)	10,805 (60.8%)
Race, n (%)		
White	42,132 (69.8%)	10,008 (56.3%)
Black	14,746 (24.4%)	6,751 (38.0%)
Other	3,451 (5.7%)	1,004 (5.7%)
Medicare/Medicaid dual eligible, n (%)	28,365 (47.0%)	9,600 (54.0%)
Body mass index in kg/m^2, n (%)[a]		
<18.5	1,796 (3.0%)	847 (4.8%)
18.5-24.9	18,115 (30.2%)	6,068 (34.4%)
25-29.9	17,476 (29.2%)	4,750 (27.0%)
≥30	22,501 (37.6%)	5,960 (33.8%)
Primary cause of end-stage kidney disease, n (%)		
Diabetes	31,305 (51.9%)	9,003 (50.7%)
Hypertension	18,688 (31.0%)	5,772 (32.5%)
Glomerulonephritis	3,143 (5.2%)	817 (4.6%)
Cystic kidney disease	894 (1.5%)	182 (1.0%)
Other	6,299 (10.4%)	1,989 (11.2%)
Catheter at HD initiation, n (%)	37,632 (62.4%)	12,710 (71.6%)
≥6 mo since HD initiation, n (%)	17,703 (29.3%)	4,500 (25.3%)
Comorbid conditions, n (%)		
Diabetes	45,820 (76.0%)	13,775 (77.5%)
Hypertension	59,725 (99.0%)	17,634 (99.3%)
Congestive heart failure	36,007 (59.7%)	11,559 (65.1%)
Atherosclerotic heart disease	33,464 (55.5%)	10,286 (57.9%)
Other cardiac disease	27,655 (45.8%)	8,857 (49.9%)
Cerebrovascular disease	14,582 (24.2%)	5,539 (31.2%)
Peripheral vascular disease	26,552 (44.0%)	8,672 (48.8%)
Chronic obstructive pulmonary disease	20,713 (34.3%)	6,909 (38.9%)
Atrial fibrillation	9,750 (16.2%)	3,406 (19.2%)
Liver disease	4,393 (7.3%)	1,452 (8.2%)
Cancer	8,664 (14.4%)	2,660 (15.0%)
Interventions to maintain prefunctional access patency, n (%)		
Angioplasty	15,024 (24.9%)	3,350 (18.9%)
Surgery for anatomical complication	10,748 (17.8%)	2,251 (12.7%)
Thrombectomy or thrombolysis	2,131 (3.5%)	2,122 (11.9%)
New access creation (prior failure)	18,991 (31.5%)	7,646 (43.0%)
Prescription medications, n (%)		
Antiplatelet	9,643 (16.0%)	2,956 (16.6%)
Statin	28,226 (46.8%)	7,974 (44.9%)
Antihypertensive	31,035 (51.4%)	9,107 (51.3%)
Antiarrhythmic	2,104 (3.5%)	696 (3.9%)
Antidiabetic	23,358 (38.7%)	6,801 (38.3%)

Abbreviations: AVF, arteriovenous fistula; AVG, arteriovenous graft; HD, hemodialysis.
[a]Body mass index values missing in n = 579 patients. Percentages are reported with respect to the available sample size for this covariate.

year before the index date using the definitions in Table S2. Interventions to maintain access patency were identified using procedure codes in the year before the index date based on the definitions in Table S1. Use of key prescription medications on the index date were identified using Part D claims.

Statistical Analysis

Descriptive statistics were used to summarize baseline characteristics by vascular access type (AVF and AVG). Starting from the index date, patients were followed until the earliest of: date of the outcome of interest; death; kidney transplant; switch to a catheter access or to peritoneal dialysis (if longer than 30 days); first oral anticoagulant prescription; loss of Medicare coverage; August 31, 2015; or 3 years of follow-up. Cumulative incidence curves were estimated for each outcome, separately by access type. The cumulative incidence function was used to account for death as a competing risk.[9] Hazard ratios (HRs) comparing AVG with AVF for each outcome of interest at 3 months, 1 year, and 3 years of follow-up were estimated using Cox proportional hazards models adjusted for the baseline covariates in Table 1. Missing values for BMI category were multiply imputed with 10 datasets using multinomial logistic regression; results were pooled according to Rubin's rules.[10] A sensitivity analysis was also conducted among the subgroup of patients with a prior failed AVF.

To explore whether the associations differed across subgroups, cumulative incidence curves and HRs were estimated with stratification by sex, age, race, BMI, time since HD initiation, prior thrombectomy or thrombolysis, prior access failure, atrial fibrillation, and antiplatelet medication use. Interactions were evaluated on the multiplicative scale.

RESULTS

Patient Characteristics

Construction of the study cohort is shown in Figure S2. A total of 60,329 AVF users and 17,763 AVG users who were newly using their AV access for HD in kidney failure, and who were not receiving oral anticoagulation, were included in the study. Overall, the mean age was 68.9 ± 12.3 years, 48.1% were women, and 66.8% were White. Patients who were older, women, Black, Medicaid-eligible, normal weight or underweight, catheter users at HD initiation, or who had comorbid conditions were more likely, on average, to use an AVG (Table 1). Prior interventions to maintain prefunctional access patency, including thrombectomy or thrombolysis and new AV access creation (ie, prior access failure), were more common among AVG users, whereas angioplasty and surgical repairs were more common among AVF users (Table 1). The numbers of previous failed AVFs and AVGs are shown in Table S3.

Cumulative Incidence of Loss of Access Patency

Estimates of cumulative incidence for AVF and AVG users for each loss of access patency outcome over the 3 years of follow-up are presented in Figure 1. Loss of patency was consistently more common among AVG users. By 3 years, the probability of needing an intervention for any reason to maintain full function of the access (ie, loss of primary unassisted patency) was 87% in AVG users and 69% in AVF users (Fig 1A). Loss of primary assisted patency, typically constituting the need for an intervention to treat access thrombosis, was more than 3-fold higher among AVG users (49%) compared to AVF users (15%) by 1 year (Fig 1B). Complete abandonment of the access or new access creation (loss of secondary patency) was much less common than loss of primary patency, but still was more than 2-fold higher among AVG users (22%) compared to AVF

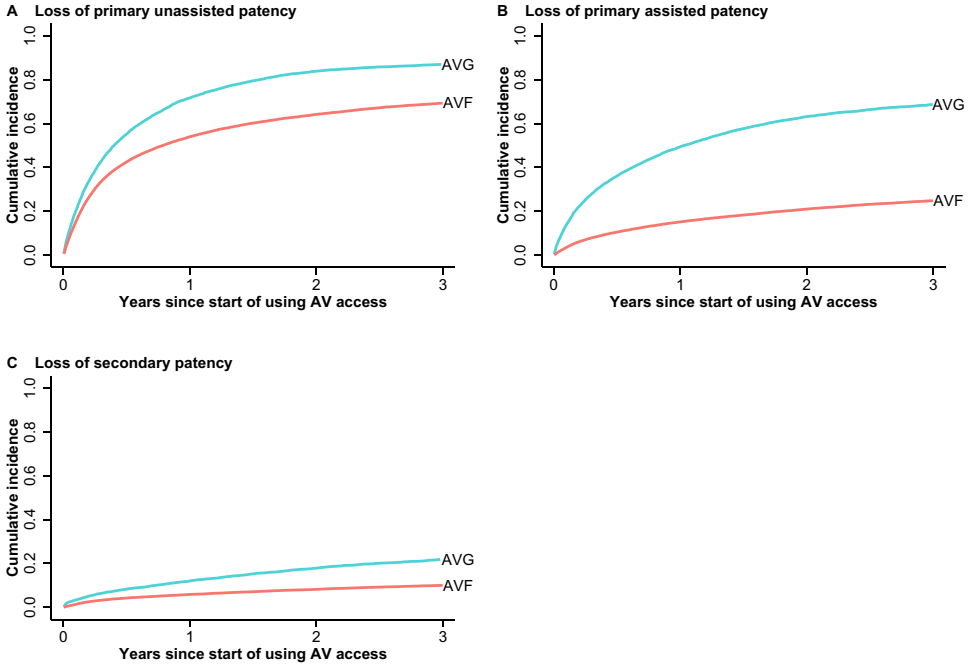

Figure 1. Cumulative incidence of loss of access patency. Abbreviation: AV, arteriovenous.

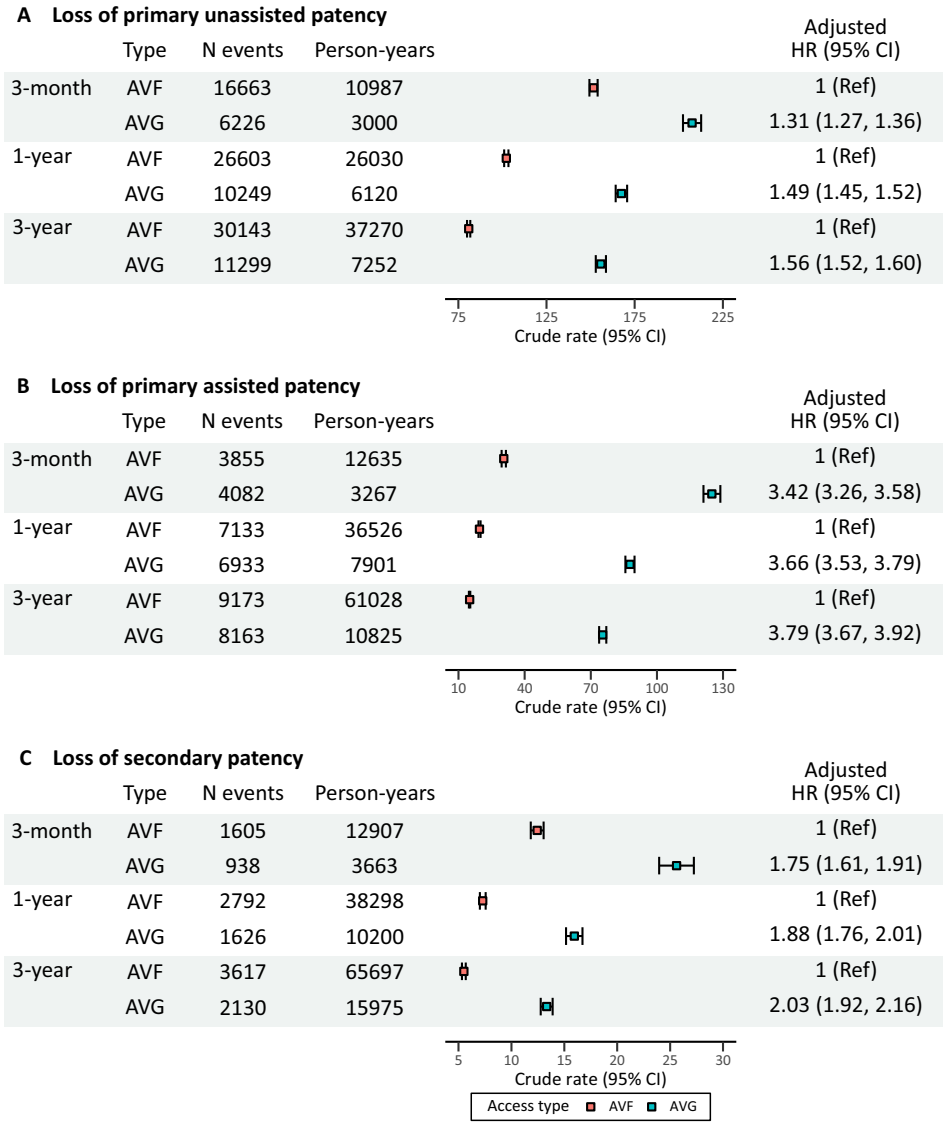

Figure 2. Association of access type with risk of loss of patency. Hazard ratios are adjusted for age category, sex, race, Medicaid enrollment, BMI category, primary cause of end-stage kidney disease, catheter at hemodialysis initiation, time since hemodialysis initiation, comorbid conditions, interventions to maintain prefunctional patency, and prescription medications. Abbreviations: AVF, arteriovenous fistula; AVG, arteriovenous graft; CI, confidence interval; HR, hazard ratio; Ref, reference.

users (10%) by 3 years (Fig 1C). Patterns of incidence of loss of access patency were similar among the subgroup of patients with a previous failed AVF (Fig S3).

Regression Models for Loss of Access Patency

Crude rates and adjusted HRs comparing AVG versus AVF users for each loss of patency outcome through 3 months, 1 year, and 3 years of follow-up are presented in Figure 2. Patency loss was highest in the first 3 months after starting to use an AV access for HD and then plateaued with longer follow-up. AVG use was consistently associated with higher risk of patency loss compared to use of an AVF, independent of the sociodemographic and clinical characteristics shown in Table 1. By 1 year, HRs comparing AVG users versus AVF users were 1.49 (95% confidence interval [CI], 1.45-1.52) for loss of primary unassisted patency (Fig 2A), 3.66 (95% CI, 3.53-3.79) for loss of primary assisted patency (Fig 2B), and 1.88 (95% CI, 1.76-2.01) for loss of secondary patency (Fig 2C). Associations were similar in the subgroup analysis of patients with a previous failed AVF (Table S4).

Stratified Cumulative Incidence

Cumulative incidence estimates for AVF and AVG users stratified by subgroups of interest are presented in Figures 3-5. The most striking pattern was observed for patients who underwent thrombectomy or thrombolysis intervention before first use of the AV access for HD,

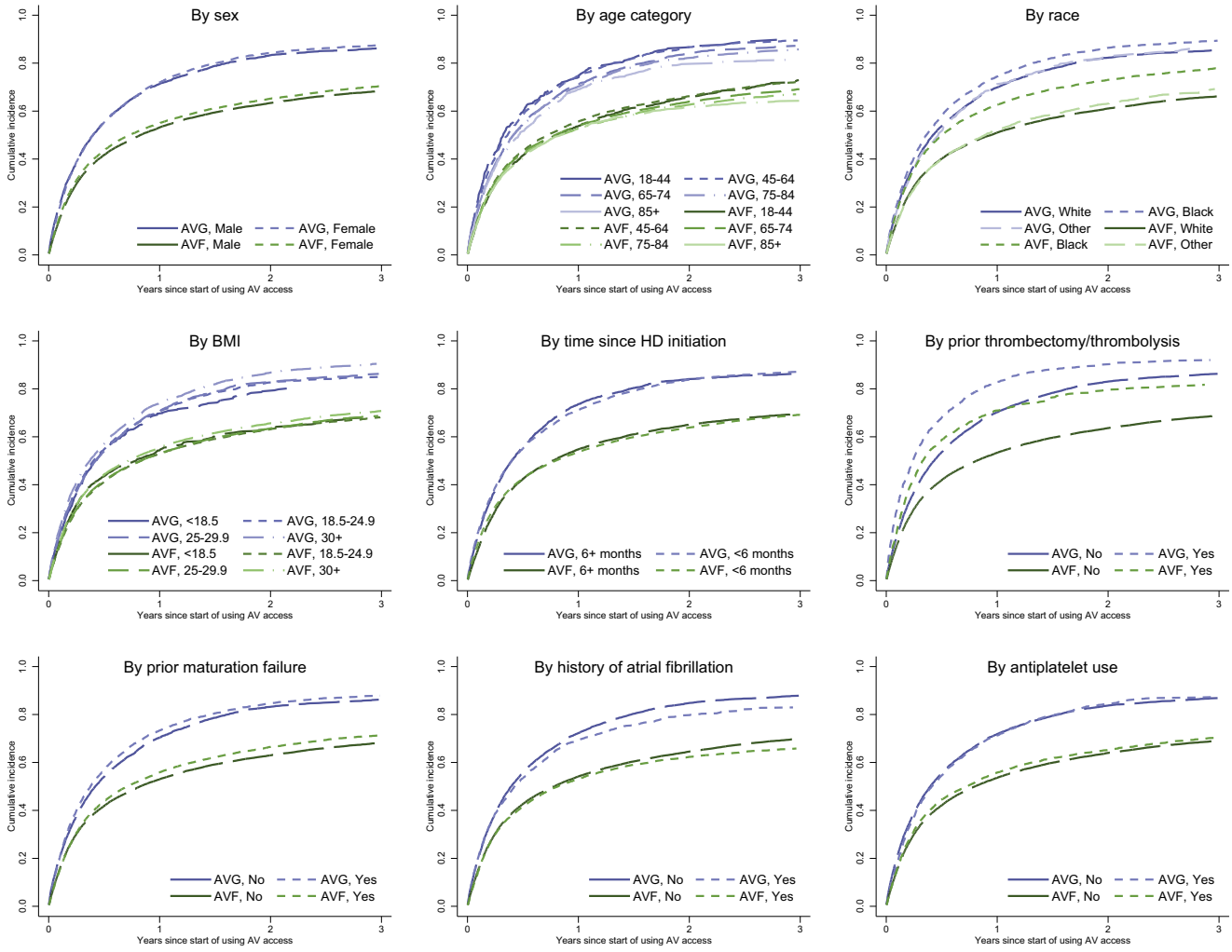

Figure 3. Cumulative incidence of loss of primary unassisted patency stratified by patient characteristics. Abbreviations: AV, arteriovenous; AVF, arteriovenous fistula; AVG, arteriovenous graft; BMI, body mass index; HD, hemodialysis.

which was highly predictive of loss of primary unassisted and assisted patency (Figs 3-5); notably, in the first year of using an AV access for HD, individuals with an AVF who had undergone a prior thrombectomy or thrombolysis had a higher incidence of primary unassisted patency loss than individuals with an AVG who had not undergone a previous thrombectomy or thrombolysis. Another prominent finding was that Black individuals, particularly AVF users, had a higher incidence of loss of primary patency compared to individuals of White or other race who were using the same access type (Figs 3-5). Perhaps unexpectedly, the youngest individuals (those aged 18-44 years) generally had higher incidence of patency loss than older individuals. Among AVF users, women had a higher incidence of patency loss of all types compared to men (Figs 3-5). Conversely, among AVG users, men had a higher incidence of secondary patency loss (Fig 5). Furthermore, patients in the obese BMI category (≥30 kg/m^2) and using an AVG had a higher incidence of each type of patency loss compared to those in other categories of BMI (Figs 3-5). Individuals who had experience prior maturation failure had higher incidence of loss of primary unassisted and primary assisted patency but not secondary patency. Lastly, incidence of patency loss was similar between users and nonusers of antiplatelet medications (Figs 3-5).

Stratified Regression Models

Figures S4-S6 show adjusted HRs, stratified by subgroups of interest, for the comparison of AVG versus AVF for each patency loss outcome through 1 year of follow-up. The stratified HRs were generally similar to the overall 1-year HRs for each outcome. However, there was evidence of interaction in some instances. Most notably, comparing AVG users to AVF users, the relative risk of loss of primary assisted patency was lower among patients with a history of thrombectomy or thrombolysis (HR, 2.60; 95% CI, 2.33-2.89) than among patients without such a history (HR, 3.79; 95% CI, 3.65-3.94) (P for interaction <0.001). Also, the relative difference in risk of loss of primary

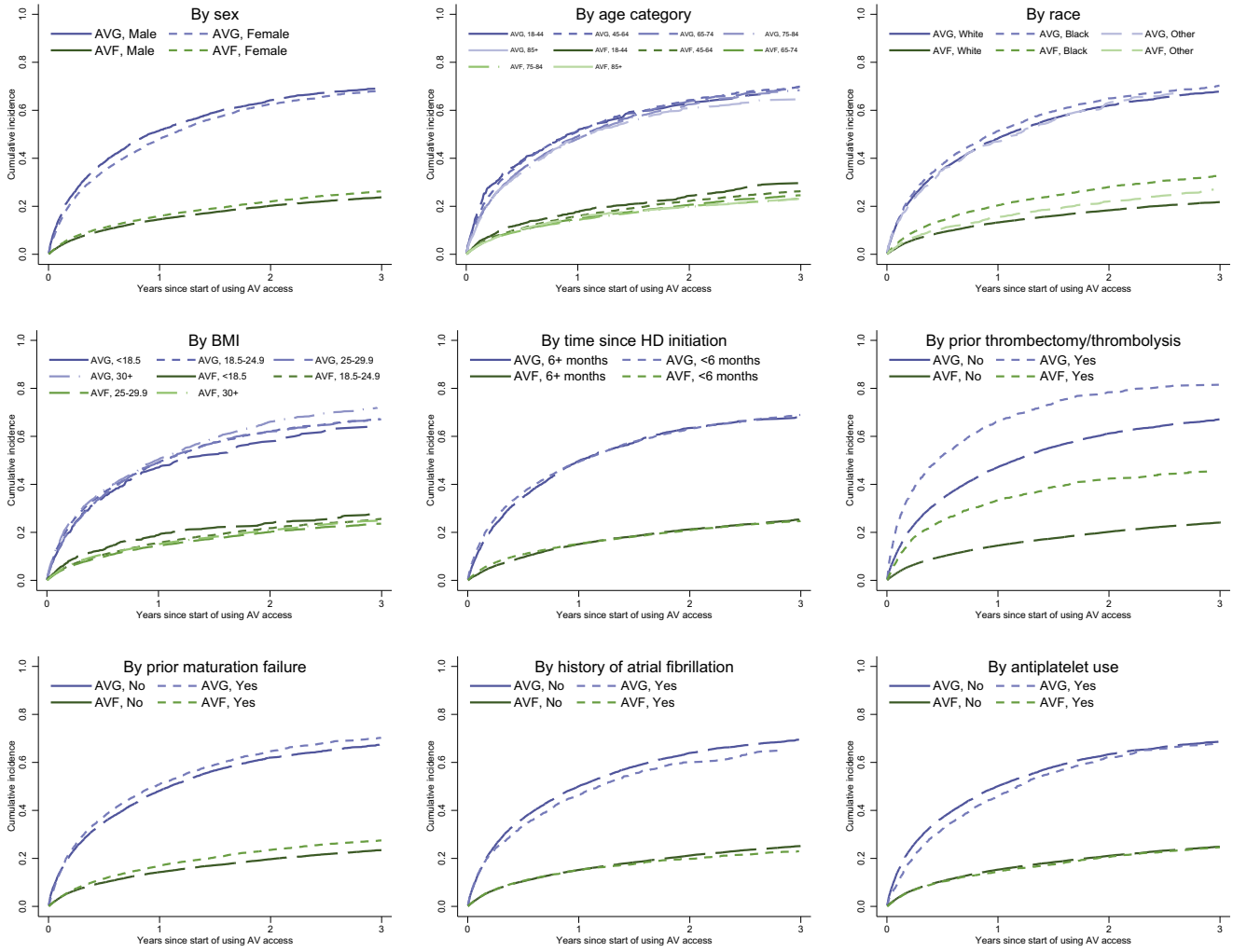

Figure 4. Cumulative incidence of loss of primary assisted patency stratified by patient characteristics. Abbreviations: AV, arteriovenous; AVF, arteriovenous fistula; AVG, arteriovenous graft; BMI, body mass index; HD, hemodialysis.

assisted patency and loss of secondary patency comparing AVG users to AVF users was smaller for women than for men (P for interaction <0.001 for each outcome).

DISCUSSION

In this study, we used a large cohort of patients receiving maintenance HD from USRDS data to determine absolute and relative risks of patency loss between AVGs and AVFs. We found that, among patients receiving HD who had successfully used a permanent access, loss of unassisted patency at 1 year for an AVG, as compared with an AVF, was about 1.3-fold higher; loss of primary assisted patency was about 3.3-fold higher; and loss of secondary patency was about 2.0-fold higher. After adjustment for a wide range of demographic, socioeconomic, anthropometric, comorbidity, medication, and access history–related factors, the modeled HRs demonstrated a similar signal. The results suggest that, among patients with a functioning permanent access, AVFs have superior patency compared to AVGs, particularly in terms of (primary) assisted patency and secondary patency.

Our goal was to assist nephrologists and other providers in assessing the risk of access failure outcomes in users of permanent AV accesses, by access type and patient characteristics, from the time of first use of the AV access for HD. Second, we did not seek to mimic the intention-to-treat approach, used by some others, to inform which access creation strategy might be best for a given patient. Executing an intention-to-treat–like approach is somewhat complex in the USRDS data. The intention-to-treat approach requires explicit consideration of patients who die before dialysis initiation. However, pre-ESKD claims are available in the USRDS only for patients who survive to initiate dialysis, meaning an analysis of access creation before dialysis initiation would introduce immortal time bias. Another intention-to-treat approach, which has been used by others, is to follow patients who initiated HD with a catheter from the time their first AV access was created. However, in this design, those who successfully use a

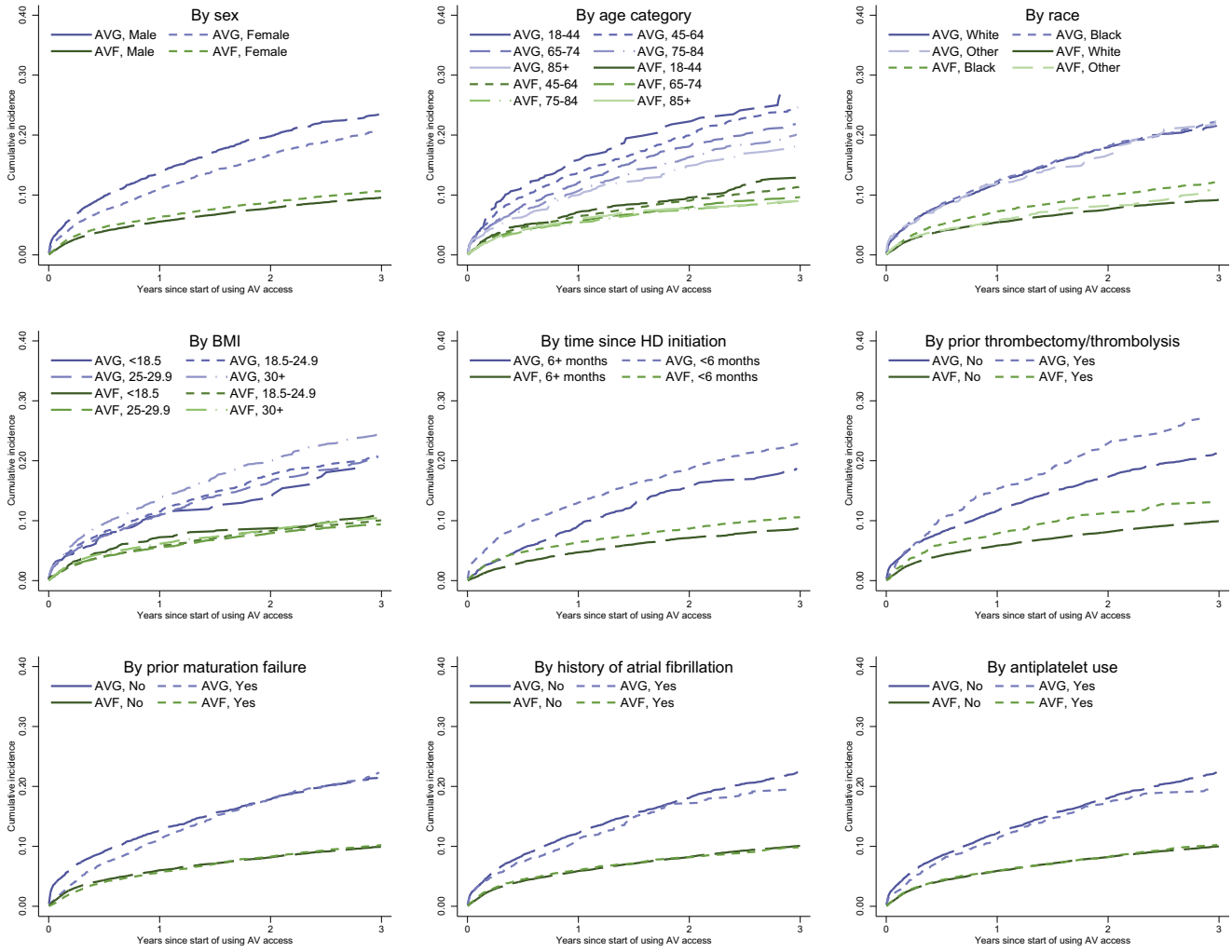

Figure 5. Cumulative incidence of loss of secondary patency stratified by patient characteristics. Abbreviations: AV, arteriovenous; AVF, arteriovenous fistula; AVG, arteriovenous graft; BMI, body mass index; HD, hemodialysis.

fistula or graft at HD initiation are excluded. To overcome these limitations, we selected an approach that is akin to an "as-treated" analysis, whereby risks of patency outcomes are modeled conditional on having achieved a functioning fistula or graft. Thus, our design allows us to include all AV access users (as opposed to only the subset who have pre-ESKD claims or who initiate HD with a catheter). Use of any future access-preserving intervention, such as a novel pharmacologic agent, would almost certainly be explored in prevalent patients dialyzing with a permanent access, meaning that our design is particularly relevant in a scenario where foundational data on access survival is required.

Although our study design has some unique aspects, some comparisons can still be drawn with other studies. We found a lower incidence of access abandonment at 1 year (4% for AVFs and 10% for AVGs) than did an earlier analysis of USRDS data by Lee et al[5] (18% for AVFs and 24% for AVGs), which was also conditioned on successful first use of the AV access. It is possible that thrombectomy techniques have improved over time, allowing salvage of access that would otherwise have been abandoned. Unsurprisingly, analyses following patients from the time of AVF or AVG creation have reported a much higher incidence of secondary patency loss (eg, 41% for AVFs and 43% for AVGs).[6] This is explained by the high rate of unsuccessful access maturation. Conversely, one study even reported worse secondary patency outcomes in AVF users.[11]

Our subgroup analyses revealed notable findings. We found that loss of primary and secondary patency among AVF users was higher in women than in men, in concordance with a previous analysis.[12] Conversely, among AVG users, we found that loss of secondary patency was higher in men compared to women, in contrast with the previous study, which found little difference by sex.[12] In general concordance with other work, however, we generally found that Black, as compared with White, patients fared more poorly across all patency types, with the exception of secondary patency in AVG users, where outcomes were

similar in Black and White patients.[13] Patients with the highest BMIs generally had worse AVG patency than patients with lower BMIs; other studies have also shown an association between obesity and poor patency outcomes.[11,14] Generally, we did not observe differences in patency between users and nonusers of antiplatelet agents. Similarly, in a clinical trial of patients with newly created AVFs, clopidogrel was ineffective at promoting successful maturation; nevertheless, in contrast with our study, the trial found that clopidogrel reduced early AVF thrombosis.[15] However, the results of that trial did not address whether clopidogrel improves AVF patency over the long term after successful first use of the permanent access—which was the conceptual framework of our present study.

The Fistula First Breakthrough Initiative and the 2006 Kidney Disease: Improving Global Outcomes (KDIGO) Vascular Access Guidelines[16] lionized a fistula-based approach, which was interpreted by many as meaning that grafts should be considered merely as a final recourse when attempting to secure a permanent access. Doubts have been expressed about the original fistula-centric approach, appropriately in our view, by important publications.[17-19] Indeed, the goals of the initiative were subsequently clarified and the initiative itself renamed.[20] The main challenge to a fistula-centric approach is the danger of nonmaturation of the fistula and subsequent need for prolonged central venous catheter use.[21] When fistula nonmaturation is considered, the relative benefits of fistulas, relative to grafts, become less strong. As such, our results should not be interpreted as supporting a fistula first–based approach. Rather, our goal was to compare outcomes in grafts to fistulas in patients who had achieved a functioning permanent access. Such a comparison is a useful component of the fistula-versus-graft debate, and the incidence curves we generated may be useful to a nephrologist rounding in a dialysis facility who is advising a patient currently using an AV access on potential future outcomes or contemplating, for example, use of a new therapy designed to preserve access patency.

Our study has important limitations. First, as noted above, our study was deliberately designed to examine the question of outcomes after first successful use of a permanent access and was not designed to inform the question of which access might be most suitable from *initial* creation in, for example, patients with late-stage chronic kidney disease approaching dialysis. Such an approach, which cannot explicitly account for primary nonmaturation of an AVF (such as one placed before or soon after initiation of HD), may make outcomes of AVGs appear relatively worse than AVFs, creating a possible "bias" against AVGs. Our findings cannot, therefore, address which access type might be most suitable as an initial attempt at access creation. Second, residual confounding is likely present, despite our extensive attempts at covariate control. Third, our analysis is based on claims, which induces some degree of imprecision. These limitations may be counterbalanced by our use of a large cohort derived from USRDS data, our patency taxonomy, and our use of monthly modifier codes as reported by dialysis facilities to Medicare, which we used to improve the accuracy of classifying vascular access during follow-up.

In conclusion, among patients undergoing maintenance HD who have successfully used a permanent HD access, AVGs were associated with nearly 4-fold higher risk of having primary assisted patency loss and approximately 2-fold higher risk of secondary patency loss compared with AVFs over long-term follow-up (1-3 years). Interventions, such as novel pharmacologic approaches, are needed to improve access patency in patients receiving HD, particularly patients who are unable to receive a fistula access.

SUPPLEMENTARY MATERIAL

Supplementary File (PDF)

Figure S1: Schematic of study outcomes. AV, arteriovenous

Figure S2: Construction of the study cohort

Figure S3: Cumulative incidence of loss of access patency in the subgroup of patients with a previous failed AVF

Figure S4: Hazard ratios, comparing AVG users versus AVF users, for one-year risk of loss of primary unassisted patency, stratified by patient characteristics

Figure S5: Hazard ratios, comparing AVG users versus AVF users, for one-year risk of loss of primary assisted patency, stratified by patient characteristics

Figure S6: Hazard ratios, comparing AVG users versus AVF users, for one-year risk of loss of secondary patency, stratified by patient characteristics

Table S1: Algorithms Used to Identify Loss of Vascular Access Patency

Table S2: Comorbid Condition Definitions

Table S3: Numbers of Previous Failed AVFs and AVGs by Access Type

Table S4: Association of Access Type With Risk of Loss of Patency in the Subgroup of Patients With a Previous Failed AVF

ARTICLE INFORMATION

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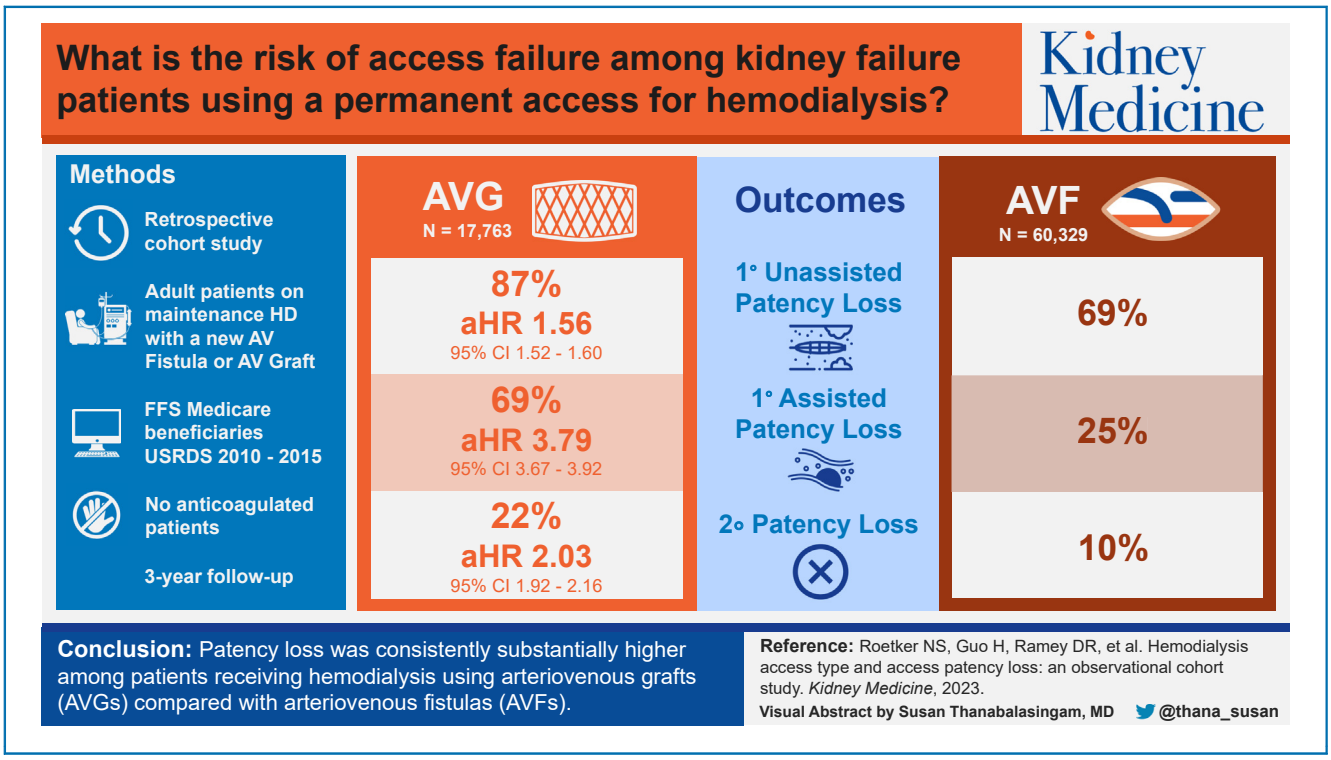
What is the risk of access failure among kidney failure patients using a permanent access for hemodialysis?
Kidney Medicine
Methods
Retrospective cohort study
Adult patients on maintenance HD with a new AV Fistula or AV Graft
FFS Medicare beneficiaries USRDS 2010 - 2015
No anticoagulated patients
3-year follow-up
AVG
N = 17,763
87%
aHR 1.56
95% CI 1.52 - 1.60
69%
aHR 3.79
95% CI 3.67 - 3.92
22%
aHR 2.03
95% CI 1.92 - 2.16
Outcomes
1° Unassisted Patency Loss
1° Assisted Patency Loss
2° Patency Loss
AVF
N = 60,329
69%
25%
10%
Conclusion: Patency loss was consistently substantially higher among patients receiving hemodialysis using arteriovenous grafts (AVGs) compared with arteriovenous fistulas (AVFs).
Reference: Roetker NS, Guo H, Ramey DR, et al. Hemodialysis access type and access patency loss: an observational cohort study. Kidney Medicine, 2023.
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