The End Stage of Dialysis Access: Femoral Graft or HeRO Vascular Access Device

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Background: Maintaining and establishing vascular access in end-stage renal disease (ESRD) patients is complicated when they are poor candidates for traditional upper extremity access. Our objective was to compare our experience with 2 alternative dialysis accesses, the femoral arteriovenous graft (fAVG) and the Hemodialysis Reliable Outflow (HeRO), in patients with limited remaining options.

Methods: A single institution, retrospective review of ESRD patients with fAVG or HeRO placed between May 2009 and February 2013 was performed. Adult patients were selected by reviewing all arteriovenous grafts placed at a single institution. Patient demographics, medical history, access characteristics, and outcomes were recorded from both institutional and dialysis center databases. Data were evaluated using Fisher's exact test, unpaired *t*-test for continuous variables, log-rank test, and univariate analysis.

Results: A total of 56 accesses in 43 unique patients met these criteria: 35 fAVG and 21 HeRO; with 1 HeRO patient lost immediately to follow-up. Clinical variables were similar except the HeRO group had more diabetic patients (60% HeRO, 22.9% fAVG; $P = 0.01$). The average number of years on hemodialysis was 7.0 ± 1.0 for fAVG and 5.7 ± 0.9 for HeRO ($P = 0.41$). Primary patency was 40.5%, 18.7%, and 14.9% for fAVG and 29.0%, 29.0%, and 0% for HeRO at 6 months, 12 months, and 2 years ($P = 0.67$), respectively. Assisted primary patency was also similar, with 43.8%, 29.4%, and 13.8% for fAVG and 34.8%, 34.8%, and 17.4% for HeRO at 6 months, 12 months, and 2 years ($P = 0.81$), respectively. Secondary patency was 62.6%, 50.6%, 19.3% for fAVG and 68.0%, 53.5%, 38.3% for HeRO at 6 months, 12 months, and 2 years ($P = 0.69$), respectively. Average number of interventions to maintain patency for fAVG was 1.1 ± 1.47 and 1.65 ± 2.52 for HeRO ($P = 0.35$). Infectious complications occurred in 29% of fAVG and 15% of HeRO ($P = 0.33$).

Conclusions: Patients who received either fAVG or HeRO experience poor access patency. ESRD patients who receive either of these procedures appear to be at the end stage of available access options.

INTRODUCTION

End-stage renal disease (ESRD) currently affects over 500,000 patients in the United States and is increasing in prevalence with over 100,000 new cases reported each year.[1] Traditional permanent hemodialysis access is placed in the upper extremities, but as medical management of patients has improved, patients are surviving longer, thereby requiring multiple accesses throughout their remaining lifetime. As a result, more patients exhaust traditional upper extremity access, and there is no established algorithm for which type of access to pursue next in these patients. They often present with a complicated access history, due in

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Ann Vasc Surg 2015; 29: 90–97
http://dx.doi.org/10.1016/j.avsg.2014.06.001

Manuscript received: March 2, 2014; manuscript accepted: June 3, 2014; published online: June 18, 2014.

part to the development of central venous stenosis or occlusion (CVO).

In the last few decades, alternatives to traditional upper extremity access have been developed to postpone eventual catheter dependence and its inherent complications, including bacteremia and CVO. Two alternative dialysis accesses used at our institution are the femoral arteriovenous graft (fAVG) and the Hemodialysis Reliable Outflow (HeRO) vascular access device (Hemosphere Inc, Minneapolis, MN). The HeRO is a hybrid graft-catheter that was Food and Drug Administration approved in 2008 for patients with CVO, providing the opportunity for construction of an additional upper extremity access. The graft component is anastomosed to either the axillary or brachial artery, then tunneled subcutaneously and connected to a nitinol reinforced silicone outflow catheter. The tip of the outflow catheter is positioned beyond the CVO, in the superior vena cava or right atrium.

Our objective was to compare our institution's experience with these 2 alternative dialysis access options in patients who are approaching the end stage of permanent hemodialysis access.

MATERIALS AND METHODS

A retrospective study was conducted on all fAVG and HeRO placed in patients over 18 years of age at University Hospitals Case Medical Center from May 2009 to February 2013.

The study was approved by the University Hospitals Institutional Review Board. Patients were identified by querying Current Procedural Terminology billing codes for the study period. Data were obtained from the hospital's electronic medical record (EMR) system and from the principal outpatient dialysis treatment group in Northeast Ohio. Demographic variables included age, race, body mass index (BMI), hypertension, coronary artery disease, congestive heart failure, cerebrovascular accident, diabetes, peripheral arterial disease (PAD), cause of ESRD, medication history, and tobacco exposure. Access characteristics were collected, including the presence of a tunneled or temporary hemodialysis catheter (TDC). For patients who had both types of access constructed during the study period, each access was analyzed independently. Only minor differences in patient demographic characteristics, such as patient age at the time of access construction, were identified between access procedures on the same patient.

Outcomes measured included primary, assisted primary, and secondary patency as defined by the recommended standards for reporting on arteriovenous access.[2] Primary patency was defined as the interval of intervention-free access survival after access placement. Assisted primary patency was defined as the interval of thrombosis-free access survival after placement and included any intervention or revision to maintain patency. Secondary patency was defined as the time from placement until access abandonment, death, or renal transplant and included any intervention or revision to restore patency. Patients were censored when lost to follow-up or when the study period ended. Functional success was defined as successful cannulation for dialysis. Bacteremia was defined as documented bloodstream infection related to fAVG or HeRO and/or associated bridging TDC. Presence of graft infection was established from review of operative notes and discharge summaries related to these episodes. Access type and location were left to surgeon discretion and preference. Surgeons at our institution follow National Kidney Foundation Kidney Disease Outcomes Quality Initiative guidelines for establishing hemodialysis access; therefore fAVG and HeRO were only considered once patients had exhausted traditional upper extremity access.

Statistical analysis performed to describe and compare the 2 groups included Fisher's exact test, chi-squared test, unpaired *t*-test for continuous variables and univariate analysis. Kaplan–Meier survival curves were compared using a log-rank test. A P value of <0.05 was considered to be statistically significant.

RESULTS

We identified 56 accesses in 43 unique patients during our study period: 35 fAVG and 21 HeRO. There were 5 patients who had both fAVG and HeRO placed during the study period. One HeRO patient was lost immediately to follow-up and, therefore, was excluded from all subsequent analysis. fAVG and HeRO patients were similar in demographics including age and BMI (Table I). More males had fAVG (65.7%) than HeRO (45%), although this was not a statistically significant difference ($P = 0.16$). The majority of fAVG and HeRO were placed in African Americans, which is representative of our ESRD patient population. Patients in both groups were on hemodialysis for a significant period of time before fAVG or HeRO construction; the average number of years on hemodialysis was 7.0 ± 1.0 for fAVG and 5.7 ± 0.92 for HeRO ($P = 0.41$).