

AV fistula rates: Changing the culture of vascular access

R.L. McGILL, R.J. MARCUS, D.A. HEALY, D.J. BROUWER, B.C. SMITH, S.E. SANDRONI

Division of Nephrology and Hypertension, West Penn Allegheny Health System, Allegheny General Hospital Pittsburgh, Pennsylvania - USA

Abstract: Purpose: Data from the United States Renal Data System show about 30% of prevailing hemodialysis (HD) patients use arteriovenous fistulae (AVF), which falls far short of the Kidney Disease Outcomes Quality Initiative (K/DOQI) goals of 40-50%. Recent initiatives to increase the use of AVF in HD patients have been criticized as unachievable under realistic practice conditions.

Methods: A multidisciplinary effort to increase AVF use was undertaken at an outpatient HD center beginning in 1998. Strategies focused on education and recruitment of patients in both inpatient and outpatient settings, preservation of veins, pre-operative vein mapping, and education of staff.

Results: AVF rates increased from 32%, to 72% over 6 years. The percentage of prosthetic grafts decreased from 40% to 13%. Central venous catheters fell from 28% to 15%. Among residual patients with catheters, 77% had maturing fistulae, as well. Infection rates in the dialysis unit decreased by 39%. Bacteremia declined by 47%. These improvements have been sustainable over the past 12 months.

Conclusions: Adherence to a strategic program similar to the Fistula First Initiative can increase fistula rates under ordinary practice conditions. High fistula rates can be achieved in male and female patients. Unanimous commitment among all members of the health care team is needed. Reduction in the risks of infection, bacteremia, endocarditis, and death may be derived from achievable changes in practice. (The Journal of Vascular Access 2005; 6: 13-7)

Key words: Vascular access, Hemodialysis, Arteriovenous fistula

INTRODUCTION

Hemodialysis has been available to humans since 1945, but became a long-term option for patients with permanently failed kidneys only when durable access to the circulation could be achieved. Since the development of the Scribner shunt in 1960 (1), many different vascular access devices have been developed.

No device enjoys the durability and reliability of an arteriovenous fistula (AVF) constructed of autogenous artery and vein, as first reported by Brescia et al in 1966 (2). Other options for autogenous AVF use other vessels of the upper and lower extremities (3). Successful autogenous AVF have functioned reliably for decades in long-term dialysis patients. Es-

tablished fistulae provide reliable function, predictable blood flows, and are far less susceptible to failure due to thrombosis and infection.

Available alternatives include arteriovenous grafts (AVG) and percutaneous central venous devices (4, 5). These alternative devices have liabilities such as increased risks of access malfunction and failure, and may prevent patients from normal hygiene activities, such as showering. Artificial vascular access devices are associated strongly with an increased risk of endovascular infections, including life-threatening bacterial endocarditis (6, 7). Medicare costs have been noted to be lower for patients with AVF than patients with AVG or catheters (8).

In recognition of the advantages of AVF, and the serious and frequent liabilities of alternative vascular

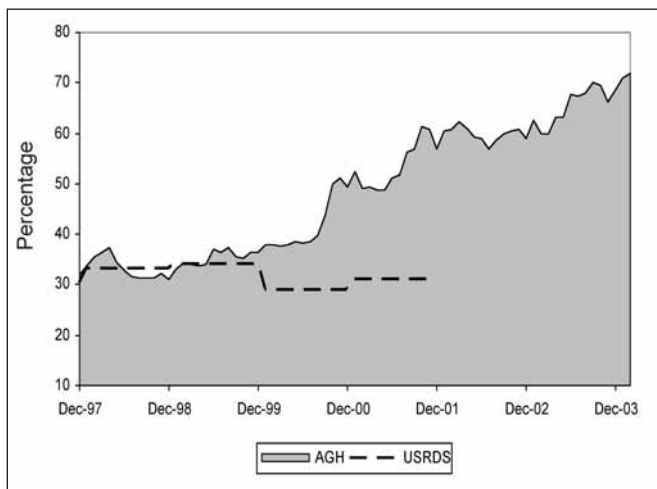


Fig. 1 - Percentage of patients with AV fistulae over time. Data obtained in this study at the Allegheny General Hospital are compared to those reported in the USRDS.

access devices, many organizations involved in promoting the quality of hemodialysis have issued guidelines calling for increased deployment of fistulae in both incident and prevalent hemodialysis patients. The Guidelines for Vascular Access of the Kidney Disease Outcomes Quality Initiative (K/DOQI) state that "Primary AVF should be constructed in at least 50% of all new kidney failure patients electing to receive hemodialysis as their initial form of renal replacement therapy. Ultimately 40% of prevalent patients should have a native AVF." (9) This recommendation has been echoed by the National Vascular Access Improvement Initiative (NVAII) in their Fistula First program, as well as by the Healthy People 2010 Program (10, 11). Examination of available information from the United States Renal Data System (USRDS) shows that the reality of American hemodialysis has failed to reflect these guidelines. The fistula rate in prevalent patients on HD has been level at 28-34% (Fig. 1). The Centers for Medicare and Medicaid Service's (CMS) mirrors this suboptimal scenario in an analysis of data from the Clinical Performance Measures (CPM) Project. In 1999, only 28% of patients dialyzed via AVF, with 49% dialyzing via AVG, and 23% via percutaneous catheters (12). The disparity between the published guidelines and the actual vascular access rates has led to controversy in nephrology. Many practitioners assail the guidelines as unrealistic and unachievable under the constraints of realistic practice conditions (13, 14). Barriers to AVF deployment are attributed to patient preference and unfavorable anatomy, lack of surgical support, and late referral of patients to nephrologists and vascular surgeons (6, 10, 13-14).

Our study was designed to determine if the K/DOQI Guidelines for Vascular Access could be achieved in a "real-world" dialysis program.

METHODS

The Allegheny General Hospital (AGH) Dialysis Program is an outpatient hemodialysis facility located in an urban community. Vascular access rates are reported to ESRD Network 4, which covers all dialysis programs in Delaware and Pennsylvania. For the purposes of this reporting, any patient with a central venous catheter was considered to be a catheter patient, even if an AV fistula was present and in use, until the catheter was actually removed. The study was undertaken in January 1998 due to increased interest in vascular access taken by the nephrologists, vascular surgeons, and the dialysis unit staff. A multidisciplinary program was undertaken to promote the placement of fistulae in incident and prevalent patients, and to encourage the conversion of grafts and catheters to autogenous fistulae. No funding was available for the establishment of the program, and interventions were designed to use only the resources available under ordinary practice conditions. The following initiatives, most of which involved interdisciplinary communication, were selected:

1. Patients were exposed to large amounts of discussion and persuasion, to increase interest and understanding of the need for AV fistulae. A pre-dialysis education program, designed according to K/DOQI workgroup recommendations (16), was available to patients of all nephrologists, to supplement the persuasive efforts of the physicians. Patients recruited for pre-dialysis education met with a multidisciplinary team, and received education about vascular access options from an experienced dialysis nurse. Patients hospitalized for vascular access complications received counseling from nephrologists, renal fellows, and all members of the dialysis staff, and were encouraged to undergo vein mapping, vascular surgery assessment, and vascular access revision surgery. Patients were also recruited during hospitalization for medical conditions unrelated to vascular access devices, if an AV fistula was not in place. Patients indicating an initial interest in peritoneal dialysis were considered at high risk for needing HD, and encouraged to undergo pre-emptive fistula placement.
2. Effort was made to conserve the integrity of native veins during hospitalizations. Orders protecting potential fistula veins were written in charts, and rewritten with every change in patient venue.

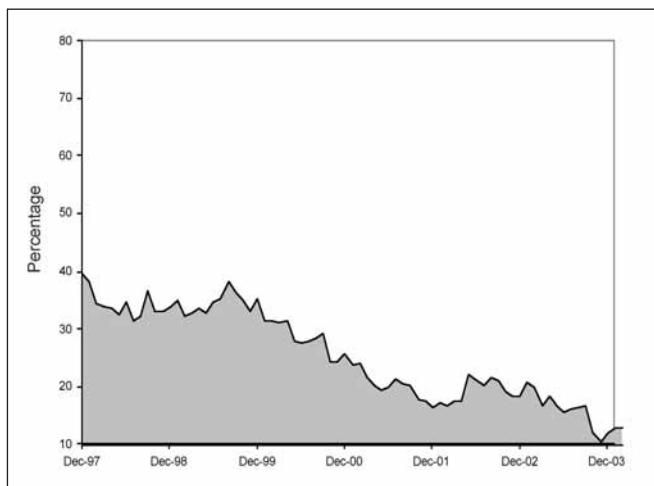


Fig. 2 - Percentage of patients with AV grafts over time.

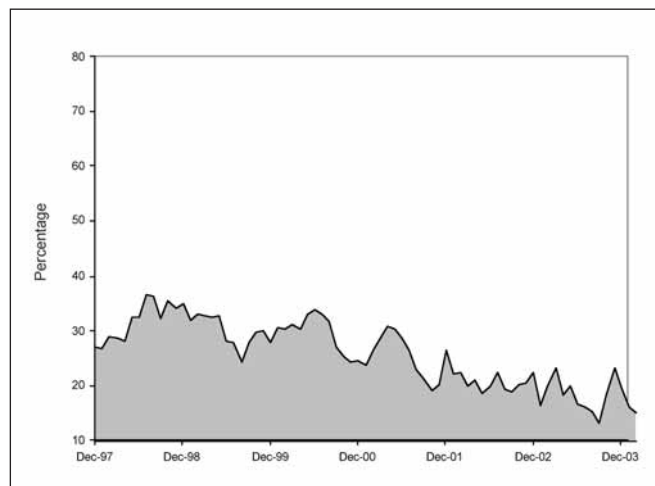


Fig. 3 - Percentage of patients with percutaneous catheters (including patients who have maturing or resting fistulae.).

Bracelets were placed on arms, and signs mounted on bedside walls. Wherever possible, colleagues were persuaded to defer non-emergency venipuncture until the time of hemodialysis. Patients were educated to take an active role in the defense against unnecessary venipuncture. Nephrologists took an active role in the planning of all central venous access in dialysis patients, and pre-dialysis patients.

3. Aggressive referral patterns to surgeons with good autogenous outcomes were undertaken, with relentless referral away from surgeons with suboptimal outcomes, high rates of prosthetic graft material, and poor responsiveness to dialysis program needs. During the fifth year of the initiative, a nine month period occurred during which dialysis patients were referred to an outside facility for vascular access surgeries, while a surgical staffing problem was being resolved. Dialysis unit policy was amended, authorizing the supervisory nursing staff to initiate vascular access referrals on any patients not already referred to surgeons, based on the previously stated preference of the individual nephrologist.

4. Widespread use of pre-operative vein mapping to guide surgical approach and select the most likely veins. Contrast venography was used heavily for guidance of revision and conversion surgeries, and to preserve, repair, and improve existing fistulae.

5. Comprehensive training of all dialysis professionals in the physical evaluation and cannulation of native AV fistulae. Education about the advantages of fistulae, and the liabilities of grafts and catheters, was made available to all staff.

The primary outcome of the study was the rate of AV fistulae in prevalent AGH hemodialysis patients reported to Network 4 between January 1998 and

TABLE I - BASELINE CHARACTERISTICS

Female	52%
Time on dialysis (months)	43.9
Diabetes	47%
Greater than 65 years old	36%
African-american	70%
Fistulae	32%
Grafts	40%
Catheters*	28%

*Any patient with a catheter is classified as a catheter patient, even if other access is available or in use

January 2004. Secondary outcomes were the rate of AV grafts and central venous catheters, patient vintage (duration of dialysis), as well as rates of infection, hospitalization, and mortality.

RESULTS

Hemodialysis enrollment has been stable at 90-100 patients over the past decade. Fistula rates had been stable at 29-34% over the 5 years preceding the study. Baseline characteristics of the dialysis population are described in Table I. In 1998, the prevailing AV fistula rate was 32%. Catheters and AV grafts were present in 28% and 40% of patients respectively. The AV fistula rate gradually increased over the study period (Fig. 1). Over the same period, the prevailing percentage of AV grafts reduced to 13% (Fig. 2). The percentage of central venous catheters reduced gradually, but far less steadily, over time, and was 15% by 2004 (Fig. 3). Of the re-

maining patients with catheters, 10 of 13 (77%) had a maturing or resting AV fistula in place. The AV fistula percentage has continued to exceed 70% since then, with 51.5% of fistulae in the forearm, and 48.5% of fistulae located above the antecubital fossa. Among residual AV grafts, 75% are located above the antecubital fossa. No fistulae or grafts are currently located in the femoral vessels of any of our patients.

Among our current patients, 51% are female. US-RDS data shows a disparity of fistula placement between male and female patients, with fistulae achieved in only about 20% of female patients, compared to about 40% of males. Among current female patients, 72% have fistulae, 17% have grafts, and 11% have catheters. In our male patients, 89% have fistulae, 9% have grafts, and only 2% have catheters.

The death rate was 1.8 ± 1.4 deaths per 100 patient months prior to this intervention, and 1.4 ± 1.3 afterwards ($p = 0.27$, NS). Patient vintage (length of time on dialysis) has increased from 44 months prior to intervention, to 48 months. Hospitalization rates were unchanged (15.2 ± 4.4 vs. 15.9 ± 3.9 episodes per 100 patient months, $p = 0.52$, NS). Urea Reduction Ratio (URR) increased from $76 \pm 16\%$ to $81 \pm 5\%$, but this did not meet statistical significance ($p = 0.202$). Vascular access infection rate (events per 100 patient months) reduced from 5.9 ± 2.8 to 2.6 ± 1.5 ($p = <0.0001$), and bacteremia decreased from 2.0 ± 1.9 to 1.1 ± 1.1 events per 100 patient months ($p = 0.026$). No cases of infectious endocarditis have been noted in the dialysis unit over the past 3 years.

DISCUSSION

In this study, a low-cost initiative based on a commitment to improved communication about vascular access issues resulted in substantial and sustainable improvements in the rate of achieving AV fistulae in prevalent hemodialysis units. Our fistula rate now exceeds the standards recommended in the NKF-K/DOQI Guidelines for Vascular Access, and high rates of successful fistula placement were achieved in both male and female patients. Much of the improvement resulted from a compensatory decrease in the employment of graft material, and conversion of existing grafts to fistulae, but the catheter prevalence was reduced by 46%, with nearly complete elimination of catheters as exclusive vascular access. The acknowledged superiority of fistula access suggests that improvements in infection rates, hospitalization rates, costs of care, and

survival, can be substantial. Catheter access has been observed to be a barrier to the delivery of adequate hemodialysis in ESRD Network 4 (15). Our results indicate that meaningful reductions in the rates of vascular access infection and bacteremia result from an increase in the fistula rate, and we are hopeful that the trends towards increased patient longevity and improved survival will become statistically significant over time.

No special resources or funding were committed to this program, which was developed in an environment of intense cost consciousness. Our patient population had many demographic risk factors for low AV fistula rates, and had considerable social and economic barriers to care. Our experience was that enhanced communication could breach these barriers, providing that sufficient energy and persuasion was employed. Meaningful change occurred when effective communication came from all members of the health care team, including nurses, nephrologists, surgeons, radiologists, dialysis technicians, ultrasound technicians, phlebotomy teams, IV teams, Emergency Department staff, social workers, and dieticians. Change could be delayed or even prevented whenever members of the health care environment deviated from a unanimous endorsement of the central communication strategy. Patient resistance to surgical intervention has diminished as an increasing pool of outpatients with good outcomes has occupied the dialysis unit. Patient-to-patient persuasion is a welcome development that reflects the development of a "fistula culture" throughout our dialysis unit.

Although our study was designed independently of the Fistula First Initiative, the activities chosen were quite similar. Our study featured more emphasis on protection of native veins, especially in inpatient settings. We included no strategy for facilitating and accelerating nephrology referral. Our success in an economically challenged, non-utopian environment, suggests that Fistula First initiative programs should be successful, when energetically applied.

Our results may not be applicable to programs with insurmountable geographic barriers to the necessary surgical and radiological talent, or programs where multidisciplinary consensus cannot be achieved. Our study provides no data on the outcomes of outside dialysis patients who underwent surgery as a result of our initiative, but received their follow up care outside of our institution. A future challenge will be the effective delivery of technical resources to dialysis programs in more remote areas, and the development of data resources to measure the impact of such initiatives.

CONCLUSIONS

A comprehensive multidisciplinary commitment to vascular access can improve the fistula rate in a large outpatient hemodialysis program, over a six year period. The NKF-K/DOQI guidelines can be reached for both male and female dialysis patients via such an effort, even in non-ideal environments. Similar programs, such as the National Vascular Access Improvement Initiative, have the potential to increase the AV fistula rate substantially in the United States. Large-scale clinical benefits can be reasonably expected to result from the reduction of catheter complications.

Address for correspondence:
Rita L. McGill, MD
320 East North Avenue
Pittsburgh, PA 15212-4774 - USA
rmcgill@wpahs.org

Presented in poster form, on October 29, 2004 at the American Society of Nephrology Meetings, St. Louis, Missouri, USA

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