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High rate of fistula placement in a cohort of dialysis patients in a single payer system

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Abstract

Arteriovenous fistulas (AVFs) are considered superior to arteriovenous grafts and catheters. Never-theless, AVF prevalence in the United States remains under the established target. The complication rates and financial cost of vascular access continue to rise and disproportionately contribute to the burgeoning health care costs. The relationship between financial incentives for a type of vascular access and rate of access placement is unclear. All chronic hemodialysis patients (n=99) receiving care at Philadelphia Veterans Affairs Medical Center as of August 1, 2008 were participants. Demographic characteristics, vascular access type, and nonrelative value unit compensation were assessed as predictors, and the vascular access prevalence rate, operative times, and frequency of access interventions were analyzed. A 73.7% AVF rate was achieved in this cohort of patients with 51.5% diabetes mellitus. The number of access procedures per patient per year remained constant over time. The Philadelphia Veterans Affairs Medical Center, a single payer system, achieved superior AVF prevalence and exceeded the national AVF target. Financial incentives for arteriovenous graft placement currently exist in the United States, as there is similar Medicare reimbursement for arterio-venous graft and basilic vein transposition, despite longer operative times for basilic vein transpositions. The high AVF prevalence at the Philadelphia Veterans Affairs Medical Center may be due to the VA nonrelative value unit-driven system that allows for interdisciplinary care, priority of AVFs, and frequent use of basilic vein transposition surgery, when appropriate. We have identified an important, hypothesis-generating example of a nonrelative value unit-based approach to vascular access yielding superior results with respect to patient care and cost.

Keywords

Fistula; hemodialysis; health care economics

INTRODUCTION

A durable vascular access with minimal complications and high blood flow rates is a critical component of the care for patients with end-stage renal disease (ESRD). Unfortunately, complications of vascular access are a cause of significant morbidity and mortality, and are responsible for an increasing share of hemodialysis-related cost.¹ 2006 United States Renal Data System (USRDS) data show that vascular access-related infections have increased by 105% since 1993.² Expenditures on vascular access have also increased, with central venous catheter (CVC) costing the most per person per year (PPPY).²

The arteriovenous fistula (AVF), graft (AVG), and the CVC are currently the mainstay of long-term dialysis access. The AVF is recommended by the National Kidney Foundation and Kidney Disease: Improving Global Outcomes (KDIGO) as the access of choice. Several retrospective studies and a few nonrandomized prospective studies have shown that AVF have superior patency rates, and lower rates of complications, such as stenosis and infection. AVFs are also more cost-effective than other forms of access.^{3,4} According to 2006 USRDS data, the cost of maintaining dialysis access PPPY is lowest for AVF (US\$3284), compared with CVC (US\$6828) and AVG (US\$7377).²

Despite its well-established superiority, the native AVF was used in <25% of patients initiated on hemodialysis in the United States in the 1990s.⁵ In order to improve vascular access outcomes, the Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines of 1997 recommended that native AVF be considered as the preferred access in at least 50% of patients.⁶ One reason for the low rate of AVF in the United States may be the fee-for-service-based reimbursement system, which favors AVG. For example, Medicare reimbursement for a basilic vein transposition (BVT) is US\$864, or 14.39 relative value units (RVUs), vs. US\$717, or 12.00 RVUs, for a graft, despite BVTs requiring significantly more operative time than grafts (see “Results”).⁷

To investigate the effectiveness of a single payer system on AVF prevalence, we conducted a retrospective cohort study of dialysis patients in the single payer system at the Philadelphia Veterans Affairs Medical Center (PVAMC). We hypothesized that this non-RVU-based system, which is largely free of financial incentives favoring AVG placement, helps promote a collaborative effort among nephrologists, vascular surgeons, and interventional radiologists to increase the AVF prevalence. A multidisciplinary and systematic pre-operative and postoperative approach as in our model has been reported to enhance the creation and maintenance of increasing numbers of AVF in dialysis patients.⁸ Here, we report an evaluation of a single payer system on vascular access rates.

METHODS

The study cohort consisted of the point prevalent population of chronic hemodialysis patients from the PVAMC as of August 1, 2008 (n=99). This study was approved by the PVAMC Institutional Review Board, which waived the requirement for informed consent. Each subject's electronic medical record was interrogated, and data regarding age, diabetes status, and dialysis access type were abstracted. As well, the interventional radiology database was assessed for trends in the need for percutaneous intervention for each year

between 2002 and 2008. Finally, the operative times for patients who received either BVT or AVG were analyzed.

All analyses were performed using STATA 10.0MP (College Station, TX, USA). The distribution of categorical variables was expressed as counts and proportions, and compared across groups using contingency tables and Fisher's exact test. The distribution of continuous variables was examined graphically and presented as medians and interquartile ranges; comparisons were made across groups using the Wilcoxon rank sum and Kruskal-Wallis tests as appropriate. A P value of <0.05 was considered statistically significant. Confidence intervals for proportions and rates were calculated assuming underlying binomial and Poisson distributions, respectively; the exact method was used in each case.

RESULTS

As of August 1, 2008, there were 99 patients receiving chronic hemodialysis through the Philadelphia Veterans Affairs Medical Center. The demographics of the cohort and subgroups defined by dialysis access are shown in Table 1. The patient population was exclusively male; mean age was 61.7 ± 11.2 years and 51.5% of subjects had the diagnosis of diabetes mellitus. There was no significant difference between the three access groups in age or rate of diabetes. Overall, 73.7% of our dialysis patients were dialyzing through an AVF as of August 1, 2008.

The AVF group was further divided into subgroups depending on the type of AVF created (Table 2). The most common type of AVF was the brachiocephalic fistula, followed by radiocephalic fistula and BVT. The number of dialysis patients and percutaneous access intervention procedures performed each year between 2002 and 2008 is shown in Table 3. In the calendar year of 2008, 98 procedures were done, or 0.99 procedure per patient per year. The number of access procedures per patient per year remained relatively constant over the 7 years.

The median (interquartile range) operative times from initial incision to closure were 105 (87–131) minutes for a BVT (Current Procedural Terminology [CPT] code 36819) and 78 (64–93) minutes for an AVG (CPT code 36830) ($Z=4.65$, $P<0.001$ by Wilcoxon rank sum test). This is consistent with data we obtained from The American College of Surgeons National Surgical Quality Improvement Program Participant User File for 2005 to 2008. The PUF was accessed for all patients undergoing a BVT operation with a primary CPT code of 36819. Of 1644 potential records, 47 were excluded because of missing or unreasonable values. The remaining 1579 patients receiving a BVT had a mean operative time of 122.4 ± 42.8 minutes. NSQIP did not include records for CPT code 36830 in their database. Comparing NSQIP BVT data and our AVG data, operative times were 57% longer for BVT than AVG, and 35% longer when our BVT/AVG data were used.

DISCUSSION

As the prevalence of ESRD continues to rise, the significance of optimizing renal replacement therapy becomes an increasingly poignant public health concern. Data indicate that hemodialysis continues to be the most commonly utilized renal replacement modality, yet its provision is hampered by suboptimal use of AVFs. For many years, AVFs have been recognized as superior access to all other options for hemodialysis. The advantages are numerous, and help achieve the overarching goals of improving patient survival and quality of life, efficiency of care, and cost containment. On average, an AVF will require 3-fold to 7-fold fewer interventions over its lifetime than an AVG, despite a longer cumulative patency.^{5,8,9} AVFs are also associated with fewer infections and hospitalizations, and in

turn, lower mortality. Finally, the cost of establishing and maintaining an AVF is 2 to 5 times lower than those with an AVG.^{3,5} A recent study by Bittl et al. found economic support for pre-emptive placement of AVF, while showing a modest primary functional benefit of pre-emptive angioplasty for functional AVF.¹⁰ While there are down sides to using an AVF, including the longer maturation time, higher primary failure rate and poorer monitoring tools, those negatives are consistently outweighed by the established benefits, from the perspective of the individual patient and the health care system. The risks associated with nonfistula-based accesses remain of great concern, and have resulted in campaigns to achieve a higher rate of AVF use across the United States, as put forward by KDOQI and KDIGO, with the newest goal being 66% by 2009.^{9,10,11} However, it should be noted that the national prevalence of AVF was only 45% per the USRDS ADR 2008.¹²

This issue becomes even more important, given the significantly greater morbidity and mortality seen in dialysis patients in the United States vs. Europe and Japan. A recent paper by Pisoni et al. showed that more than half the 30% to 43% greater (case mix-adjusted and hemodialysis practice-adjusted) mortality risk for hemodialysis patients in the United States vs. the remaining countries from the Dialysis Outcomes Practice Patterns Study (DOPPS) (France, Germany, Italy, Japan, Spain, United Kingdom, Australia, Belgium, Canada, New Zealand, and Sweden) was attributable to differences in vascular access practice, specifically less use of AVF and more use of AVG/CVC in the United States.¹³ It should be noted that the other countries in the DOPPS trials have single payer systems that do not incentivize AVG placement, and we hypothesize that this is a major reason for the better dialysis outcomes seen in those countries.

Recently, it has been shown that a transposed basilic vein is a viable alternative to other AVF and is superior to an AVG.¹⁴⁻¹⁶ The advantages of BVTs, compared with AVG, include lower rates of thrombosis and infection, lower repeat intervention rates, and equal-to-better patency rates.¹⁷ As well, BVTs only require one anastomosis, thereby reducing the likelihood of peri-anastomotic stenosis, and placement of a BVT does not preclude future placement of an AVG if the procedure becomes necessary. Therefore, transposed AVF appear to provide an attractive access option when other primary AVF sites are exhausted. In this single-center VA hospital study, we have shown that it is possible to achieve AVF rates higher than KDOQI goals through the use of BVTs, along with adoption of a multidisciplinary approach, with no change in the number of interventions per year in this patient population.

The National Vascular Access Improvement Initiative statement recommends a multidisciplinary approach to protocol-driven surveillance programs for surveillance and early intervention for failing vascular access conduits.¹⁸ Yet, there has been little published on the benefit of a multidisciplinary team, which also addresses pre-operative planning and work-up. A vascular surgery team in the Netherlands recently described their findings that an optimized care protocol, which emphasized a bimonthly multidisciplinary meeting for pre-operative workup and postoperative surveillance, resulted in an increased proportion of endovascular balloon angioplasties over surgical revisions, with less patient morbidity, and improved secondary patency.¹⁹ Our results suggest that it is possible to improve outcomes related to AVF access in a population with chronic comorbidities by adopting a multidisciplinary approach, which in turn may limit the need for access interventions. This was despite the population having a >50% prevalence of diabetes mellitus, with diabetes having been shown to increase the length to first use by over a month and decreased patency rates of venous access.²⁰⁻²³ The VA team, which meets on a weekly basis to address access care needs of the patient population, collaborates to ensure that the best access is placed and maintained for each patient, per KDOQI guidelines. As the team evaluates a patient's candidacy for AVF, they consider a 3-mm cutoff for placement, including for BVT. We

speculate that one reason this multidisciplinary approach has worked so well, is that the competing financial interest to place an AVG, that exists in the current fee-for-service system, is not present at the Philadelphia Veterans Affairs Medical Center.

There are limitations to this study, including it being a cross-sectional study of one health care institution. With 100% male patients in this study, we acknowledge that one may not be able to generalize the impact to female patients, who are more likely to have access complications. Yet we believe that our cohort is relevant in representing a prevalent population of ESRD patients with diabetes, which happens to be a high and increasing percentage of those on maintenance dialysis.²⁴ As it is a single-center study, we cannot account for any geographic differences in the rate of AVF placement, or the effects of surgical expertise. However, other reports from VA Hospitals show similarly high rates of AVF, such as O'Hare et al. reporting 72% of patients receiving an AV fistula as their initial form of permanent vascular access.²⁵

As the population of ESRD patients continues to grow, there will be great financial and health-based pressure to achieve a high percentage of AVF for incident and secondary access. Our study of all existing hemodialysis patients cared for at the Philadelphia Veterans Affairs Medical Center as of August 1, 2008 strongly suggests that it is possible to achieve a high rate of AVF by removing financial and time incentives for AVG placement, incorporating a multidisciplinary approach, and using BVT when appropriate. As the discussion surrounding a health care reform continues, improved outcomes and cost savings remain major goals for any plan. We submit that the structure in place at the Philadelphia Veterans Affairs Medical Center decreases the costs of hemodialysis access while improving patient care, and is hypothesis generating for future study, as it could be a model for future dialysis access care across the United States.

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Table 1

Demographics of study cohort overall and according to access type

	<u>All patients</u>		<u>AVF</u>		<u>AVG</u>		<u>Catheter</u>		P
	(n=99)		73		13		13		
Male (%)	100		100		100		100		1.0*
Age (mean $\pm$ SD) (years)	61.7 $\pm$ 11.2		61.9 $\pm$ 11.4		58.2 $\pm$ 12.3		63.9 $\pm$ 8.0		NS#
Diabetes (%)	51.5		52.0		46.1		53.8		>0.9*

* By Fisher's exact test.

By Kruskal-Wallis test.

AVF=arteriovenous fistula; AVG=arteriovenous grafts; NS=not significant.

Table 2

Prevalence of arteriovenous fistula types (N=73)

	Number	Percentage of total (95% CI)
Basilic vein transposition	19	26 (16–38)
Radiocephalic	23	32 (21–43)
Brachiocephalic	28	38 (27–50)
Others	3	4.1 (1.0–12)

Table 3

Total number of chronic hemodialysis patients and percutaneous interventions per calendar year

Year	Dialysis patients (n)	Percutaneous access procedures (n)	Incidence rate (95% CI) (procedure per patient per year)
2002	28	36	1.29 (0.90–1.78)
2003	30	24	0.80 (0.51–1.19)
2004	33	32	0.97 (0.66–1.37)
2005	37	26	0.70 (0.46–1.03)
2006	44	45	1.02 (0.75–1.37)
2007	76	63	0.83 (0.64–1.06)
2008	99	98	0.99 (0.80–1.21)