A Multidisciplinary Team Approach to Increasing AV Fistula Creation

A community-based nephrology practice experience

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The two types of permanent hemodialysis (HD) vascular access currently in use are the native arteriovenous (AV) fistula and the AV graft. Studies have pointed to a higher survival rate of AV fistulae compared to AV grafts. Thrombosis tends to be a frequent occurrence with AV grafts. Furthermore, the majority of thrombosed grafts will fail again after revascularization (by endovascular or surgical methods) within 6 to 12 months.[1,2] Unfortunately, only 27% of prevalent HD patients in the United States currently have an AV fistula as a permanent access.[3]

A multidisciplinary vascular access care program established by Gambro Healthcare has proven effective in implementing the National Kidney Foundation Dialysis Outcomes Quality Initiative (DOQI) guidelines for vascular access.[4] Since 1996, a multidisciplinary team approach has been used in our Renal Care Group dialysis program in the Olympia, Wash., area to increase the use of AV fistulae. The program has been successful. A recent review of Olympia-area d/ialysis patients showed that 98% of our patients have an AV fistula, with 87.7% of patients using the AV fistula for dialysis access and 10.2% using an HD catheter until the AV fistula matures. All AV grafts have been converted into secondary AV fistulae over a four-year period, and we have greatly reduced the use of HD catheters.[5]

Although the multidisciplinary program was developed in a small community-based nephrology practice, this type of approach toward the creation of optimal HD accesses was adopted by the Northwest (NW) Renal Network (#16) in 2002 as the basis for the Network's Quality Improvement Program (QIP) for vascular access, mandated by the Centers for Medicare & Medicaid Services (CMS) to increase the use of AV fistulae as dialysis accesses at facilities within the Network.

Background

Prior to 1996, the vascular surgeon who worked with our dialysis program was the only person involved in decision making and creation of the access. Once the access was created, the surgeon was no longer involved—until the access *expectedly* failed. The nephrologist was not interested in selecting the type of access or managing the access placement process. In fact, there was no active access management at all. The majority of patients were dialyzed with AV grafts and HD catheters.

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In 1996, our dialysis program received a warning letter from the NW Renal Network regarding the high rate of AV graft failure among our patients. A team of nephrologists and vascular surgeons began to meet regularly to analyze the root causes of recurrent vascular access failure and to implement necessary steps to correct the problems. The immediate conclusion was that the AV graft was not an optimal access. Grafts failed frequently despite close monitoring of access function, and required prospective angioplasty every three to six months in our program.

With the issues identified by the vascular access team, we mapped out a plan of correction.

The Problem

First, we examined who might be responsible, including:

- Primary care physicians—They often provided late referral to the nephrologist.
- Patients—Our patients had high comorbid factors with less than optimal blood vessels for fistula creation, requiring longer fistula maturation time and often more than one surgery to achieve a mature fistula. Patients are resistant to early fistula surgery as long as they are still free from uremic symptoms.
- Nephrologists—They often provided late referral to the surgeon. They had a total lack of interest and involvement, with no training in fistula creation.
- Surgeons—There was an absence of routine preoperative vein mapping and long-term access planning due to late referral.
- Dialysis staff—They lacked proper training in cannulation of frail fistulas in elderly diabetic dialysis patients. There was a high incidence of accidental hematoma or failure to cannulate the fistula.

We also found that there was no dialogue between the nephrologist, other medical professionals, and the patients.

The Solution: A Multidisciplinary Approach

We then decided to take a multidisciplinary team approach to resolving the problem. Again, we mapped out our strategy and examined the "who" part of the equation.

- Primary care physicians—A letter was sent to each primary care physician to inform him or her of the importance of early referral (see sample letter, p. 61). Follow-up phone calls were made each time a late referral occurred.
- Patients—They were educated about the importance of early fistula creation and the potential need for several surgeries before a mature fistula could be achieved. The nephrologist's role in the education of patients and caregivers is key in facilitating effective dialysis access placement, including education regarding vein preservation for future fistula creation. We also stressed the importance of predialysis orientation classes developed by the multidisciplinary team.
- Nephrologists—Training the process of fistula creation is required, including preoperative vein mapping and vein selection, the hemodynamics of fistula creation, and vascular surgery techniques. It is recommended that the nephrologist become familiar with diagnostic imaging department procedures and schedule time in the operating room to observe access placement surgery.
- Surgeons—Preoperative planning is done for every patient; vein mapping by physical examination or Doppler vessel mapping is performed. New surgical techniques—transposition of upper arm, deeper cephalic and basilic veins,[6] and the Gracz procedure[7]—are introduced.
- Doppler technologists—Proper training in vein mapping technique is required.
- Dialysis staff—A dialysis access coordinator is designated to educate other staff about the difference in techniques used when cannulating a fistula versus cannulating a graft, and to introduce alternative fistula cannulation techniques, such as constant-site (buttonhole) cannulation,[8] the use of silicone intravenous catheters for cannulating new AV fistulae, and the use of Doppler devices to assist cannulation. Staff members who are experts in cannulation are identified to access new or difficult fistulae. The access coordinator stresses the importance of sterile technique in using the HD catheter access to prevent sepsis. He or she supervises the monitoring of access function with a focus on early intervention and prevention of access thrombosis.

Next, we decided how to implement the solution.

- Mapping—This is required if physical examination fails to detect suitable veins. Arteries are selected with a minimum internal diameter of 2 mm (required without calcification or stenosis). Selection of veins is also made with a minimum diameter of 2–3 mm required. Dilatation is expected to be at 50% with compression by a tourniquet.[9] If the vein is too deep (more than 10 mm), transposition will be necessary.
- Systematic creation of secondary fistula from failed grafts—Failed grafts are no longer revised. While the AV graft is still functioning, the nephrologist performs vein mapping either by physical examination or Doppler. Long-term planning for each patient is documented in writing and updated monthly as needed.

When the graft thromboses, the surgeon creates a secondary fistula based on the nephrologist's long-term plan. If the vein is too deep, transposition surgery is also required in order to create a usable AV fistula, and a tunneled HD catheter is also placed as a transitional access.

If the newly created secondary fistula is superficial enough, it may be used immediately without the need of a catheter. The nephrologist usually refers these cases to surgery before the graft actually thromboses, when the dialysis staff notices clinical signs of impending graft thrombosis.

If no arterialized veins are found on vein mapping (forearm grafts with stenotic upper-arm outflow veins or upper-arm grafts), a primary AV fistula is created in the contralateral arm while the graft is still functioning. When the graft fails, the fistula should be ready for use, thus avoiding the placement of a transitional HD catheter.

- Early referral—The goal is at least three months prior to the patient's expected need for dialysis. The nephrologist per-

forms vein mapping using a tourniquet during the first office visit. Patient and family members are instructed about vein preservation during the first visit. The arm with the best veins will be protected, whether it is the dominant one or not. Needlesticks are allowed primarily in hand veins and posterior forearm basilic veins. A prescription is written for each patient to present to the laboratory phlebotomist at the time of each blood draw.

Doppler vein mapping of most patients at risk (diabetic, elderly, or those with cardiovascular disorders) is done in preparation for early fistula creation. Timing of surgery depends on the patient's cardiovascular status and assessed quality of targeted vein(s). If arm vessels are of poor quality and the patient is at risk of an acute ischemic coronary event (leading to acute congestive heart failure and pulmonary edema and unexpected emergency need of dialysis), fistula creation is done at least a year before the need of HD, even when serum creatinine levels are only 2–3 mg/dL. Distal radiocephalic fistula (Cimino) will be the first choice, if appropriate. Patient and family will be instructed by the nephrologist about the higher risk of primary failure of Cimino and the potential need for additional surgery.

In addition, fistulae are placed in all pre-end-stage renal disease patients regardless of their future choice of renal replacement therapies including peritoneal dialysis (PD) and renal transplant.

- Late referral—No grafts are used; urgent surgical consult as indicated. The nephrologist performs vein mapping before calling the surgeon personally, indicating recommended timing for surgery and recommended site for access placement. If vessels are suitable and patient expected life span is high, a Cimino fistula is preferable. If the patient has poor distal vessels and an expected short life span, an upper-arm fistula is preferable due to its higher rate of success and shorter maturation time.[6] The RRT transitional access to be placed can include a tunneled HD catheter, or a PD catheter with PD as the mode of renal replacement therapy until the fistula matures.
- New surgical approaches—Changes in dialysis patient population demographics (see Table 1) include higher rates of diabetes mellitus and cardiovascular disease; the advanced age of our patient population has required appropriate changes in surgical procedures. There is a higher use of upper-arm fistulae (see Table 2) due to poorer distal vessels in this patient population. Prevention of steal syndrome is mandatory; a smaller anastomosis is created (less than 4 mm) and intraoperative Doppler monitoring of distal arterial blood flow is done with adjustment of anastomosis size before closing the incision. Transposition of deep veins is completed in 32.6% of our patient population (see Table 2, p. 58), using mostly upper-arm veins, basilic and cephalic veins, and (rarely) the forearm cephalic vein as well. This is mandatory in obese patients and when the upper-arm basilic vein is used. Transposition is done in two stages: an AV anastomosis, followed by vein transposition two months later. Doppler mapping is required for vein reassessment prior to transposition of the AV fistula. If the vein has already been arterialized by a forearm graft, transposition and anastomosis can be done in one step. Double outflow upper-arm fistula (Gracz procedure) is done, which arterializes both upper-arm cephalic and basilic veins using a perforating vein for anastomosis. This allows the use of both veins and reduces the risks of steal syndrome and potential injury to the anastomosis.

Results

We implemented our new vascular access policy in 1996. With yearly improvements, we no longer had any AV grafts in use in our prevalent population by 2001, with the exception of an occasional patient who transferred to our clinic from an area in which many AV grafts were placed. Table 2 (see p. 58) shows the distribution of vascular access types. By 2001, 98% of total patients had an AV fistula. Of those, 87.7% had an adequately mature fistula that was currently used. Among our patients, 12% were dialyzed with a catheter. Among those catheter patients, however, 10.2% had both a catheter and a maturing fistula.

A majority of fistulae were upper-arm fistulae: 41.6% brachiocephalic and 22.9% brachiobasilic. Only 35.4% were radiocephalic; 32.6% of AV fistulae were transposed. Some degree of steal syndrome was reported in 10.8%. Preoperative Doppler mapping was used in 65% of patients.

The predominant use of upper-arm fistulae and the need for preoperative Doppler assessment and vein transposition reflect a different and more vulnerable dialysis population compared to the one in the 1980s (see Table 1, p. 58). The average age of our current population is older, at 62.2 years (standard deviation 13.6); there are more female patients (65%), and these patients have increasing numbers of comorbid conditions (diabetes mellitus = 71.4%; ischemic vascular diseases = 63%; obese = 28%, and late referral = 22%).

Discussion

Over the past two decades, the dialysis patient population in the United States has undergone profound changes. Dialysis patients are older with higher comorbid factors, not unlike our own patients in the Olympia area. It has become much more challenging to care for these patients, especially in regard to their vascular access. Many individuals are presenting to the nephrologist very late in the progression of their renal disease. Repeated phlebotomies and intravenous catheters have destroyed their superficial arm veins. Their distal radial arteries tend to be calcified and stenotic and unsuitable for fistula creation. Fistula creation is more problematic, and requires time and creative multidisciplinary effort to succeed.

Early referral requires the involvement of the patient and his or her primary care provider. In many instances, preoperative selection of suitable blood vessels requires Doppler mapping in addition to routine physical examination. Specialized surgical approaches are needed—increased use of the upper arm for AV fistula placement, prevention of steal syndrome by careful assessment of anastomosis size, and transposition of deeper veins to allow easy cannulation.

Dialysis staff need to be trained in cannulation techniques of the AV fistula, including differences in cannulation of grafts and fistulas, buttonhole techniques, and the use of but-

tonhole blunt-tip needles, silicone catheters, and Doppler devices to assist cannulation.

Summary

Despite high patient comorbid factors, our Renal Care Group program was able to totally eliminate placement of AV grafts and to use only fistulae with an acceptable rate of catheter use—all within four years' time. This demonstrated the importance and value of a multidisciplinary vascular access team. Organization was the key element. All the team members were already in place prior to 1996, but they were not focused on vascular access and lacked education in this area. With the nephrologist not trained in fistula creation and not involved in that process, the absence of leadership led to a high number of dialysis grafts and catheters and frequent thrombotic and infectious complications.

The nephrologist must assume the team leadership since he or she is the only provider who can interact with all other team members (see Table 3, p. 60). It is recommended that each nephrology group select a lead nephrologist to begin the team-building process (see Table 4, p. 60).

A checklist (see Table 5) should be maintained for each pre-dialysis or dialysis patient as documentation for vein mapping and a surgical plan. This will make preoperative vein mapping mandatory for every patient.

Education is important at all levels of the multidisciplinary team. This training effort should be started during nephrology fellowship, surgery and radiology residency, dialysis staff education programs, and renal networks. In 2002, the NW Renal Network led the way with fistula creation seminars, focusing on practicing nephrologists, surgeons, radiologists, and dialysis caregivers. The result of this Vascular Access Quality Improvement Program is pending. ■

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