Dialysis Access in Europe and North America: Are We on the Same Path?

Maurizio Gallieni, M.D.,[1,2] Ramesh Saxena, M.D., Ph.D.,[3] and Ingemar Davidson, M.D., Ph.D., F.A.C.S.[4]

ABSTRACT

Large differences in dialysis access exist between Europe, Canada, and the United States, even after adjustment for patient characteristics. Vascular access care is characterized by similar issues, but with a different magnitude. Obesity, type 2 diabetes, and peripheral vascular disease, independent predictors of central venous catheter use, are growing problems globally, which could lead to more difficulties in native arteriovenous fistula placement and survival. Creation of dedicated dialysis access teams, including a vascular access coordinator, is a fundamental step in improving vascular access care; however, it might not be sufficient. The possibility that factors other than patient characteristics and surgical skills are important in determining outcomes is likely; it might explain apparent contradictions of end-stage renal disease (ESRD) practices (kidney transplant, peritoneal dialysis, patterns of vascular access use in hemodialysis), where some countries excel in one area and score poorly in another. We are on the same path, but we have a long way to go.

KEYWORDS: Arteriovenous fistula, hemodialysis, vascular access, catheter, graft

Objectives: Upon completion of this article, the reader should be able to better interpret the differences existing in Europe and North America in the choice of treatment for end-stage renal disease, clinical characteristics of patients, and dialysis access use.
Accreditation: Tufts University School of Medicine (TUSM) is accredited by the Accreditation Council for Continuing Medical Education to provide continuing medical education for physicians.
Credit: TUSM designates this educational activity for a maximum of 1 *AMA PRA Category 1 Credit*™. Physicians should only claim credit commensurate with the extent of their participation in the activity.

Large differences in the approach to vascular access exist between Europe, Canada, and the United States, even after adjustment for patient characteristics.[1] However, striking differences also exist within different European countries, as well as among different end-stage renal disease (ESRD) networks in the United States. In the United States National Surveillance report for 2002, Finelli et al[2] reported that 41.6% of patients received dialysis through an arteriovenous graft (AVG), 32.7% through an arteriovenous fistula (AVF), and 26.3% through a temporary or permanent central venous catheter (CVC). Among the 18 U.S. ESRD networks

[1]Nephrology and Dialysis Unit, S. Paolo Hospital, Milan, Italy; [2]Department of Medicine, Surgery, and Dentistry, University of Milano, Italy; [3]Division of Nephrology, Department of Internal Medicine, University of Texas Southwestern Medical Center, Dallas, Texas; [4]Division of Transplant, Department of Surgery, Parkland Memorial Hospital, University of Texas Southwestern Medical Center, Dallas, Texas.

Address for correspondence and reprint requests: Maurizio Gallieni, M.D., Department of Medicine, Surgery, and Dentistry, University of Milano, Via di Rudini, 8, 20142 Milano, Italy (e-mail: maurizio.gallieni@unimi.it).

Update on Dialysis Intervention; Guest Editors, Sidney Regalado, M.D., and Steven M. Zangan, M.D.

Semin Intervent Radiol 2009;26:96–105.
DOI 10.1055/s-0029-1222452. ISSN 0739-9529.

designated by the Centers for Medicare and Medicaid Services (CMS), use of fistulas ranged from 25.4 to 53.4%.

In 2002, the first series of data was published on vascular access from the Dialysis Outcomes and Practice Patterns Study (DOPPS).[3] One of the goals of this prospective, longitudinal study of hemodialysis (HD) practices and associated outcomes was to examine vascular access use in the United States and in five European countries (France, Germany, Italy, Spain, and the United Kingdom [U.K.]). Facilities and patients were selected to provide nationally representative samples of the HD population in each country. The same data collection protocol was used in all countries allowing a direct comparison of outcomes across countries and types of facilities. In Europe, AVF accounted for 80% of all accesses, with 10% of patients using grafts. High AVF use was seen in all five European countries, ranging from 67% in the U.K. to 90% in Italy. In contrast, grafts were the predominant access type in the United States, comprising 58% of all accesses, with only 24% of U.S. patients using an AVF. Catheter use was 17% in the United States compared with 8% in Europe. The main finding of the study was that the facilities preferences and approaches to vascular access practice are major determinants of vascular access use, justifying, in part, the large differences in clinical practice found between Europe and the United States. However, the study also demonstrated significant differences in patient characteristics, Fig. 1 illustrates a representative U.S. patient with extreme deterioration of vessels, not uncommon in U.S. vascular access clinics and very rare in European renal units. U.S. patients were more likely diabetic (46% versus 22% of the population), affected by peripheral vascular disease (23% versus 19%), with a heavier history of angina pectoris (37% versus 25%). In addition, U.S. patients had a higher number of females (47% versus 43%), a higher mean body mass index (BMI; 25.1 ± 5.9 versus 24.1 ± 4.7 kg/m^2), and a shorter dialysis vintage (3.4 versus 5.1 years on HD). Strikingly, the adjusted odds ratio (OR) for the probability of having an AVF versus AVG among prevalent HD patients in Europe and the United States was 21 ($p < 0.0001$). Conversely, significantly unfavorable ORs (indicating that the covariate is associated with decreased odds of AVF use) were found for female versus male gender (OR 0.40), presence of peripheral vascular disease (OR 0.68), presence of diabetes mellitus (OR 0.76), history of angina pectoris (OR 0.80), age (for every 10 years older, OR 0.89), BMI (for every 3 unit increase, OR 0.92).

More recently, DOPPS investigators examined international trends in vascular access use and trends in patient characteristics and practices associated with vascular access use from 1996 to 2007.[1] In that period, AVF use rose from 24 to 47% in the United States and slightly declined in Italy and other European countries. More-

Figure 1 Patient referred for vascular access surgery, underscoring the difficulties that might be encountered in the US patient population. This patient had already undergone multiple procedures and at the time of referral she was dialyzed with two single-lumen tunneled catheters.

over, AVG use fell by 50% in the United States from 58% use in 1996 to 28% by 2007. Catheter use rose 1.5- to 3-fold among prevalent patients, even if nondiabetic. Furthermore, 58 to 73% of incident patients used a catheter for the initiation of HD in five countries despite 60 to 79% of patients having been seen by a nephrologist more than 4 months prior to ESRD. Patients were significantly less likely to start dialysis with a permanent vascular access (VA) if treated in a facility that had a longer time from referral to access surgery evaluation or from evaluation to access creation. Longer times from access creation until first AVF cannulation were associated with higher catheter use as well. Across three phases of data collection, patients consistently were less likely to use an AVF versus other VA types if female, of older age, having greater BMI, diabetes, peripheral vascular disease, or recurrent cellulitis/gangrene. In addition, countries with a greater prevalence of diabetes in HD patients had a significantly lower percentage of patients using an AVF.[1] To better assess similarities and differences among different countries in the field of dialysis access, we summarized in Table 1 information derived from different studies.[1,4–8]

It appears that specific country-related and facility-related factors have a major influence in the choice of dialysis access. According to our ideal approach

Table 1 United States, Canada, Japan, and Europe: Similarities and Differences in Chronic Kidney Disease Patients and in Clinical Care

	USA	Canada	Japan	Europe (Range)	Italy	Sweden	Germany
Prevalent dialysis patients/pmp	1563	628	1857	(126–998)	755	800	998
Incident dialysis patients/pmp/year	342	154	267	(84–213)	147	122	213
Mortality rate for dialysis patients (%)	20.7	14	9.7	15.9	14.1	20	16.3
Transplants/pmp	57.6	32.3	<1	(5.3–77.1)	30.1	41.5	30
Age of prevalent patients (years; *mean or **median)	54.4*	65**	66*	(57–71)**	70.8**	59.9**	70**
Diabetes (%)	45.6	35	41.9	(17–40)	22.9	24.9	34.2
BMI >25 (%)	63	47	21	NA	44	40	60
Peripheral vascular disease (%)	27.5	32.3	11.5	(17.5–37.8)	18.6	23.1	28.8
Peritoneal dialysis (%)	7.8	18.9	3.7	(4–47)	10	21	4
Prevalent AVF (%)	47	50	91	(57–83)	83	59	80
Prevalent grafts (%)	28	11	7	(2–13)	5	13	10
Prevalent CVC (%)	25	39	2	(10–41)	12	28	10
Incident AVF (%)	16	26	69	(26–72)	60	31	72
Incident grafts (%)	15	4	1	(0–9)	0	9	5
Incident CVC (temporary or tunneled) (%)	69	70	26	(23–73)	40	58	23

NA, not available; pmp, per million population; BMI, Body Mass Index; AVF, arteriovenous fistula; CVC, central venous catheter.
Data derived from references 1,4,5,6,7,8.

to advanced chronic kidney disease (CKD) treatment (Table 2), the best health system should have a high prevalence of transplanted patients, peritoneal dialysis patients, and, among patients treated by HD, a high rate of native AV fistula as vascular access.

As we can see from Table 1, Japan has the best prevalence of AVF and very good survival rates, but very low peritoneal dialysis (PD) and transplant rates. Germany has the lowest prevalence of CVC in Europe, but their performance in PD is the worst. Canada and Sweden have the best PD rate among the countries considered, but they have a very high prevalence of CVC. The United States has the best transplant rate, but does not fare well in PD and in vascular access (low AVF), as well as in survival for dialysis patients, despite the fact that it has excellent doctors with well-recognized publications, who have access to solid grants for high-quality initiatives, like the Fistula First Initiative[9] and the Dialysis Access Clinical Trials Consortium.[10] The United States Renal Data System (USRDS) also provides interesting data on vascular access practices.[11] The information provided refers to prevalent HD patients and includes catheter, AVF, and graft placements (expressed as number of events per 1,000 patient years). In addition, data on patient counts for vascular access interventions and hospitalizations, vascular access intervention events (removal, replacement, and declot), vascular access hospitalizations (for mechanical complication, infection, and sepsis) are also available. Such data will certainly be useful in evaluating the effects of the Fistula First Initiative.

Table 2 Ideal Treatment of End-Stage Renal Disease and Approach to Vascular Access

When glomerular filtration rate falls below 30 mL/min (CKD stage 4) consider:
Preemptive transplant (no dialysis access)
Plan dialysis access (PD catheter or AV access)
Choice of dialysis
Peritoneal dialysis first choice (at least 40% of incident patients)
Plan vascular access in selected patients, based on the probability of transfer to hemodialysis
Hemodialysis second choice; prevalent patients should ideally have the following access distribution:
AV fistula (70–90%)
AV graft (10–30%)
Tunneled internal jugular catheter (5–15%)
Transplant after starting dialysis
Remember to preserve the (right) femoral / iliac veins to avoid vascular complications at the time of kidney transplant

CKD, chronic kidney disease; PD, peritoneal dialysis; AV, arteriovenous

Why do Italian patients have a high prevalence of AVF? We believe that the main reason is the fact that when the first dialysis units were opened, difficulties arose in finding dedicated vascular surgeons and giving adequate priority to dialysis access surgery. In a rather unique way, nephrologists, who in some cases had a surgical background as urologists or transplant surgeons, started performing vascular access surgery, creating a situation where time from diagnosis of ESRD to access surgery was kept at the minimum and the nephrologist–surgeon knew the problems linked to access use, especially cannulation issues. In addition, the presence of a National Health System allowed timely referral from the general practitioner to the nephrologist. In some way, a primitive dialysis access team was already in action, all of it inside the same renal unit. Then, the figure of the nephrologist–surgeon grew and in some cases reached high levels of skill, while several dedicated vascular and transplant surgeons solved the most difficult cases of vascular access creation and revision, becoming second-level specialized access surgeons with great experience.[12] Interestingly, because in Italy only certified radiologists can work with x-ray machines, vascular interventional nephrology did not develop with the same ease; therefore, most renal units developed a collaboration with an interventional radiologist, with the exception of color Doppler ultrasonography-guided angioplasty.[13]

Why so many catheters in Canada? Canada has a national health system, but the pattern of vascular access distribution is much different from Italy. This is in striking contrast with the excellent penetration of the PD technique, which may be favored by patients when they live far away from a HD unit. Two recent studies addressed this problem.[14,15] Mendelssohn et al[14] analyzed data from the DOPPS study, reporting that even though 85% of Canadian patients had been seen by a nephrologist for more than 1 month prior to starting dialysis, CVC use was 33% in prevalent patients and 70% in incident patients, contrary to the preferences of Canadian dialysis clinic medical directors. A possible reason for this discrepancy is the length of time from referral until permanent vascular access creation (61.7 days compared with 29.4 days in Europe or 16 days in the United States). In turn, this longer delay time may be a consequence of the lower number of access surgeons in Canada compared with the United States and some European countries. In a situation similar to that faced by Italian nephrologists, Canadians did not have the opportunity to start surgical activity in vascular access, while it is common practice for a nephrologist to insert a tunneled catheter. Graham et al[15] found a significant influence of duration of HD on the type of access. In patients within 6 months of HD initiation, there was a very high prevalence of CVC use (75%), but as dialysis vintage increased, the prevalence of CVC use decreased progressively, reaching a low of 21.3% in patients after 5 years of HD. System/resource limitations accounted for the highest percentage of factors influencing the choice of CVC as HD access within the first 6 months of HD (54.8%), compared with only 8.6% of factors influencing access choice in patients on HD beyond 5 years. This institution has a dedicated dialysis access team and allocated operating room time for access creation; however, there are a limited number of access surgeons available.

Nonetheless, only 10.5% of patients with CVC were awaiting AVF creation, revision, or maturation; 28.2% of patients with system /resource limitations influencing CVC choice were either awaiting assessment for peritoneal dialysis, undecided about modality choice, or awaiting transplant. Vascular issues accounted for the majority of factors influencing CVC use (47.1% of patients), whereas poor cardiac status influenced decision making in 8.8% of patients. The authors concluded that patient-specific factors (vascular factors and medical contraindications) are the predominant influences on CV catheter use in their prevalent HD patients.[15]

Interesting news on time trends in vascular access surgery come from the Swedish vascular registry (Swedvasc).[16] An analysis of 12,342 open and endovascular HD access operations performed between 1987 and 2006 was undertaken. The median age of patients having their first surgery significantly increased from 56 to 68 during the first decade, then remained stable. The frequency of diabetes increased from 12 to 32%. The percentage of AVF performed as first access surgery remained unchanged; however, the number of patients with multiple procedures increased over time and percutaneous angioplasties increased during the last decade. With an increasing number of operations, arterial inflow shifted toward a more proximal position.

Although outcomes of vascular access are still better in Europe, a clear change in clinical policies is taking place in the United States, with significant results and an improved profile of vascular access use. The Fistula First Breakthrough Initiative, whose goal is to ensure that every patient receiving HD has the opportunity to have a native AVF as the optimal vascular access where feasible, certainly contributed to such an improvement.[8,17] Similarly, the Netherlands, a country with one of the lowest AVF rates in Europe, fostered the CIMINO initiative,[18] a multicenter guidelines implementation program, which promoted an increase in the number of AVFs and a decrease in untunneled catheters. This was counterbalanced by an increase of tunneled catheters, indicating that the choice of access placement depends predominantly on center-specific factors.

Thus, we—Europeans and Americans alike—are indeed on the same path and have the same goals.

A DIALYSIS ACCESS ALGORITHM

In keeping with the idea of sharing experiences and improving the outcomes of dialysis access, we recently described a dialysis access algorithm approach to the patient needing renal replacement therapy, considering long-term improved patient outcome as the ultimate objective.[19] In the ideal world (Table 2), the impending renal failure diagnosis is proactively managed with a preemptive living donor kidney transplant or by the timely creation of the best (PD or HD) dialysis access for the individual patient. However, because of patient denial and late consideration for dialysis access placement, and sometimes because of organizational pitfalls of nephrologic and surgical facilities, the reality is plagued by the fact that many patients initiate HD with a dual lumen catheter. On the other hand, in situations where timely and accurate education is given to the patient with advanced CKD, a significantly higher number of patients (40%) choose PD and only a small fraction start HD with a temporary catheter.[20]

We believe that high-quality patient education and adequate vascular access planning and management can be achieved only with a teamwork approach, representing a continuum of care treatment model of the ESRD patient, where emphasis is placed on team members being in close proximity and ideally in the same clinic.[21] This allows timely decision making from the surgeon, the nephrologist, and the interventional radiologist ("pit-stop approach"). This concept also implies clear and effective communication between team members with emphasis on patient safety, outcome, and comfort.

A dialysis access short- and long-term plan should be updated on a regular basis. With a proactive approach, future access problems can be anticipated and addressed with the overall goal to avoid dialysis interruptions with temporary central vein catheter and associated morbidity.

HOW TO IMPROVE THE OUTCOME OF DIALYSIS ACCESS

Two seemingly simple measures would dramatically improve the outcome of future dialysis access: early referral and vein preservation. Other factors that would promote a higher prevalence of native AVFs are the use of microsurgery; extensive use of vessel mapping to identify suitable vessels for surgery and the presence of stenosis/thrombosis of central veins; building a well-organized dialysis access team, including a dialysis access coordinator; improving surgeon education and training in dialysis access surgery, especially transposition and other more complex AVFs; improving staff cannulation skills; and improving infection rates.

Performing dialysis at lower blood flow rate, but in longer dialysis sessions to keep dialysis effective, might also be a reason why Europeans can maintain a failing access for enough time to avoid the use of a catheter while preparing a new access.

Early Referral

Early referral to a nephrologist and to an access surgeon for evaluation increases the likelihood for placing a native vein AVF and avoiding morbidity from a temporary catheter placement.[22,23] Indeed, starting dialysis with a permanent AV access is associated with improved survival of the access itself, compared with patients whose AVF or AVG has been placed after the start of dialysis. However, it should be kept in mind that DOPPS I data showed that most (55%) of the 46% of U.S. patients starting dialysis with a venous catheter was seen by a nephrologist more than 30 days prior to ESRD. Similarly, the problem of incident patients starting dialysis without a permanent access placed during CKD was also relevant in European patients: 56% of them had seen a nephrologist more than 30 days prior to ESRD.[3] Therefore, both in Europe and in the United States, the situation could be improved with a better understanding of factors determining the lack of a permanent access in patients seen by a nephrologist more than 30 days before the start of dialysis.

Vein Preservation

Preserving veins by preventing venipunctures and intravenous (IV) lines in potential dialysis access veins for AVF placement also increases the chances for native vein AVF. There is much abuse of potential AVF veins from IV lines and blood draws. Only the dorsal aspect of the hand should be allowed for venous blood access. Patients undergoing HD can have blood draws done during dialysis treatment to preserve veins. PICC lines (peripherally inserted central catheters) must not be used in patients with a future dialysis need, and certainly not in stage 4 to 5 ESRD patients.

Microsurgery

Microsurgery appears to offer significant advantages in AVF creation, improving immediate success and long-term patency, as reported in the most difficult dialysis population, children.[24] It implies the use of a surgical microscope, microsurgical instruments, prophylactic hemostasis, and no-touch surgery. Using this approach, Bourquelot et al[25] reported the outcomes of dialysis AV access microsurgery in 380 children: the ratio AVF/AVG was 93%/7% and the creation of a distal AVF was possible in 78% of the children. The immediate patency rate was 96% and only 10% of AVF failed to mature. Remarkably, the 24-month patency rate was 85% in distal radial-cephalic AVF, 72% in brachial-basilic AVF, 47% in brachial-cephalic AVF, while AVG patency was only 5%. The French experience may be difficult to duplicate in different settings, but the excellent results reported with this approach should be seriously considered now that patient characteristics are deteriorating and an increased number of catheters is being used in most countries.

Vessel Mapping

Vessel mapping is of paramount importance in planning and obtaining a successful vascular access.[26] A pertinent patient history and physical examination are important first steps in assessing the course of action, both prior to access placement and when evaluating an established access with problems. These basic evaluations direct decisions on more expensive and often invasive testing. A carefully performed history and physical exam will yield proper patient selection for the most optimal dialysis modality and site of access placement. A pertinent history includes type and nature of past access procedures (especially catheters, namely CVC and PICC lines) and pacemakers, breast and axillary dissection surgery, chest radiation, and emergency vascular cut-downs. Physical examination includes a detailed search for veins in both upper extremities starting with the forearm cephalic and basilic veins. Vascular examination must assess both the arterial and the venous system, through inspection and palpation. Visible veins are marked with an indelible pen to guide Doppler ultrasound examination (DUE), which is often used to confirm or correct the initial impression based on history and physical examination, and to define surgical and interventional anatomy. DUE is the most cost-effective noninvasive test for dialysis access planning. Nearly all patients requiring dialysis access should undergo DUE examination. The quality of the DUE is operator dependent. Ideally, the surgeon should be present to direct the sequence of examination steps and mark the skin, documenting vessel size, intended surgery sites, and anatomic variations. The specific features assessed during DUE of the venous system, the arterial system, and of dialysis access grafts can be found in our previous publication.[26] DUE can also be used to assess blood flow problems associated with established HD access. It will confirm the clinical diagnosis and direct the treatment in the majority of cases. In a more complex access situation, invasive imaging technology such as a fistulogram is warranted. DUE and IV contrast fistulogram are not competitive but complementary. In most instances, when DUE examination suggests pathology, a fistulogram with simultaneous interventional treatment is indicated.

Access blood flow measurement, followed by the correction of hemodynamically significant stenoses to prolong access survival, is the recommended method for AVF surveillance for stenosis, but whether it may be beneficial and cost-effective is controversial.[27] Access blood flow measurement allows an accurate identification of AV accesses at risk of failure, with an access blood flow less than 700 to 1000 mL/min and/or a reduction in flow more than 25% as optimal predictors for stenosis. Access blood flow less than 400 mL/min suggests incipient thrombosis. Recently, Tessitore et al[28] evaluated in a 5-year controlled, nonrandomized study on 159 HD patients with mature AVFs whether adding access blood flow surveillance to clinical monitoring (combined with elective stenosis repair) reduces thrombosis and access loss rates. They found that adding access blood flow surveillance to clinical monitoring is associated with a better detection and elective treatment of stenosis, a 73% reduction in thrombosis rate, 86% reduction in CVC placements, 65% reduction of access loss, with a concomitant reduction of global access-related costs, although the cumulative access patency was only extended in the first 3 years after fistula maturation. Thus, access blood flow surveillance, when coupled with preemptive intervention, reduces the thrombosis rate in AVF, suggesting that the functional access life can be prolonged.

The Dialysis Access Team

Effective dialysis access care can be better achieved by a systematic management, involving the patient, dialysis staff, clinical and interventional nephrologists, interventional radiologists, and access surgeons. Team-building efforts will increase people's effectiveness and satisfaction, improve patient outcomes, and reduce costs as summarized in Table 3.[29]

Such an approach was first described ~10 years ago.[30,31] Becker et al[30] demonstrated that by implementing a vascular access care pathway, emphasizing coordinated patient evaluation and outpatient surgery, improved outcomes associated with vascular access surgery, including costs and length of hospital stay, with a better patient satisfaction. Allon et al[31] described the development of a multidisciplinary approach, involving nephrologists, access surgeons, and radiologists. A full-time dialysis access coordinator scheduled all access procedures with the surgeons and radiologists, and

Table 3 Goals of the Dialysis Access Team: Moving from Crisis Management to Proactive/Interactive Planning

Crisis Management	Proactive/Interactive Planning
1. Clotting diagnosed at time of dialysis	1. Surveillance, preventive angioplasty
2. "Add-on" — evening case	2. Dedicated procedure rooms
3. Delays are the rule	3. Delays rare
4. Turnaround time 24 hours — weeks	4. Turnaround time 2–6 hours
5. Cost — high	5. Cost — 20–50% less
6. Admission common	6. Admission rare
7. Overuse of catheters	7. Catheters rare
8. Missed treatments	8. Seldom missed treatments
9. Prone to high failure rate	9. Success rate high (93–99%)
10. No reliable database	10. Close follow-up/database
11. Lack of leadership	11. Clear line of command

tracked outcomes. A computerized database was used for prospective documentation of procedures and complications. Confidential, detailed analyses and recommendations for improvements were provided periodically to the surgeons and radiologists. After the implementation of this multidisciplinary care, the approach to clotted grafts evolved from an inpatient surgical procedure to an outpatient radiologic procedure, with an increase of immediate technical success rate of graft declots from 48 to 69%; elective placement of AVG evolved from a 3-day inpatient hospitalization to a largely outpatient procedure; surgical complications of new AV graft surgery decreased from 25% to 11%; aggressive detection and correction of graft stenosis decreased the incidence of graft thrombosis by 60%; and the proportion of native AVF construction in new dialysis patients increased from 33 to 69%. This study also confirms that an integrated multidisciplinary approach can reduce surgical complications of access surgery and decrease access failures, with a concomitant decrease in hospitalization for access procedures and a substantial cost saving.

Subsequently, the DOPPS I study also pointed out that an important aspect of incident HD patients care is the process and organizational structure of the referral network for placing vascular accesses.[3] A fast process of less than 2 weeks from time of referral until access placement was associated with a 1.8-fold higher likelihood of new ESRD patients beginning HD with a permanent vascular access. More recently, Flu et al[32] showed that the implementation of a bimonthly multidisciplinary meeting in vascular access surgery (with the presence of the vascular surgeons, nephrologists, interventional radiologists, dialysis nurses, and the ultrasound technicians) optimized the timing, indication, type of intervention, and the logistics of AV access management during the preoperative and postoperative period. Importantly, a significant increase in endovascular balloon angioplasties and a significant decrease in surgical revisions were observed, resulting in less patient morbidity. Also, higher primary and secondary patency was achieved after the introduction of the new optimized care protocol.

Dialysis Access Coordinator

A dedicated dialysis access coordinator (or dialysis access manager) can greatly increase the efficiency of dialysis, by maintaining a comprehensive database of access procedures and their short-term and long-term complications (including infections), monitoring and directing communications between all the involved parties, assuring that access screening is properly performed, and arranging for timely evaluations and interventions. The experience with transplants clearly demonstrated that a transplant coordinator improves transplant outcomes, and dialysis access management should give similar results in improving AVF prevalence. In summary, the dialysis access coordinator assesses and identifies the vascular access needs of patients; procures, delivers and coordinates services for the patient in the outpatient and hospital setting; provides for ongoing monitoring of the patient's vascular access to assure adequate dialysis is obtained and maximum life of the access is achieved; and plans for future intervention, if necessary. An Australian group[33] recently confirmed the effectiveness of introducing a dialysis access coordinator in the renal unit. They demonstrated that after a situational analysis showed poor overall coordination of surgical waiting lists, multifaceted intervention, including the introduction of a vascular access nurse coordinator and an algorithm to prioritize surgery, significantly increased the proportion of patients starting HD therapy with an AVF from 56 to 75%, with a concomitant 40% reduction in catheter-days.

Improving Surgeon Education and Training in Dialysis Access Surgery

More data from the DOPPS allow some considerations on the issue of appropriate surgical training in dialysis access placement.[34] The study aim was to investigate whether intensity of surgical training influences type of vascular access placed and AVF survival. Prospective data from 12 countries in the DOPPS were analyzed; outcomes of interest were type of vascular access in use (AVF versus AVG) at study entry and time from placement until primary and secondary access failures, as predicted by surgical training. During training, U.S. surgeons created fewer fistulas (U.S. mean = 16 versus 39 to 426 in other countries) and noted less emphasis on vascular access placement compared with surgeons elsewhere. Significant predictors of AVF versus AVG placement included number of AVF placed during training and degree of emphasis on vascular access creation during training. Risk of primary fistula failure was 34% lower when placed by surgeons who created 25 or more (versus less than 25) AVFs during training. Therefore, the authors concluded that surgical training is key to both fistula placement and survival, yet U.S. surgical programs seem to place less emphasis on fistula creation than those in other countries, underscoring the importance of enhancing surgical training in AVF creation.[34]

Improving Cannulation Skills

One important issue is the timing of cannulation after AVF surgery. Rayner et al[35] showed that cannulation before 14 days of AVF life was associated with a 2.1-fold increased risk of subsequent AVF failure compared with AVF cannulated after 14 days, while no significant difference in AVF failure was seen for AVF used in 15 to 28 days compared with 43 to 84 days. Accordingly, AVF ideally should be left to mature for at least 14 days before first cannulation. Another relevant issue is cannulation technique, specifically the potential advantages of the buttonhole versus the standard rope-ladder technique.[36] The buttonhole technique, cannulation of exactly the same site, offers the advantage of an easy cannulation procedure. However, it can be used only in native fistulas and cannulation is preferably executed by a "single-sticker." A comparison of the two techniques in 33 self-cannulating home HD patients with a native arteriovenous fistula was undertaken, prospectively observing for 18 months cannulating ease, number of bad sticks, pain, time of compression after needle removal, bleeding, infectious complications, and aneurysm formation. With the buttonhole method, cannulating ease improved distinctly; this was especially favorable in patients with a short fistula vein. Reported cannulation pain did not change significantly. The incidence of bad sticks decreased significantly, as well as time of compression after needle removal, without increased incidence of bleeding. Three patients developed a local skin infection of their buttonhole during the study, which determined a change in the disinfection routine prior to cannulation. Thus, the buttonhole method seems to improve cannulating ease avoiding the possible formation of aneurysms, but precautions have to be taken to prevent infectious complications. Indeed, Doss et al[37] also suggested that the infection rate with the buttonhole method of needle insertion may be underestimated.

Improving Infection Rates

The vascular access site is the most common site for infection in HD patients, and access site infections are particularly important because they can cause loss of the vascular access and disseminated bacteremia; they also account for ~15% of deaths in dialysis patients. The primary risk factor for access infection is the access type, with CVC having the highest risk, AVG intermediate, and AVF the lowest risk of infection. The incidence of vascular access related infections is 1.3 to 7.2/100 patient months in the United States and 3.2 to 5.7/100 patient months in Europe.

A recent 8-month observational prospective study on nosocomial bacterial infections in dialysis patients was conducted in 19 renal units in Piedmont, Northern Italy.[38] Results have been compared with data from a U.S. infection surveillance network. Considering all access-related infections, Ferrero et al[38] found incidence rates of 1.47/100 patient months, compared with 3.22/100 patient months in the United States. Interestingly, when considering local infections results were similar (1.34 versus 1.43/100 patient months, respectively), whereas systemic infections differed markedly (0.19 versus 1.78/100 patient months). In tunneled catheters, the difference in the rate of systemic infections was 0.76/100 patient months in Piedmont versus 4.84/100 patient months in the United States. This difference might be due to more accurate CVC handling in Italian dialysis units, where the opening and closure of a CVC are usually performed aseptically by two operators, and at least one of them is a certified nurse.

CONCLUSIONS

Vascular access care in dialysis patients from different countries is characterized by similar issues, although with different magnitude. Obesity, of epidemic proportions in the United States, is also a growing problem globally, which could cause more difficulties in native AVF creation. The same consideration applies to type 2 diabetes, which is a growing problem as well. Peripheral vascular disease appears to be a previously underestimated independent predictor of CVC use.

Creation of dedicated dialysis access teams, including a vascular access coordinator, is in our view a fundamental step in improving vascular access care.

Social issues, system and resource limitations, and patient-specific factors (vascular factors and medical contraindications) may influence decision making in the choice of AV access versus CVC. Thus, it is possible that an increase in CVC use will occur if the dialysis population continues to age and deteriorate clinically, unless more aggressive care and AV surgery activity are undertaken before the start of dialysis.

Important differences still exist among Europe and the United States, as demonstrated by the recent AVF DAC Study,[39] which showed that in the United States 20 to 50% of fistulas do not mature adequately for use, and that early AVF failure is a major barrier to increasing fistula prevalence, prolonging catheter use. Such figures raised surprise among European nephrologists and dialysis access surgeons.[40]

The possibility that factors different from patients characteristics and surgical skills are important in determining outcomes is likely, and it might explain the apparent contradiction of ESRD practices (kidney transplant, peritoneal dialysis, patterns of vascular access use in HD), where some countries excel in one area and score poorly in another. We join many other physicians–researchers in advocating more randomized trials and appropriate epidemiological studies to improve evidence-based care of dialysis patients and their vascular access.

REFERENCES

1. Ethier J, Mendelssohn DC, Elder SJ, et al. Vascular access use and outcomes: an international perspective from the Dialysis Outcomes and Practice Patterns Study. Nephrol Dial Transplant 2008;23(10):3219–3226

2. Finelli L, Miller JT, Tokars JI, Alter MJ, Arduino MJ. National surveillance of dialysis-associated diseases in the United States, 2002. Semin Dial 2005;18(1):52–61
3. Pisoni RL, Young EW, Dykstra DM, et al. Vascular access use in Europe and the United States: results from the DOPPS. Kidney Int 2002;61(1):305–316
4. Rayner HC, Pisoni RL, Bommer J, et al. Mortality and hospitalization in haemodialysis patients in five European countries: results from the Dialysis Outcomes and Practice Patterns Study (DOPPS). Nephrol Dial Transplant 2004; 19(1):108–120
5. Dialysis and Transplant Italian Registry—RIDT. Available at: http://www.sin-ridt.org/sin-ridt.org.htm. Accessed January 18, 2009
6. Registry ERA-EDTA. ERA-EDTA Registry 2006 Annual Report. Amsterdam: The Netherlands, Academic Medical Center, Department of Medical Informatics; 2008; Available at: http://www.era-edta-reg.org/index.jsp?p=annrep. Accessed January 18, 2009
7. 2006 United States Renal Data System (USRDS) Annual Data Report. Available at: http://www.usrds.org/2006/ref/L_vasc_access_06.pdf. Accessed January 18, 2009
8. Rajagopalan S, Dellegrottaglie S, Furniss AL, et al. Peripheral arterial disease in patients with end-stage renal disease: observations from the Dialysis Outcomes and Practice Patterns Study (DOPPS). Circulation 2006;114(18):1914–1922
9. Fistula First National Vascular Access Improvements Initiative. Available at: http://www.fistulafirst.org/. Accessed January 19, 2009
10. The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) Dialysis Access Clinical Trials Consortium. Available at: http://www.niddk.nih.gov/patient/dac/DAC.htm. Accessed January 20, 2009
11. 2006 United States Renal Data System (USRDS) Annual Data Report. Available at: http://www.usrds.org/2006/ref/L_vasc_access_06.pdf. Accessed January 18, 2009
12. Berardinelli L. The endless history of vascular access: a surgeon's perspective. J Vasc Access 2006;7(3):103–111
13. Bacchini G, La Milia V, Andrulli S, Locatelli F. Color Doppler ultrasonography percutaneous transluminal angioplasty of vascular access grafts. J Vasc Access 2007;8(2):81–85
14. Mendelssohn DC, Ethier J, Elder SJ, Saran R, Port FK, Pisoni RL. Haemodialysis vascular access problems in Canada: results from the Dialysis Outcomes and Practice Patterns Study (DOPPS II). Nephrol Dial Transplant 2006;21(3):721–728
15. Graham J, Hiremath S, Magner PO, Knoll GA, Burns KD. Factors influencing the prevalence of central venous catheter use in a Canadian haemodialysis centre. Nephrol Dial Transplant 2008;23(11):3585–3591
16. Ljungström KG, Troëng T, Björck M. Time-trends in vascular access surgery in Sweden 1987-2006. Eur J Vasc Endovasc Surg 2008;36(5):592–596
17. Lok CE. Fistula first initiative: advantages and pitfalls. Clin J Am Soc Nephrol 2007;2(5):1043–1053
18. Huijbregts HJ, Bots ML, Moll FL, Blankestijn P; JCIMINO Members. Accelerated increase of arteriovenous fistula use in haemodialysis centres: results of the multicentre CIMINO initiative. Nephrol Dial Transplant 2007;22(9):2595–2600
19. Davidson IJ, Gallieni M, Saxena R, Dolmatch B. A patient centered decision making dialysis access algorithm. J Vasc Access 2007;8(2):59–68
20. Golper T. Patient education: can it maximize the success of therapy? Nephrol Dial Transplant 2001;16(suppl 7):20–24
21. Davidson IJA. Access clinic, access decisions and multidisciplinary care our patients deserve. J Vasc Access 2006;7: 235–238
22. Astor BC, Eustace JA, Powe NR, et al. Timing of nephrologist referral and arteriovenous access use: the CHOICE Study. Am J Kidney Dis 2001;38(3):494–501
23. National Kidney Foundation. K/DOQI clinical practice guidelines for chronic kidney disease: evaluation, classification, and stratification. Am J Kidney Dis 2002;39(2, Suppl 1):S1–S266
24. Bourquelot P. Vascular access in children: the importance of microsurgery for creation of autologous arteriovenous fistulae. Eur J Vasc Endovasc Surg 2006;32(6):696–700
25. Bourquelot P, Cussenot O, Corbi P, et al. Microsurgical creation and follow-up of arteriovenous fistulae for chronic haemodialysis in children. Pediatr Nephrol 1990;4(2):156–159
26. Davidson IJ, Chan D, Dolmatch B, et al. Duplex ultrasound evaluation for dialysis access selection and maintenance: a practical guide. J Vasc Access 2008;9(1):1–9
27. Tessitore N, Bedogna V, Poli A. The role of surveillance in mature arteriovenous fistula management. J Vasc Access 2004;5(2):57–61
28. Tessitore N, Bedogna V, Poli A, et al. Adding access blood flow surveillance to clinical monitoring reduces thrombosis rates and costs, and improves fistula patency in the short term: a controlled cohort study. Nephrol Dial Transplant 2008;23(11):3578–3584
29. Davidson I. Access clinic. Access decisions and the multidisciplinary care our patients deserve [abstract]. J Vasc Access 2006;7(4):235–238
30. Becker BN, Breiterman-White R, Nylander W, et al. Care pathway reduces hospitalizations and cost for hemodialysis vascular access surgery. Am J Kidney Dis 1997;30(4):525–531
31. Allon M, Bailey R, Ballard R, et al. A multidisciplinary approach to hemodialysis access: prospective evaluation. Kidney Int 1998;53(2):473–479
32. Flu H, Breslau PJ, Krol-van Straaten JM, Hamming JF, Lardenoye JW. The effect of implementation of an optimized care protocol on the outcome of arteriovenous hemodialysis access surgery. J Vasc Surg 2008;48(3):659–668
33. Polkinghorne KR, Seneviratne M, Kerr PG. Effect of a vascular access nurse coordinator to reduce central venous catheter use in incident hemodialysis patients: a quality improvement report. Am J Kidney Dis 2009;53(1):99–106
34. Saran R, Elder SJ, Goodkin DA, et al. Enhanced training in vascular access creation predicts arteriovenous fistula placement and patency in hemodialysis patients: results from the Dialysis Outcomes and Practice Patterns Study. Ann Surg 2008;247(5):885–891
35. Rayner HC, Pisoni RL, Gillespie BW, et al; Dialysis Outcomes and Practice Patterns Study. Creation, cannulation and survival of arteriovenous fistulae: data from the Dialysis Outcomes and Practice Patterns Study. Kidney Int 2003; 63(1):323–330
36. Verhallen AM, Kooistra MP, van Jaarsveld BC. Cannulating in haemodialysis: rope-ladder or buttonhole technique? Nephrol Dial Transplant 2007;22(9):2601–2604
37. Doss S, Schiller B, Moran J. Buttonhole cannulation—an unexpected outcome. Nephrol Nurs J 2008;35(4):417–419

38. Ferrero S, Argentero P, Saltarelli M; Vascular Access Regional Group. Vascular access related infections in the Piedmontees Dialysis centres. (Abstract)J Vasc Access 2009; 10(1):72
39. Dember LM, Beck GJ, Allon M, et al; Dialysis Access Consortium Study Group. Effect of clopidogrel on early failure of arteriovenous fistulas for hemodialysis: a randomized controlled trial. JAMA 2008;299(18):2164–2171
40. Chemla ES, Morsy M. A European perspective on the Dialysis Access Consortium (DAC) Study regarding the effects of clopidogrel on early failure of arteriovenous fistulas for hemodialysis. J Vasc Access 2008;9(4):229–230