

The natural history of vascular access for hemodialysis: A single center study of 2,422 patients

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Background. Our objective is to provide provision of primary and secondary patency rates data and incidence of complications. Despite the publication of some review articles and small prospective trials about vascular accesses, controversy still exists regarding the choice of the outflow conduit and especially the choice of the fistula to be formed in secondary and tertiary access procedures.

Methods. This is a retrospective study of 2,422 consecutive patients who underwent 3,685 vascular access procedures in a tertiary care hospital, including radial-cephalic (RCAVF), brachial-cephalic (BCAVF), brachial-basilic (BBAVF), and prosthetic graft (PTFE) fistulas. Maximum follow-up period was 20 years. Actuarial patency rates were obtained by Kaplan-Meier analysis.

Results. The median primary patency (days) of the most common 1st choices for vascular access were 712 (95% CI: 606, 818), 1,009 (95% CI: 823, 1,195), and 384 (95% CI: 273, 945) days for RCAVF, BCAVF, and PTFE, respectively. The median secondary patency was 1809 days (95% CI: 1,692, 1,926) for the RCAVF. The median primary patency of BBAVF (2nd or 3rd choice for vascular access) was 1,582 days (95% CI: 415, 2,749). The cumulative incidence of clinically important complications for the patients who received a RCAVF, BCAVF, BBAVF, and u-PTFE was 0.25, 0.57, 0.33, and 0.61 per patient-year, respectively.

Conclusion. We advocate maximal use of autogenous conduits, except probably the case of the older diabetic patient, in whom access at the antecubital fossa should be the first choice. BBAVF is an excellent fistula and should probably be constructed before prosthetic graft placement. (Surgery 2009;145:272-9.)

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THE MOST COMMONLY PERFORMED PRIMARY ACCESS FISTULA is the radial-cephalic (RCAVF) that was introduced in 1966 by Brescia et al.¹ Other types of vascular accesses include the brachial-cephalic (BCAVF)² and the brachial-basilic (BBAVF)³ arterio-venous fistulas. Moreover, prosthetic materials have been used as venous conduits whenever autologous veins were deemed insufficient.⁴ The most common synthetic grafts are made from polytetrafluoroethylene (PTFE) and are used extensively either in the forearm (f-PTFE), in the upper arm (u-PTFE), or in the axilla (a-PTFE).⁵ In a selected group of patients, instead of a surgically constructed fistula, a permanent central vein dialysis catheter (PC) is used.⁶

The consensus among physicians is that the patency rates for autogenous arteriovenous hemodialysis accesses are superior to those for prosthetic counterparts. This belief is reflected in the National Kidney Foundation Clinical Guidelines for Vascular Access (NKF/DOQI), which recommend RCAVF and BCAVF as the 1st and 2nd choices for access, respectively, followed by prosthetic grafts, BBAVF, and permanent catheters as further choices down the line.⁷ These recommendations are based mainly on the presumed superior patency rates of autogenous fistulas. Although this superiority seems to be verified by recent review articles and small prospective trials,⁸⁻¹¹ controversy still exists, especially regarding the best type of fistula to be formed in secondary and tertiary access procedures when primary fistulas have failed and the best type of fistula to be formed in specific subgroups of patients (ie, diabetics). Indeed, a recent review paper supports the superiority of autogenous hemodialysis accesses¹⁰ especially after a concurrent meta-analysis indicates a high primary failure rate in RCAVF.¹² Moreover, some studies,¹³

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but not all,¹⁴ show no difference in fistula patency and maturation rates. These controversies stem from the lack of prospective, well-powered studies with long follow-up.

The NKF/DOQI recommend that the choice of intervention for failing accesses should be dictated by local expertise.⁷ Secondary patency is achieved either by open operative interventions, which include redo-RCAVF (ReRCAVF), patch angioplasty, and so on, or by endovascular interventions, which include percutaneous transluminal angioplasty, stent placement, and so on. Again, supporting data are scarce. The 3 randomized controlled trials examining the treatment of the "failing" access point toward the observation that once the PTFE grafts thrombose, their long-term outcome is dismal, and subsequent access options should be explored.¹⁵⁻¹⁷

Complications may follow vascular access procedures.¹⁸ The most important complications are edema of the forearm¹⁹ (which is frequently underreported⁸), steal syndrome,²⁰ bleeding,²¹ and infection²² (which is usually observed in patients who receive prosthetic grafts).²⁰ Once again, there is a lack of prospective studies that document complication rates.

In this study, all patients underwent a vascular access procedure in a single tertiary center that follows the NKF/DOQI guidelines. The purpose of this paper was to provide data on primary and secondary patency rates and incidence of complications from this large, with a long follow-up, cohort of patients.

PATIENTS AND METHODS

Patients. Between January 1986 and December 2005, 2,422 consecutive patients with end-stage renal failure underwent 3,685 vascular access procedures in a tertiary care hospital. Patients' preoperative assessment, vascular access(es), intraoperative findings, postoperative patency, and complications were recorded prospectively in a centralized database system. Preoperative assessment included a standard physical examination, blood pressure measurements on both arms, and screening for diabetes mellitus. Patients (55% female, median age 61, 8.3% diabetics) underwent 1 or more procedures, including RCAVF ($n = 1873$), BCAVF ($n = 904$), BBAVF ($n = 68$), PTFE ($n = 457$), and PC ($n = 270$). An additional 482 rescue procedures for failing RCAVF were performed, including ReRCAVF ($n = 355$), thrombectomy ($n = 105$), and aneurysmal repair ($n = 22$). No rescue procedures were employed for failing accesses other than RCAVF.

Operative procedure. All procedures were performed under local anesthesia with the use of 2% xylocaine (Xylocaine; AstraZeneca, Monts, France). Patients who underwent placement of an artificial conduit received 1 postoperative dose of antibiotic prophylaxis against Gram-positive cocci. RCAVF was constructed by exposing the radial artery and cephalic vein through a longitudinal incision 4–5 cm proximal to the radial styloid process. After sufficient vein mobilization that required ligation of tributaries occasionally, an end-to-end, vein-to-artery anastomosis was performed with interrupted 6-0 polypropylene monofilament sutures (Prolene; Ethicon, Amersfoort, The Netherlands).

The BCAVF was constructed by exposing the brachial artery and cephalic vein through a transverse incision just above the antecubital fossa. After sufficient vein mobilization that required ligation of tributaries occasionally, an end-to-side vein-to-artery anastomosis was performed with a running 6-0 polypropylene suture.

The BBAVF was constructed by exposing the brachial artery and basilic vein through a curvilinear incision starting in the antecubital fossa and ending about 15 cm more proximal. After sufficient mobilization that always required ligation of tributaries, the vein was transposed to a more superficial position, and an end-to-side, vein-to-artery anastomosis was performed with a running 6-0 polypropylene suture.

Regular PTFE grafts (Gore-Tex; WL Gore & Associates, Flagstaff, Ariz) with an internal diameter of 6 mm were positioned in a subcutaneous fashion with the use of a tunneler device either in the forearm (f-PTFE, basilic vein-to-brachial artery), in the upper arm (u-PTFE, axillary vein-to-brachial artery), or in the axillary fossa (a-PTFE, axillary vein-to-axillary artery). Venous (end-to-end) and arterial (end-to-side) anastomosis were performed with a running 6-0 polypropylene suture.

The ReRCAVF began by exploring the previous RCAVF, the old anastomotic site was excised, thrombi were removed from both venous and arterial limbs by the use of the standard Fogarty catheter technique, and finally, the anastomosis was reconstructed in an end-to-end, vein-to-artery fashion with interrupted 6-0 polypropylene sutures. Thrombectomy was performed with a balloon catheter through a transverse incision in the outflow limb that was later repaired by interrupted 6-0 polypropylene sutures. Repair of aneurysms was performed by aneurysmectomy and repair of the defect with an autologous vein patch secured in place with a running 6-0 polypropylene suture. At the time of operation and for all types of

vascular accesses, both outflow and inflow conduits were evaluated before construction of the anastomosis as follows: Veins should bare no valves at their mobilized part (approximately 5 cm) and should be at least 3 mm in diameter after distention. The size of the vessel was determined by insertion of a pediatric feeding tube catheter of at least 3 mm in diameter. Arteries should demonstrate a good pulsatile flow after arteriotomy. Radial arteries that showed diminished flow were distended by the use of a balloon catheter. At the completion of the anastomosis, a palpable thrill or an audible bruit should be felt on top of the outflow limb. The absence of a palpable thrill or audible bruit mandated a re-exploration of the anastomosis. No systematic heparin was administered during the procedures nor did postoperative anticoagulation occur.

Patients were examined regularly by a nephrologist. The first cannulation of the access was performed when the vessels had matured adequately, usually after 4–6 weeks. PC (MedComp, Harleysville, Pa) were placed either in the subclavian or in the jugular vein. Both limbs should be functional; otherwise, the catheter was removed. PC was introduced to our practice 10 years ago.

Follow-up. Clinical follow-up was performed in patients twice a year, except in those who received a kidney transplant or who were withdrawn from hemodialysis for other reasons. Patients who developed complications were followed at more frequent intervals as necessary. The maximum and minimum follow-up periods were 20 and 1 year(s), respectively. Median follow-up was 6 years. Dialysis adequacy and complications were recorded during each visit into a centralized database system that was designed 20 years ago and remained practically unchanged until now. No angiographies were performed.

End points. The number and type of vascular accesses required for each patient were analyzed. Primary patency rate was defined as adequate function for dialysis (≥ 250 mL/min) without any intervention. Fistulas were defined as “failing” either when they ceased to flow or when 3 consecutive sessions of inadequate dialysis (> 250 mL/min) were documented by the dialysis nurse. No ultrasonographic or angiographic criteria for determination of a “failing” access were used routinely. All “failing” RCAVF were re-explored routinely. All other “failing” fistulas, autologous or prosthetic, were not usually re-explored. Secondary patency was defined as an adequate function for dialysis (≥ 250 mL/min) after a secondary intervention (ReRCAVF, thrombectomy, aneurysm repair).

Edema was defined as a 20% increase in the forearm circumference of the limb with the vascular access when compared with the opposite limb. Steal syndrome was defined as persistent (< 30 days) coldness of the fingers of the limb with the vascular access that became worse on exertion. Bleeding was defined as any hematoma that required wound exploration or any fistula rupture. Infection was defined as erythema of the skin around the vascular access that either resolved after initiation of antibiotics or required an intervention (pus evacuation, prosthetic graft removal, etc.).

Statistical analysis. For statistical analysis, the statistical package of SPSS 11.0 for Mac (SPSS Inc., Chicago, Ill) was used. Patient demographics were described as means or medians. Type and order of access were described with actual numbers and percentiles when applicable. Actuarial patency rates were obtained by Kaplan-Meier analysis. Patients with a patent AVF who died ($n = 378$), received a kidney transplant ($n = 980$), were withdrawn from hemodialysis alive ($n = 50$), or lost to follow-up ($n = 68$) were censored. Percentile distributions including median values (with 95% confidence intervals) were calculated. The complication rates were defined as the number of complications per patient-year for a certain type of vascular access.

RESULTS

Type and order of accesses. The most common first choices of vascular access for the 2,422 patients were RCAVF ($n = 1,681$), BCAVF ($n = 423$), and u-PTFE ($n = 99$). Moreover, 190 various other procedures (BBAVF, f-PTFE, a-PTFE, etc) were performed. Of the patients who had a planned RCAVF as a 1st choice of vascular access, 16.3% ($n = 327$) had that abandoned after operative exploration because of an inadequate vein or artery. Six-hundred and twenty-eight patients (25.9%) required a 2nd vascular access. The main 2nd choice procedures were BCAVF ($n = 256$), RCAVF ($n = 192$), and u-PTFE ($n = 80$). In addition, 100 various other accesses were performed. Two-hundred and ninety-nine patients (12.3%) required a 3rd vascular access. The most common 3rd choice procedures were BCAVF ($n = 94$), u-PTFE ($n = 63$), and BBAVF ($n = 53$). Furthermore, 89 various other accesses were performed. Eighty-one patients (3.3%) required more than 3 (up to 10) dialysis accesses. Finally, 3 types of rescue procedures (355 ReRCAVFs, 105 thrombectomies, 22 aneurysm repairs) were performed at various time points in order to

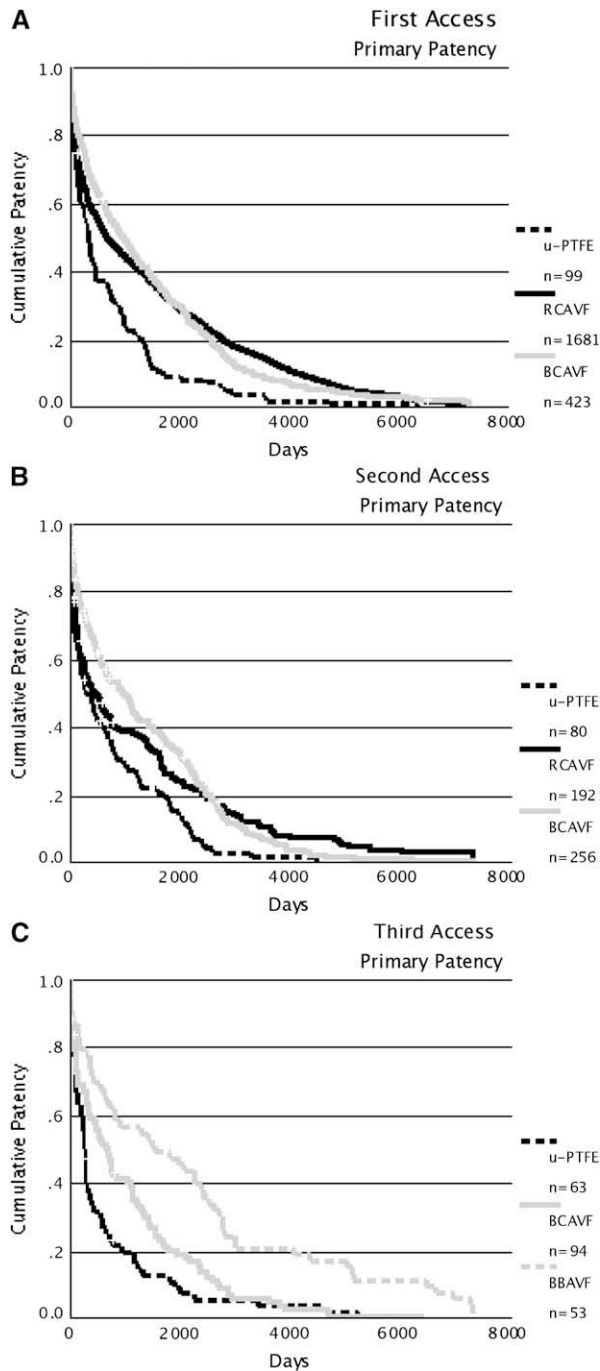


Fig 1. (A), Primary patency rates of the procedures performed as a first choice for vascular access. Patency rate is shown in fractions and time in days. Notice that after 2000 days of function RCAVF patency is superior to BCAVF. (B), Primary patency rates of the procedures performed as a second choice for vascular access. Patency rate is shown in fractions and time in days. Notice that autologous vein are constantly superior to prosthetic graft conduits. (C), Primary patency rates of the procedures performed as a third choice for vascular access. Patency rate is shown in fractions and time in days. Notice the patency superiority of BBAVF even when compared with BCAVF.

Table I. Patency rates of all the patients for the most common procedures performed, stratified by choice

Patency percentiles	25%	50%	75%
<i>Primary patency (days ± SE)</i>			
First choice			
RCAVF	2,430 ± 91	712 ± 54	114 ± 13
BCAVF	2,285 ± 104	1,009 ± 94	267 ± 38
u-PTFE	1,032 ± 39	384 ± 56	106 ± 23
Second choice			
RCAVF	1,926 ± 259	477 ± 123	77 ± 16
BCAVF	2,294 ± 112	1,009 ± 136	212 ± 58
u-PTFE	1,284 ± 382	315 ± 139	122 ± 22
Third choice			
BCAVF	1,578 ± 214	715 ± 112	121 ± 26
u-PTFE	749 ± 210	304 ± 27	115 ± 32
BBAVF	2,822 ± 696	1,582 ± 595	427 ± 159
Regardless choice			
PC	1,508 ± 143	490 ± 96	94 ± 23
<i>Secondary patency (days ± SE)</i>			
Regardless choice			
ReRCAVF	3,334 ± 117	1,809 ± 59	654 ± 51

Patency is expressed with percentile distribution (in days) of functional fistulas.

re-establish patency in 482 out of 1873 RCAVFs (25.7%). Of the 3,685 vascular accesses, 270 (7.3%) were PC. The type and order of accesses are displayed in Fig 1, A–C.

Primary patency. The median primary patencies (days) of the most common first choices for vascular access were 712 (95% CI: 606, 818), 1,009 (95% CI: 823, 1,195), and 384 (95% CI: 273, 945) days for RCAVF, BCAVF, and u-PTFE, respectively (Fig 1, A). The median primary patencies of the most common second choices for vascular access were 477 (95% CI: 235, 719), 1,009 (95% CI: 741, 1,277), and 315 (95% CI: 42, 588) days for BCAVF, RCAVF, and u-PTFE, respectively (Fig 1, B). The median primary patencies of the most common third choices for vascular access were 715 (95% CI: 494, 936), 304 (95% CI: 251, 357), and 1,582 (95% CI: 415, 2,749) days for BCAVF, u-PTFE, and BBAVF, respectively (Fig 1, C). The median primary patency was 490 (95% CI: 301, 679) days for the PC. The percentile distribution of primary patency is displayed in Table I. In diabetic patients, the median primary patencies of the most common first choices for vascular access were 268 (95% CI: 145, 391), 924 (95% CI: 524, 1,324), and 206 (95% CI: 121, 444) days for RCAVF, BCAVF, and u-PTFE, respectively (Table II).

Secondary patency. The median secondary patency was 1,809 (95% CI: 1,692, 1,926) days for

Table II. Patency rates of diabetic patients for the most common procedures performed, stratified by choice

Patency percentiles	25%	50%	75%
<i>Primary patency (days ± SE)</i>			
First choice			
RCAVF	1,674 ± 321	268 ± 62	70 ± 21
BCAVF	2,068 ± 347	924 ± 203	299 ± 163
u-PTFE	768 ± 465	206 ± 121	71 ± 39
Second choice			
RCAVF	1,632 ± 165	177 ± 344	70 ± 35
BCAVF	2,178 ± 378	1,515 ± 751	142 ± 44
u-PTFE	1,821 ± 1,131	206 ± 267	96 ± 51
Third choice			
BCAVF	1,570 ± 707	393 ± 211	78 ± 32
u-PTFE	1,219 ± 402	458 ± 113	331 ± 65
BBAVF	2,110 ± 458	1,582 ± 961	187 ± 47
<i>Secondary patency (days ± SE)</i>			
Regardless choice			
ReRCAVF	2,789 ± 170	1,772 ± 242	508 ± 147

Patency is expressed (in days) with percentile distribution of functional fistulas.

the RCAVF when they were constructed either as a 1st or as a 2nd choice (Fig 2). The percentile distribution is displayed in Table II. For the same procedure in diabetic patients, the median secondary patency was 1772 (95% CI: 1,297, 2,247) days (Table II).

Complications. The cumulative incidence of the complications recorded for the group of patients who received a RCAVF was 0.25 per patient-year. The incidence for the group of patients who received a BCAVF, BBAVF, and u-PTFE was 0.57, 0.33, and 0.61 per patient-year, respectively. The incidence of each separate complication stratified by type of access is displayed in Table III.

DISCUSSION

The available literature is controversial regarding primary patency rates for vascular access procedures. The 1st year primary patency rate of RCAVF varies between 33%¹¹ and 92%.²³ The corresponding number for BCAVF ranges from 70%²⁴ to 85%,²⁵ whereas for PTFE grafts, reported patency rates vary from 44%¹¹ to 87%²⁶ and for BBAVF from 35%²⁷ to 94%.²⁸ Primary patency data for PC are scarce. In this study, we have chosen to present patency rates with Kaplan-Meier analysis and to calculate the percentile patency values for each type of fistula (ie, the duration of time [in days] after which the 25%, 50% [median], and 75% of an access is still functional). This

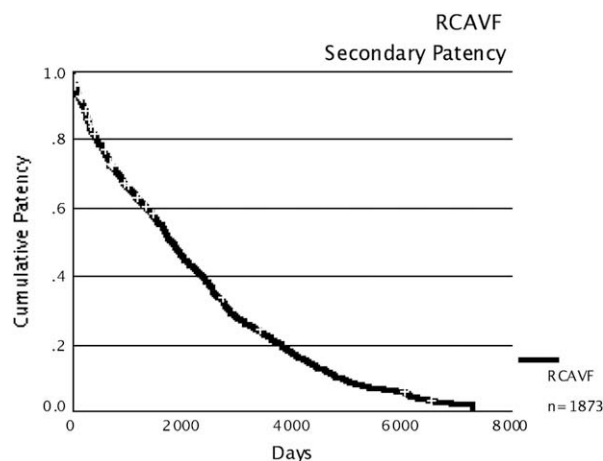


Fig 2. Secondary patency rate of the RCAVF performed either as a 1st or as a 2nd choice for vascular access. Patency rate is shown in fractions and time in days.

description of patency is not only statistically superior but also takes advantage of the long (20 years) actuarial follow-up. For comparison purposes, we have also calculated the first-year patency rates of 70%, 74%, 58%, 79%, and 58% for RCAVF, BCAVF, u-PTFE, BBAVF, and PC, respectively.

Even before the implementation (March 1995) of the original NKF/DOQI guidelines²⁹ or its revision,⁷ our order of preference for fistula placement was the RCAVF for primary access, followed by the secondary BCAVF, and if either of these was not viable, then a tertiary fistula should be fashioned using a synthetic material before proceeding (if necessary) to BBAVF or (in selected patients) to PC. Analysis of the patency curves yielded interesting observations. Autogenous fistulas showed superior patency than prosthetic grafts either as 1st, 2nd, or 3rd choice. Almost 50% of RCAVF, BCAVF, and u-PTFE were patent after 2, 3, and 1 year(s), respectively. Interestingly, when 6 years of function were reached, RCAVF exceeded BCAVF in performance; 10 years after construction, 18% of RCAVF and 12% of BCAVF were still functional (Fig 1, A). An important observation was made about BBAVF. More than 50% were still patent after 4 years, a number that indicates that this technically demanding access should be higher in our order of preference, before placement of prosthetic grafts. This notion has been supported recently by other authors as well.⁸ Nearly 50% of PC were still functional a year and a half after placement. As anticipated, diabetic patients showed worse patency rates¹⁴ and the difference was striking; 50% of RCAVF and u-PTFE accesses were still patent for a little bit more than half a year, whereas almost 50% of BCAVF and

Table III. Main complications observed after construction of the 4 most common vascular access procedures

Complication	Number per patient-year			
	RCAVF	BCAVF	BBAVF	u-PTFE
Vein stenosis/edema	0.20	0.42	0.28	0.30
Steal syndrome	0.01	0.10	0.01	0.12
Bleeding	0.03	0.04	0.03	0.04
Infection	0.01	0.01	0.01	0.15

Incidence is expressed in complication occurrence per patient-year.

BBAVF fistulas were still functional after 3 and 4 years, respectively. Interestingly, in this group of patients, RCAVF never exceeded BCAVF in performance, a fact that could be explained by the compromise observed in the radial arteries of diabetic patients (calcified vessels, extensive atherosclerosis, etc). Based on these results, one might argue that in the old diabetic patient, the best first access option is to skip the wrist procedures and go straight to an autogenous fistula in the antecubital region. The old diabetic patient has a short life expectancy, so the need to “conserve” access sites is low, whereas the need to provide a well-functioning fistula is high, in order to achieve better quality of life by minimizing rescue procedures. Constructing a BCAVF in the old diabetic patient maximizes arterial inflow and, therefore, lowers the need for secondary procedures.

Although interventions for the “failing” vascular access have been described for practically any type of fistula,⁹ the understanding that once the prosthetic grafts thrombose their long-term outcome is dismal, and that subsequent access options should be explored,³⁰ leads to the practice of aggressive rescue procedures more for the autogenous and less for the prosthetic graft fistulas. Once again, the available literature is controversial regarding secondary patency rates. For example, the corresponding number for RCAVF ranges from 52%³¹ to 80%.³² In this study, we have performed rescue procedures (mainly ReRCAVF) only for RCAVF. The first-year secondary patency rate for this type of access was 85%. Almost 50% of RCAVF were still patent after 5 years when 1 or more rescue procedures were employed. Rescue interventions improved the function of RCAVF in diabetic patients. Based on these results, one might argue that in the young diabetic patient, where the “conservation” of access sites is of importance (“the young vasculopath patient” problem), the best first access option is the RCAVF, followed by a rescue procedure to assure secondary patency.

The most important observed complications were arm edema, steal syndrome, bleeding, and infection. Edema occurred most notably after BCAVF, which is a finding in agreement with previous studies.⁸ The incidence of steal syndrome was low as anticipated,²⁰ usually occurring after BCAVF and u-PTFE. Bleeding was infrequent, without any predominance in a certain type of fistula, which is an observation similar to the ones reported by other authors.²¹ Finally, infection was most common for the PTFE graft, which is a well-documented observation.^{20,22}

Duplex ultrasonography is the most widely used tool to assess the patency and diameter of peripheral veins and arteries prior to a creation of a vascular access.³³ Preoperative diameters of veins and arteries of less than 1.6–2.5 mm have been associated with early fistula failure.^{34,35} This is reflected in the recommendation by the European Vascular Access Society guidelines, which suggest to perform preoperative diagnostics in order to decrease early failure and nonmaturation of newly created dialysis accesses.³³ Even with the use of preoperative ultrasonography, early failure rates of autologous fistulas remain high.³⁶ Moreover, ultrasonography yields variable results. Indeed, preoperative ultrasonography has a sensitivity, specificity, positive predictive value, and negative predictive value of 20–44%, 94–100%, 60–100%, and 73–81% for prediction of adequate function, respectively.^{23,37} In contrast, it has been recently suggested that a contrast-enhanced magnetic resonance angiography protocol enables a more accurate determination of upper extremity venous diameters, and hence, it might decrease the early failure and nonmaturation rates in patients undergoing access surgery.³⁸ No routine preoperative ultrasonographic evaluation of veins and arteries is implemented in our center. It is tempting to assume that adopting such a modality will decrease the number of patients (16.3%) in which we had to abandon the originally planned procedure because of inadequate vessels and will also improve

the early patencies and maturation rates of newly constructed fistulas.

Early observational data indicated that flow measurements,³⁹ routine Doppler ultrasonographic studies,⁴⁰ and organized testing of venous resistance,^{41,42} alone or in various combinations, could detect subclinical stenosis of fistulas and therefore be used as screening tools for monitoring the function of a dialysis vascular access.⁴³ Based on studies like that, NKF/DOQI guidelines recommend periodic surveillance for all types of vascular accesses with one of the aforementioned modalities.⁷ Of the noninvasive tests, a prime directive for screening techniques, the most widely used is the Transonics Doppler ultrasound system (Transonics Systems Inc., Ithaca, NY),⁴⁴ which uses an ultrasound dilution method to determine flow. Although the early observational data seemed to support implementation of these screening strategies,⁴⁵ subsequent randomized trials reached conflicting conclusions.¹⁷ In a recent systematic review and meta-analysis of 12 randomized trials that examined the clinical utility of monitoring using ultrasonography or blood flow,⁴⁶ Tonelli et al concluded that screening decreases the risk of an intermediate clinical outcome (fistula thrombosis) rather than a more definitive outcome (fistula loss) and that choosing not to offer routine screening is also reasonable at present. Moreover, it has been recently suggested that bi-monthly clinical assessment is equal to flow measurements as a surveillance method to prevent hemodialysis access thrombosis.⁴⁷ No routine surveillance strategy of vascular accesses is implemented in our center besides a thorough clinical assessment twice a year. It is tempting to assume that performing more frequent clinical assessments (ie, 4 or 6 times a year) will improve our patency rates. In addition, if a future, well-designed, and executed clinical trial advocates the use of a routine screening modality, we will not hesitate to adopt it in our clinical practice.

In conclusion, we have performed a retrospective analysis of prospectively collected data regarding arteriovenous dialysis access. We have presented the 20-year experience of a tertiary center. Despite lack of sophisticated preoperative evaluation and postoperative follow-up and interventions, adherence to some simple technical rules, such as use of vein conduits larger than 3 mm and presence of an immediate postoperative thrill or bruit, yielded very good primary and secondary patency rates. Of note, we never used anticoagulants. Moreover, the use of antibiotics was minimized. Based on our results, we advocate maximal use of autogenous conduits, except probably the case of the older diabetic

patient, where an elbow access should be the first choice. BBAVF is an excellent fistula and should probably be constructed before prosthetic graft placement. Finally, PC is a reasonable "way out" in technically demanding patients with a short (approximately 2 years) life expectancy.

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