

Maturation and Failure Rates in a Large Series of Arteriovenous Dialysis Access Fistulas

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The objective of this study was to document maturation and failure rates in a large homogeneous series of arteriovenous fistulas (AVFs). Between January 1, 1996, and December 31, 2001 (60 months), a single surgeon (AFS) in 1 academic medical center, constructed 374 AVFs. In this series, all AVFs were developed in vessels that had not undergone previous vascular access surgery. Recently, a retrospective review of these records revealed that 291 subjects had had complete follow-up for at least 3 months, and they constitute the material for this study. AVFs were considered a failure if an early occlusion/thrombosis occurred, if in 3 months the AVF had not matured on clinical examination, or if cannulation in the dialysis center was not feasible. A total of 91 AVFs did not mature, for an overall failure rate of 31%. An evaluation of failure rates indicated rates in females were higher than in males (41% versus 27%). Other risk factors, including HIV+ status, hypertension, and diabetes, demonstrated minimal failure differences (33%, 31%, and 36%, respectively).

Introduction

At present there are approximately 325,000 patients on hemodialysis in the United States. End stage renal disease (ESRD) is growing by approximately 15% each year. This means there is an effective doubling in 4 to 6 years. The annual cost in the United States for ESRD is projected to ex-

ceed \$38 billion by the year 2010.¹ It has been estimated that each patient on hemodialysis in the United States averages 1.5 surgical procedures per year. This means there are approximately 500,000 related surgical procedures performed this year. The National Kidney Foundation Dialysis Outcome Quality Initiative (KDOQI) has published guidelines recommending an aggressive approach to the creation of arteriovenous fistulas (AVFs).² This recommendation is based on the knowledge that primary AVFs have fewer complications and infections when compared to prosthetic grafts. Furthermore, AVFs are believed to have superior primary patency rates than prosthetic bridge grafts.³

AVFs can be created in the forearm, upper arm, or thigh. In this series the thigh was used in a single case. Figure 1 shows an immediate post-operative radiocephalic AVF. Note the enlarged

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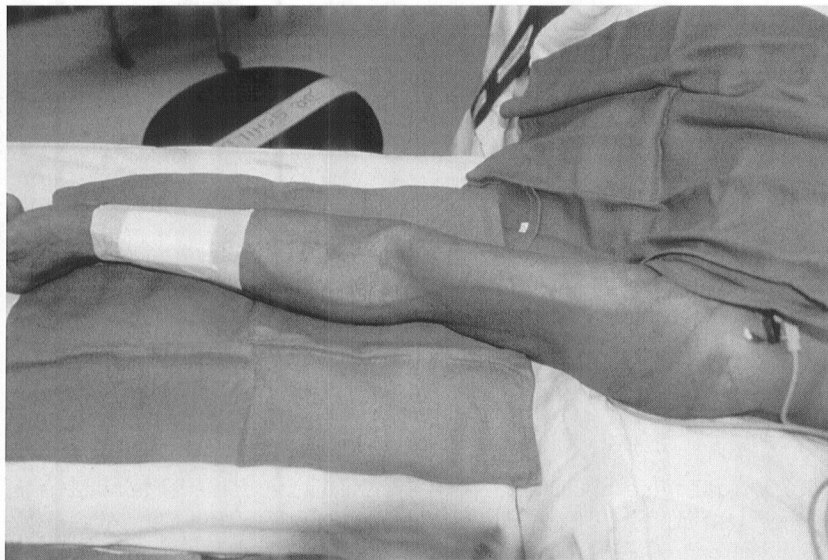


Figure 1.
Immediately
postoperative AVF.

cephalic vein extending from the wrist to the shoulder. In addition to standard anatomic approaches, AVFs can also be created by transposition of veins. In AVF construction, if the vein is small, it may be possible to create a larger aperture for anastomosis by using the technique illustrated in Figure 2.

In reviewing the literature associated with AVF maturation, we noted a wide range in failure rates (20–70%).⁴⁻¹² We undertook to identify our overall AVF failure rate and failure rates by gender and comorbid status.

Methods

Between January 1, 1996, and December 31, 2001 (60 months), a single surgeon (AFS) in this academic medical center constructed 373 AVFs in upper extremities and 1 AVF in a lower extremity. In this series, all AVFs were developed in vessels that had not undergone previous vascular access surgery. For placement of an AVF we require that the vein and artery be at least 2.5 mm in diameter (internal). This criterion is in accord with KDOQI recommendations.² In our center, preoperative vein mapping is performed when clinical evaluation does not suggest a suitable vein is present or if proximal stenosis is suspected.

A retrospective review of the 374 records revealed that 291 subjects had had complete follow-up for at least 3 months, and they constitute the material for this study. Seventy-seven

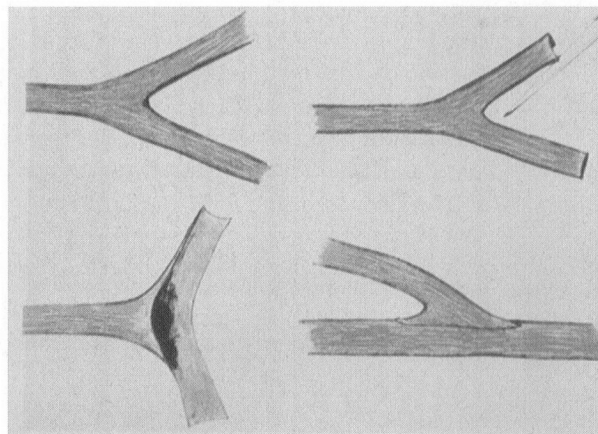


Figure 2. Technique for large aperture anastomosis.

patients were lost to follow-up and 6 had not reached 3 months postprocedure at the time of this analysis.

AVFs were considered a failure for 3 reasons. Early occlusion/thrombosis was the first criterion. If an AVF on clinical examination was not mature at 3 months, it was considered a failure. Finally, if cannulation in the dialysis center was not possible, this was the third failure class.

Table I provides the demographics and comorbidities for our 291 subjects divided by gender. There were 206 men (71%) and 85 women (29%). Overall 58% of our subjects were Black. Fifty-three percent of our patients were hypertensive, 30% had both hypertension and diabetes, and 16% were HIV+.

Table I. Demographics and comorbidities.

	Men (n=206)	Women (n=85)
Mean age, yr	48.9	50.6
Age range, yr	15-87	14-77
White race, n (%)	83 (28%)	38 (13%)
Black race, n (%)	122 (42%)	47 (16%)
Other races, n (%)	01 (<1%)	0
Total by gender, n (%)	206 (71%)	85 (29%)
Hypertension, diabetes, or HIV+, n (%)	17 (8%)	12 (14%)
Hypertension, n (%)	106 (51%)	49 (58%)
Diabetes, n (%)	03 (1%)	04 (5%)
Hypertension and diabetes, n (%)	69 (33%)	19 (22%)
HIV+, n (%)	36 (17%)	11 (13%)

Table II. Failure rates.

Risk	Men	Women	Men + Women
All, n (%)	27.2 (56/206)	41.2 (35/85)	31.3 (91/291)
No hypertension, diabetes, or HIV+, n (%)	17.6 (3/17)	50.0 (6/12)	31.0 (9/29)
Hypertension only, n (%)	28.3 (30/106)	32.7 (16/49)	29.7 (46/155)
All hypertensives, n (%)	29.1 (51/175)	36.8 (25/68)	31.3 (76/243)
Diabetes only, n (%)	0.0 (0/3)	75.0 (3/4)	43.9 (3/7)
All diabetics, n (%)	29.2 (21/72)	52.2 (12/23)	34.7 (33/95)
Hypertension and diabetes, n (%)	30.4 (21/69)	47.4 (9/19)	34.1 (30/88)
All HIV+, n (%)	27.8 (10/36)	54.5 (6/11)	34.0 (16/47)

Results

In our series the failure rate for men and women combined was 31.3% (91 of 291). The failure rate for men was 27.2% (56 of 206). For women the failure rate was 41.2% (35 of 85) (Table II). This follows from the fact that female vessels are generally smaller and, therefore, less amendable to AVF construction. Even when the criteria for

AVF were met, the failure rate in women was clearly higher.

We next evaluated failure rate as a function of comorbidities, which included hypertension, diabetes, and HIV+ status. The combinations we considered were the following: no comorbidity, hypertension only, all hypertensives, diabetes only, all diabetes, hypertension and diabetes, and all HIV+. Interesting, in this study comorbidities

in any combination did not significantly affect failure rate (Table II). For these comorbidities, comparisons between men and women demonstrated p values ranging from 0.08 to 0.58, which are not statistically significant. Figure 3 summarizes our data and illustrates that, in every category, women had an increased failure rate. The p value for all men versus all women was statistically significant at 0.02.

We performed AVFs in 5 sites: radiocephalic, radiobasilic, brachiocephalic, brachio basilic, and saphenofemoral. The majority of cases were either radiocephalic (125) or brachiocephalic (151). This constitutes 95% of the study population. For men the failure rate was 30.3% at the radiocephalic site and 22.8% at the brachiocephalic site. In women the failure rate was 47.2% at the radiocephalic site and 34.7% at the brachiocephalic site (Figure 3). This confirms clinical experience and illustrates that the brachio basilic site, often with larger vessels, had superior success rates. Despite these findings it is recommended AVFs be created in as distal a position as possible, so that when occlusion occurs, a more proximal AVF can be created.

Conclusion

In our series, which extended over 5 years, we placed more AVFs in men than in women despite the fact that published data suggest that men and

women present for dialysis at the same frequency.¹³ Since this is a selection bias, we feel the cause is due to smaller female vessels, which are less amenable to AVF construction.

With the criteria described above, our overall failure rate was 31.3% (men and women). Further, we found the failure rate in women to be higher than in men (41% versus 27%). We feel the most logical cause for this difference is size of vessels (arteries and veins). It is generally accepted that atherosclerosis is more aggressive in men.^{14,15} However, in this population, the women are often hypertensive, diabetic, and early postmenopausal. This risk combination may produce a form of atherosclerosis that accelerates more rapidly than in men. Finally, women are known to have a more active vasomotor tone, which transiently increases peripheral resistance.¹⁶

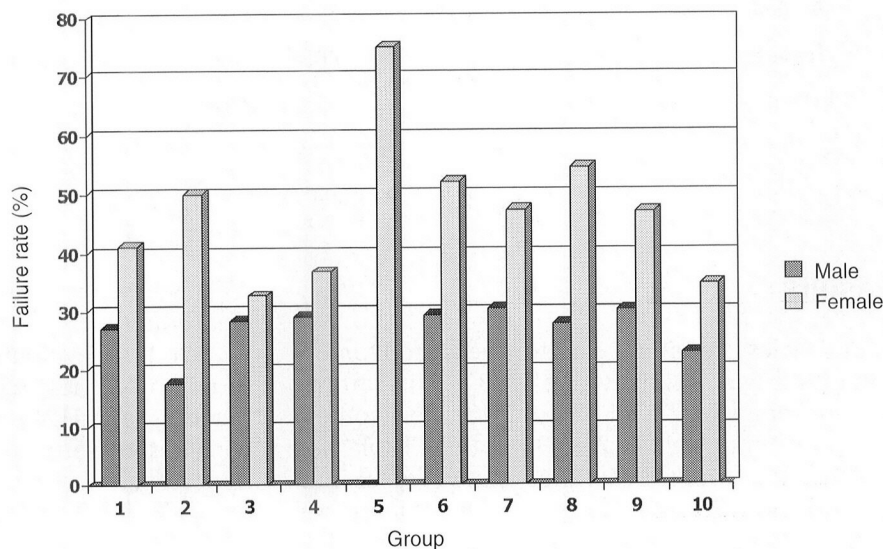
For both men and women the construction of AVF at the brachiocephalic site was superior to that at the radiocephalic site. Again, we believe this is a manifestation related to larger vessels.

When we initiated this study we expected to find increased failure rates in patients with obvious comorbidities (hypertension, diabetes, and HIV+ status). Careful review of our data indicates minimal failure differences for these comorbidities ranging from 31% to 36%.

KDOQI guidelines suggest that AVF be performed in at least 50% of vascular access procedures.³ Published data suggest AVF failure rates in the 20% to 70% range.⁵⁻¹³ This is confirmed by our studies, which demonstrated AVF failure rates between approximately 17% and 55%. Patients

Figure 3. Failure rate summary.

- Group definitions:
1. All subjects
 2. No comorbidities
 3. Hypertension only
 4. All hypertensives
 5. Diabetes only
 6. All diabetes
 7. Hypertension and diabetes
 8. HIV+ status
 9. Radiocephalic AVF
 10. Brachiocephalic AVF



who have an AVF constructed that fails require a second vascular access operation (another AVF or graft). We believe vein mapping, when indicated, and improved selection may reduce the number of further operations. Our data should improve selection (AVF versus grafting) and potentially require revising KDOQI guidelines.

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