Arteriovenous fistulas as vascular access for hemodialysis: The preliminary experience at the University Hospital of the West Indies, Jamaica

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BACKGROUND: The demand for vascular hemodialysis access creation is steadily increasing. To satisfy the demand, a vascular access team was established at the University Hospital of the West Indies, Jamaica. The outcomes of this practice are reported.

METHODS: A retrospective study of all patients who had permanent vascular dialysis access established at the University Hospital of the West Indies between January 1, 2002, and December 31, 2006, was performed. Data were analyzed using SPSS version 12.0 (SPSS Inc, USA).

A direct anastomosis between an autogenous artery and vein was considered an arteriovenous fistula (AVF). When prosthetic material was used, the access was considered to be an arteriovenous graft. Accesses that were nonfunctional after six weeks of maturation were considered to be primary failures, while those that failed after previous successful dialysis were considered to be secondary failures. Primary patency was defined as the interval between access placement and the first intervention for failure. Secondary patency was the interval between access placement and abandonment. Cumulative patency was defined as the number of accesses that remained patent over a given time period, regardless of the number of interventions performed.

RESULTS: Of 41 patients, nine were excluded due to incomplete data. Final analyses were performed on 32 patients with a mean ($\pm$ SD)

age of 42.3 ± 15.3 years (range 18 to 66 years, median 43 years).

The access type was an AVF in 100% of cases, which included distal radiocephalic fistulas in 27 patients, brachial-cephalic fistulas in three patients and proximal radiocephalic fistulas in two patients. Operations were performed in four (12.5%) incident and 28 (87.5%) prevalent dialysis patients. The mean delay between initiation of dialysis and AVF creation was 21.2 ± 26.1 months (range one to 94 months, median 10 months).

There were eight (25%) primary failures. Of the remaining 24 patients, there were seven (29.2%) secondary failures from thrombosis. There was primary patency for a mean of 723.9 ± 422.1 days (range 199 to 1314 days, median 678 days). Only one (4.2%) patient had thrombectomy to prolong AVF function, resulting in secondary patency for 439 days. Cumulative patency was 62.5%, 33.3%, 25% and 4.2% for one, two, three and four years, respectively.

CONCLUSIONS: The rate of AVF creation for end-stage renal disease patients in this setting far exceeds the target goals set forward by the National Kidney Foundation published updated Dialysis Outcomes Quality Initiative (NKF/DOQI) Guidelines and the Centers for Medicaid & Medicare Services Fistula First initiative. This is being achieved with acceptable rates of morbidity and patency. There is room for improvement in postoperative surveillance to increase early detection of failing accesses and allow for increased utility of interventions for assisted patency.

Key Words: Arteriovenous fistula; Hemodialysis; Stage V kidney disease; Vascular access

The demand for vascular access for renal replacement therapy is increasing because the incidence of end-stage renal disease (ESRD) is rising worldwide (1). In 2010, an estimated 2.5 million patients will require hemodialysis compared with 1.49 million in 2000 (1). Similar trends are occurring in Jamaica (2). In 2007, it was reported that there were 250 prevalent (established ESRD patients) and 500 incident (new) ESRD patients who required hemodialysis per million people per year in Jamaica (3).

The ideal method of vascular access for hemodialysis in these patients is through an arteriovenous fistula (AVF) – a surgically created communication between an artery and a vein that results in increased blood flow through an accessible conduit (4). A vascular access team was established at the University Hospital of the West Indies (UHWI), Jamaica, to facilitate early AVF creation and postoperative AVF surveillance in ESRD patients. This service is supported by dedicated nephrology services, immediate access to an on-site hemodialysis unit, specialized

microvascular operative equipment and a full range of auxiliary services, including Doppler ultrasound vascular mapping and intraoperative fluoroscopy. We performed a retrospective audit of AVF creation in this setting to establish the outcomes of this practice at the UHWI in Jamaica.

METHODS

Approval from the UHWI Faculty of Medical Sciences ethics committee was secured to collect and analyze data for the present study (UWI/ECP76 2008/2009). The operative log at the UHWI was retrospectively evaluated to identify all patients with ESRD who underwent operative procedures to establish vascular access between January 1, 2002, and December 31, 2006. The patients' hospital records were retrieved for detailed analysis.

Patients were excluded from analysis if their hospital records were unavailable or incomplete. Only patients who had new permanent accesses created were evaluated. Patients who

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TABLE 1
Etiology of end-stage renal disease in patients with vascular access operations

Pathology	Etiology	n (%)
Combined etiology		7 (21.9)
• Combined	Hypertension and diabetes	7
Vascular diseases		6 (19)
• Vessel disease	Hypertension alone	6
Glomerular diseases		8 (25)
• Proliferative glomerulonephritis	Systemic lupus erythematosus	1
• Diabetic glomerulosclerosis	Diabetes alone	4
• Focal glomerulosclerosis	Drug-induced	3
Tubular-interstitial diseases		2 (6.3)
• Reflux nephropathy	Posterior urethral valves	2
Cystic diseases		1 (3.1)
	Polycystic kidney disease	1
Hereditary diseases		3 (9.4)
	Renal agenesis/hypoplasia	1
	Sickle cell disease	2
Other causes/unspecified		6 (19)
Total		32

had additional operative procedures were included if they had access creation at the same sitting.

The data extracted from hospital records included patient demographics, comorbidities, details of previous access, location and type of new AVF, operative details, morbidity and patency. The data were entered into a Microsoft Excel worksheet (Microsoft Corporation, USA) and analyzed using SPSS version 12.0 (SPSS Inc, USA).

A direct anastomosis between an autogenous artery and vein was considered to be an AVF. Once the surgeon interposed prosthetic material between the native vessels, the access type was considered to be an arteriovenous graft (AVG).

The vascular access was considered to be functional if it was able to support the patient's dialysis prescriptions by providing blood flow of greater than 300 mL/min during dialysis sessions. An AVF or AVG that could not be cannulated and/or could not provide blood flow of greater than 300 mL/min for adequate dialysis was considered to be a failed access.

Accesses that were nonfunctional after allowing six weeks for maturation were considered to be primary failures, while those that failed after previously being used for successful dialysis were considered secondary failures.

Primary patency was defined as the interval between access placement and the first endovascular or surgical intervention to address access failure. Secondary patency was the interval between access placement and abandonment, including any period after surgical or endovascular interventions. Cumulative patency was defined as the number of accesses that remained patent over a given time period, regardless of the number of interventions performed. Patients whose accesses were not used at six weeks because of mortality, successful receipt of kidney transplants or an interval between access creation and termination of the study period that was shorter than six weeks

were considered to have 'indeterminate patency' for the purpose of the present study.

RESULTS

There were 41 vascular access operations performed during the study period. Nine cases were excluded due to incomplete data or unavailable hospital records. Of the remaining 32 patients, there were 18 men with a mean ($\pm$ SD) age of 40.9 ± 16.1 years (range 18 to 66 years, median 42.5 years) and 14 women with a mean age of 45.7 ± 13.5 years (range 35 to 67 years, median 45 years).

The etiology of ESRD in these patients is outlined in Table 1. Overall, 53.1% of patients had chronic lifestyle diseases; four had diabetes alone, six had hypertension alone and seven had a combined etiology.

There were no reports of prosthetic material used to create AVGs in the present series. All the procedures were performed with small-diameter polypropylene sutures to anastomose autogenous vessels, using surgical loupes as visual aids (Table 2). The most common operative procedure was the creation of a Brescia-Cimino (distal radiocephalic) fistula, which was performed in 27 patients, followed by the creation of brachial-cephalic fistulas in three patients and mid-forearm radiocephalic fistulas in two patients.

In the present series, AVFs were created in four (12.5%) incident and 28 (87.5%) prevalent dialysis patients. Two of the prevalent dialysis patients had already commenced peritoneal dialysis and the remainder had hemodialysis across temporary catheters (one internal jugular, six subclavian and two femoral catheters), tunnelled catheters (four internal jugular and two subclavian catheters) or previous AVFs (10 radiocephalic and one brachial-cephalic catheter). The mean duration of time on dialysis before AVF placement in these patients was 21.2 ± 26.1 months (range one to 94 months, median 10 months).

There were eight (25%) primary failures. Of the remaining 24 patients, seven (29.2%) experienced secondary failures. In these patients, there was primary patency for a mean duration of 723.9 ± 422.1 days (range 199 to 1314 days, median 678 days). Only one (4.2%) patient had any form of intervention (operative thrombectomy) in an attempt to prolong AVF function, and this resulted in secondary patency for 439 days.

At the termination of the study period, 17 of 24 (70.8%) patients were still being dialyzed across a functional AVF after a mean duration of 656.1 ± 498.6 days (range 270 to 1710 days, median 374 days) from initial placement. There were four deaths during the study period and none were attributable to a direct complication of vascular access operations.

DISCUSSION

Successful hemodialysis depends on the creation and maintenance of adequate vascular access. There is a consensus that the ideal form of vascular access for hemodialysis is a native AVF (4-6). Patients who are already receiving dialysis across a functional AVF have lower complication rates and longer duration of event-free patency than patients with catheter access (4,7-10) and AVGs (7,10,11).

There are also better outcomes when patients commence hemodialysis with a functional AVF compared with those who initiate treatment with catheter access (11). The National

Kidney Foundation (NKF) published updated Dialysis Outcomes Quality Initiative (NKF/DOQI) guidelines in 2006 (4,5). The NKF/DOQI guidelines have defined target goals for hemodialysis by AVF in at least 50% of incident dialysis patients (5). The United States' Centers for Medicare & Medicaid Services (CMS) adopted the NKF/DOQI goals when it launched the Fistula First Breakthrough Initiative in 2005 (6). In our setting, only 12.5% of incident dialysis patients had AVF creation without previous catheter access. This figure is significantly lower than the NKF/DOQI and CMS targets and lower than those reported from other Caribbean countries. The Cayman Islands, the nearest Caribbean territory to Jamaica, have reported 100% incident AVF placement three years after the inception of a vascular access service for hemodialysis (12).

The overwhelming majority of our patients commenced hemodialysis across catheters (87.5%). Additionally, the duration of time required for conversion from catheter access to AVF in prevalent dialysis patients was prolonged (21.2 months). There is room for improvement by reducing the number of incident dialysis patients commencing treatment using catheter access and by reducing the interval between commencement of therapy and AVF creation.

There are several avenues by which this can be achieved locally. It has been demonstrated that early referral to nephrologists and good collaboration with vascular surgeons reduce the need for temporary dialysis access for first dialysis (12) and increase the rate of successful AVF placement (13-15). All patients with ESRD at the UHWI are managed in a centralized, fully stocked dialysis unit in which patients have ready access to dedicated nephrologists, vascular surgeons, specialized dialysis nurses and radiologists. Closer collaboration among these disciplines may result in earlier referrals for vascular access. Policy makers must also ensure that dedicated operating room time, space and personnel are available if the volume of operations for AVF creation is to increase to realize NKF/DOQI and CMS goals.

It was notable that there were no AVGs created in the present series. There are vast data proving that native AVFs are superior to grafts as a form of vascular access for dialysis (4-7,10). Compared with AVGs, they are associated with increased event-free patency and reduced morbidity and mortality at a significantly lower cost, with lower rates of positive blood cultures, antibiotic use and hospitalizations (4-6,11).

Despite overwhelming evidence in favour of AVFs as vascular access points for dialysis (4-11), there remain marked differences in their use. As recently as 2003, the Dialysis Outcomes and Practice Patterns Study (DOPPS) (16,17) showed that the use of AVFs reached 60% to 80% in Europe and Japan compared with 30% in the United States, irrespective of comorbidity, race or geographic distribution. In our setting, the publicly funded health care system did not allow a reliable supply of graft material. This actually promoted the use of AVFs in all cases in our setting.

The most common operative procedure was the creation of the distal radiocephalic fistula, initially described by Brescia et al in 1966 (18). This operation is still considered to be the gold standard for vascular access for hemodialysis (19) and it accounted for 27 (84.4%) of our operative procedures. High radiocephalic (2) and brachial-cephalic (3) AVFs were reserved

TABLE 2
Outcomes of arteriovenous fistula creation by the University Hospital of the West Indies (Jamaica) vascular access team

Outcome	All fistulas, n=32	%
Previous dialysis requirements		
Incident dialysis patients	4	12.5
Prevalent dialysis patients	28	87.5
Method of dialysis (prevalent), n=28		
Previous arteriovenous fistula	11	39.3
Tunnelled catheters	6	21.4
Temporary catheters	9	32.1
Peritoneal dialysis	2	7.1
Type of vascular access		
Prosthetic arteriovenous graft	0	0
Native arteriovenous fistula	32	100
Suture material		
5/0 polypropylene	1	3.1
6/0 polypropylene	6	18.8
7/0 polypropylene	14	43.8
8/0 polypropylene	10	31.3
9/0 polypropylene	1	3.1
Overall morbidity, n=24		
Operative mortality	0	0
Bleeding	0	0
Steal syndromes	0	0
Surgical site infection	0	0
Thrombosis	7	21.9
Long-term outcomes		
Primary failure, n=32	8	25.0
Secondary failure, n=24	7	29.2
Primary patency, days		
Mean $\pm$ SD	723.9 $\pm$ 422.1	
Range	199–1314	
Median	678	
Mode	–	
Secondary patency (days)	439	
Cumulative patency, n=24		
1 year	15	62.5
2 years	8	33.3
3 years	6	25.0
4 years	1	4.2
5 years	0	0

for patients with previous Brescia-Cimino AVFs that had failed.

The outcomes of the classic Brescia-Cimino operation were accompanied by acceptable rates of morbidity, operative mortality and long-term function (4,20,21).

The reported incidence of primary failure in the medical literature varies from 7% (22) to 40% (23). The NKF/DOQI Work Group did not recommend the use of primary failure as an index of quality because it would discourage attempts at AVF construction in patients with complex vascular anatomy (4). Nevertheless, most large-volume centres reported 15% to 30% primary failure rates for distal radiocephalic AVF (12,20,21) and our results were comparable, with 25% primary failures.

The NKF/DOQI made similar recommendations that primary and/or secondary patency should not be used as an index

of quality because it would discourage AVF creation (4). Although there are wide variations in AVF patency in the medical literature, the cumulative patency rates at this institution (62.5%, 33.3%, 25% and 4.2% after one, two, three and four years, respectively) were comparable with those reported by large-volume centres (21-24).

Secondary patency could only be reported in one case in the present series because there was a paucity of additional interventions for assisted patency. This may have been due to poor AVF surveillance and late detection of thrombosis. More structured surveillance and/or closer collaboration with nephrologists and/or dialysis nurses may result in increased utility of

these accepted interventions and improve the secondary patency rates in this setting (25-27).

CONCLUSION

The 100% rate of AVF creation for patients with ESRD at the UHWI in Jamaica far exceeds the target goals set forward by the NKF/DOQI and the CMS Fistula First Breakthrough Initiative. This is being achieved with acceptable rates of morbidity, operative mortality and primary patency. There is room for improvement in postoperative surveillance to increase early detection of failing accesses and allow for increased utility of interventions for assisted patency.

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