

Research Article

Evaluation of the Efficacy of the Single Stage Brachio-Basilic Transposition Fistula

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Submitted: 22 August 2014

Accepted: 14 September 2014

Published: 15 September 2014

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Abstract

Introduction: In keeping with established international guidelines our institute follows an "all-autogenous" approach with regard to hemodialysis access. Upper arm transposition fistulas can allow for access options when forearm autogenous options are not suitable. We evaluate our experience with a single staged brachio-basilic arteriovenous fistulas (BBAVF) to assess efficacy and patency.

Methods: We retrospectively reviewed all patients who underwent a BBAVF formation from January 2005 to December 2011.

Results: 30 fistulas were created on 30 patients. Median age is 50 years old, 16 (53%) patients are male. Renal failure was associated with diabetes in 11 (37%) patients and 22 (73%) patients were already receiving hemodialysis prior to fistula formation. For eight (26%) patients BBAVF was the first attempt at upper extremity access. Median basilic vein diameter was 4.5 mm (range of 2.8- 6.7 mm). Median length of follow up was 15 months. Primary patency rates at 6 months, 1 year, and 2 year were 79%, 65 %, and 59 % respectively. Primary assisted patency rates were 86%, 81 %, 67% and secondary patency rates were 93%, 93%, 93 % respectively. No patients went on to have a prosthetic graft placement. A total of 20 secondary procedures were required to maintain patency, 15 surgical revisions were performed on 9 patients and 5 endovascular procedures on 3 patients.

Discussion: In our experience a single stage BBAVF provides an excellent option for maintaining autogenous hemodialysis access with good long term patency.

Keywords

- Brachio-basilic
- Fistula
- Dialysis
- Vascular patency
- Complications

ABBREVIATIONS

Arteriovenous Prosthetic Grafts (AVG), Autogenous arteriovenous Fistulas (AVF), Brachio-Basilic Arteriovenous Fistulas (BBAVF), End Stage Renal Failure (ESRF), National Kidney Foundation's / Kidney Disease Outcomes Quality Initiative (NKF/DOQI).

INTRODUCTION

The number of patients with end stage renal failure (ESRF) requiring renal replacement by hemodialysis is rising rapidly at an estimated rate of 6-8 % per year [1]. The increased survival rates of patients on dialysis and the changing cohort of older and more co-morbid patients the challenge of providing long-term dialysis access is of ever increasing importance [1,2]. The National Kidney Foundation's / Kidney Disease Outcomes Quality Initiative (NKF/DOQI) recommends autogenous arteriovenous fistulas (AVF) as the preferred method for long-term hemodialysis access [3]. Several studies have shown an improved patency, lower complication rates, and increased cost effectiveness of AVF compared to arteriovenous prosthetic grafts (AVG) [4-6].

The radio-cephalic AVF at the wrist and the brachio-cephalic AVF at the antecubital fossa are the favored first and second choice access options respectively [3]. However, the basilic vein can allow for AVF creation when suitable forearm veins are not available and may prevent the need to resort to AVG [7]. The brachio-basilic arteriovenous fistula (BBAVF) was first described by Dagher in 1976 [8]. Several modifications to the technique have occurred over time with both single-stage and two-stage procedures being performed [6]. The deep, straight, large caliber basilic vein which is also protected from venopuncture make it an ideal hemodialysis conduit. However, its anatomical location necessitates superficialisation to allow needle access [8]. Our institute follows an "all- autogenous" approach in the creation of hemodialysis access conduits. The purpose of this study was to examine our experience with a single-stage BBAVF and assess patency and long term efficacy.

MATERIALS AND METHODS

All patients undergoing formation of a BBAVF from January 2005 to December 2011 were identified using hospital and operative coding registries and cross referenced with surgeons

operating logbooks and the renal access database. Patients in this study were all evaluated and treated by surgeons at Wellington Regional Hospital. Operations were performed by three vascular surgeons during the study period.

Preoperative upper extremity duplex ultrasound venous mapping is routinely performed and patients are then clinically reviewed in collaboration with the renal access team. Starting with the non dominant hand the most distal vein greater than 2.5mm is used. If no appropriate autogenous forearm or upper arm cephalic options exist, a BBAVF is then preferentially performed. AVG are only used as a last resort when all autogenous options are deemed unsuitable. Ultimately, the decision of the type of dialysis access is determined by the operating surgeon with consideration of the above factors.

BBAVF are performed as a single stage procedure under general anaesthesia. The basilic vein is transposed through an anteriorly positioned subcutaneous tunnel to form an end to side anastomosis with the brachial artery at the level of the antecubital fossa. Following the operation patients are closely followed until maturation. No routine ultrasound surveillance is done after maturation. Patency was assessed by clinical examination and a duplex ultrasound was used in the initial evaluation of a malfunctioning access. Patient notes were examined retrospectively. Pre-operative characteristic, baseline demographics, duration of follow up and patency were recorded. Fistula patency was defined according to the Society for Vascular Surgery guidelines [9]. Primary patency is defined as the interval from the time of access placement until any intervention designed to maintain or re-establish patency, access thrombosis, or the time of measurement of patency. Primary assisted patency is the interval from the time of access placement until access thrombosis including intervening manipulation designed to maintain the functionality of a patent access. Secondary patency is the interval from the time of access placement until access abandonment, thrombosis, or the time of patency measurement including intervening manipulations designed to re-establish functionality in thrombosed access. Data was entered into a Microsoft Excel (Microsoft Corp, Redmond, Wash) spreadsheet for analysis. Kaplan-Meier analysis was performed to determine patency using SPSS version 21 (Chicago, IL, USA).

RESULTS AND DISCUSSION

30 BBAVF were formed on 30 patients. The median age of patient was 50 year old (range of 15-75 years), 16 (53%) of the patients were males. ESRF was due to diabetes in 11 (37 %) patients and glomerulonephritis in 11 (37 %). Patient baseline characteristic data is presented in table 1. BBAVF was the first attempt at upper extremity access for eight (26%) patients. The remaining 22 patients had a total of 34 previous upper extremity access attempts including two patients that had previous attempts with AVG by surgeons from other hospitals. 21 (70%) patients had already started hemodialysis prior to BBAVF formation. BBAVF was formed on the non-dominant arm in 25 (83%) patients. The median basilic vein diameter was 4.4 mm (range = 2.8 - 6.7 mm).

There was no 30 day mortality. Early (<30 days) complications occurred in three patients (10%). One patient required return

to operating theatre for bleeding soon after fistula formation, one patient had thrombosis within 24 hours of the procedure requiring a return theatre to restore patency, and one patient require oral antibiotics for a wound infection 3 weeks following the operation (table 3). Median follow up time was 15 months (range = 2 - 67 months). Three fistulas failed to mature, however angioplasty was able to assist the fistula to mature in two cases. Median time to first cannulation was 13 weeks (range of 1 - 65 weeks). Primary patency rates at 6 months, 1 year, and 2 year was 79%, 65 %, and 59 % respectively. Primary assisted patency rates were 86%, 81%, 67% and secondary patency rates were 93%, 93%, 93 % respectively (Figure 1).

A total of 20 secondary procedures were required to maintain patency, 15 surgical revisions on nine patients and five endovascular procedures on three patients (Table 2). The most common indication for surgical intervention was late (>30 days) access thrombosis which occurred in six patients (20%). Patchplasty was required in four patients (13%) for fistula stenosis, with the great saphenous vein used (GSV) in two cases and bovine pericardium patch in two cases. One patient developed steal syndrome 14 months after formation and was successfully treated with a GSV bypass from the fistula to the proximal radial artery (revascularization using distal inflow). Of the patients requiring re-intervention, patency was not able to be restored in three fistulas and these were abandoned. Five patients required temporary hemodialysis catheter placement until a revised fistula could be accessed again. Five (17%) patients went on to receive renal transplant, 10 patients have died with a patent BBAVF.

DISCUSSION

Reliable access to circulation is paramount to the ability to achieve adequate hemodialysis. Autogenous arterio-venous fistulas is the "gold standard" in providing long term

Table 1: Patient characteristic.

	N = 30	%
Median age (range)	50 years (15 - 75)	
Male : Female	16 : 14	
Ethnicity		
• European	17	57 %
• Maori	9	30 %
• Asian	2	6.5 %
• Pacific	2	6.5 %
Smoking status		
• Current	6	20 %
• Ex smoker	5	17 %
• Never	19	63 %
Comorbidities		
• Ischemic Heart Disease	10	33 %
• Diabetes	1	37 %
• Peripheral vascular disease	7	23 %
Etiology of renal failure		
• Diabetes	11	37 %
• Glomerulonephritis	11	37 %
• Renal cystic disease	3	10 %
• Reflux	2	6 %
• Other causes	3	10 %

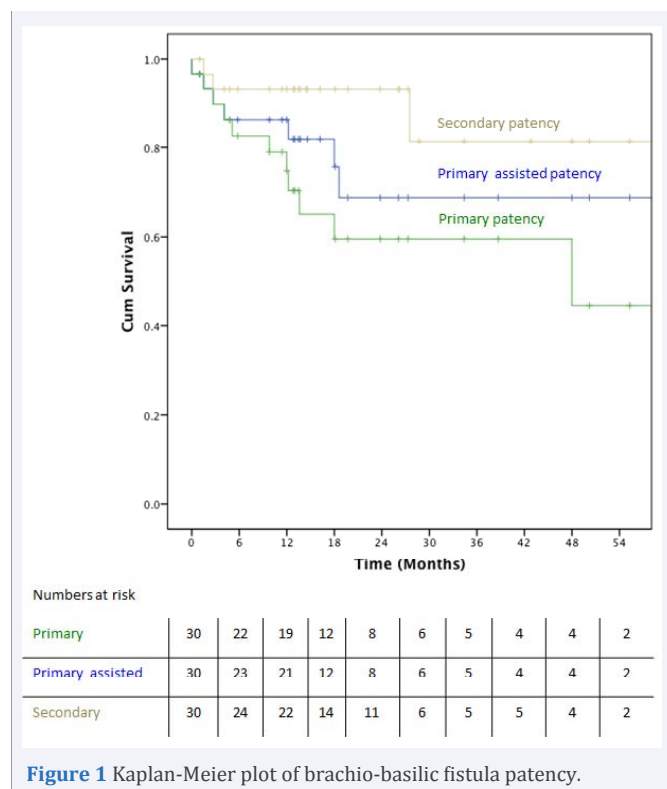


Figure 1 Kaplan-Meier plot of brachio-basilic fistula patency.

Table 2: Indications for intervention for brachio-basilic fistula patients.

Surgical Intervention	Number of procedures
Access Thrombosis (>30 days)	6
Stenosis	4
Bleeding, Early post operative	1
Access Thrombosis (<30 days)	1
Pseudoaneurysm at needle stick site	1
Steal syndrome	1
Endovascular	
Stenosis :Fistuloplasty	5

haemodialysis access [3]. The NKF/DOQI guidelines reflects this and an initial 40% target prevalence of AVF for hemodialysis access has now been updated and increased to 65% (3,10). These guidelines are on the background of a changing ESRF patient population. Patients on dialysis now live longer, are older and have underlying chronic conditions like diabetes, ischemic heart disease and peripheral vascular disease. Furthermore, they are more likely to have had previous failed upper extremity access, previous central venous catheter placement, and be dialysis dependent at time of access placement [2,11,12]. These are all known predictors of fistula failure and associated with higher complication rates [7].

In this study our primary, primary-assisted, and secondary patency rates are comparable to other reported series, a recent review in 2011 has reported BBAVF primary patency rates of 23 – 90% and secondary patency rates of 47 – 96% at 1 year [2]. Our outcomes are also in keeping with NKF/DOQI guidelines recommended patency rates of 70% at 1 year, and 60% at 2

years for all kinds of AVF [3]. However, these outcomes were achieved in a more challenging patient population, 22 patients (73%) had a total of 34 previous failed upper extremity access attempts including two patients with previous AVG placement. In order to maintain patency a third of our patients have undergone at least one intervention. However, this still compares favorably to AVG in which re-intervention rates have been reported at 50 – 91% [12,13]. The most common indication for re-intervention was thrombosis at greater than 30 days and fistula stenosis which are generic complications for all access procedure. Specific complications associated BBAVF relates to the magnitude of the operation compared to the simpler forearm fistula. However, infective, bleeding, and access related hand ischemia requiring intervention occurred in only one patient (3%) respectively. This is below the reported 10-18% predicted rate that can occur in any brachial artery based access procedure [2,14,15].

We performed a BBAVF as a single-stage procedure however there are a variety of described techniques and the debate about single versus two-stage procedure, transposition vs. superficialisation is ongoing with good arguments for and against [16,17]. One of the main underlying reasons for surgeons performing two staged BBAVF is to allow sufficient time for the basilic vein to arterialize and mature prior to transposition. However, in our series there was only one case that failed to mature. There has only been one underpowered randomized control comparing single versus two-staged BBAVF in 40 patients [18]. This showed higher patency rates in the two staged procedure compared to the single procedure, 50% versus 80%. However, the two staged BBAVF requires a longer delay until dialysis is commenced compared to a single stage procedure, as patient need to undergo two operations. Also as many patients will be receiving dialysis through central line whilst awaiting fistula access, a two staged procedure may put patients at prolonged risk of complications from central lines [2]. More recently, Bourquelot et al. have been reported success with a distal ulnar basilic arteriovenous fistula created at the wrist using microvascular surgical techniques, although lower rates of steal have been reported there is also an failure to mature rate of up to 30% and a longer time to maturation [19].

The BBAVF have well documented long term advantages with regard to patency, lower thrombotic and infective complication rates compared to AVG [5,20]. Also the cost of renal access is highest amongst those patients with AVG, with the cost of vascular access related care being reported as five times lower for patients who started hemodialysis with functioning AV fistula compared to those treated with a AVG or percutaneous catheter [4]. The disadvantages of the BBAVF are the increased length of operative time, increased complexity of the procedure, and a longer delay until access can be commenced compared with AVG. Furthermore, a major additional benefit of the BBAVF is the ability to place AVG subsequently in the same upper arm location if the fistula should fail [7]. However, no patient in our series went on to require a AVG placement.

The main limitations of our study are the small numbers of patients, the retrospective study design, and lack of a comparison group. However, a randomized trial would be required to best

answer the question as to which is the better technique single versus two-stage brachio-basilic transposition fistula.

In conclusion the single staged BBAVF is an excellent hemodialysis access option with good long-term patency and acceptable morbidity. Despite the increasing number of patients with diabetes, peripheral vascular disease, and those of older age, we believe the creation of a native AV fistula is possible in the vast majority of cases and the BBAVF should be in the armamentarium of all renal access surgeons.

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Cite this article

Reddy SK, Khashram M, Evans R (2014) Evaluation of the Efficacy of the Single Stage Brachio-Basilic Transposition Fistula. *Ann Vasc Med Res* 1(1): 1003.