

# Brachiobasilic Arteriovenous Fistula for Hemodialysis Access: Experience at King Hussein Medical Center

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## ABSTRACT

**Objective:** To evaluate the (one, two, three) year primary and secondary patency of brachiobasilic arteriovenous fistula (BBAVF) as hemodialysis vascular access and procedure complications at King Hussein Medical Center.

**Methods:** A retrospective single-center study, analyzing the patency of 129 BBAVF procedures for hemodialysis vascular access and associated complications. Follow up patency was assessed by adequacy of BBAVF for hemodialysis over 3 years' period.

**Results:** (One, two, three) year primary patency was (75, 62, 47) % respectively and (one, two, three) year secondary patency was (77, 64, 50) % respectively. Failure of maturation was seen in 16 patients (12%). Hematoma developed in 5 patients (3.9%). Bleeding related to infection developed in 3 patients (2.3%). Wound infection developed in 13 patients (10.1%). Arterial steal developed in 14 patients (10.9%). Venous hypertension developed in 12 patients (9.3%). Ischemic monomelic neuropathy developed in 2 patients (1.6%). Pseudoaneurysm at puncture sites developed in 12 patients (9.3%). Thrombosis developed in 24 patients (19%). There was no procedure related mortality.

**Conclusion:** BBAVF is an important and effective option in KHMC for chronic renal failure patients requiring hemodialysis with acceptable patency and complication rates.

**Key words:** Brachiobasilic arteriovenous fistula, hemodialysis access.

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## Introduction

As the population of end stage renal failure patients requiring hemodialysis continues to increase as a result of improved survival of patients on dialysis, the inclusion of older patients onto dialysis programs and the falling availability of renal transplants, it is important to provide them with a well-functioning vascular access for hemodialysis to achieve long term survival and optimal quality of life with decreased morbidity and mortality of such a procedure. <sup>(1-6)</sup> since the creation of the first autologous arteriovenous (AVF) fistula in 1966, <sup>(1)</sup> vascular access has become an increasingly common procedure. The Brescia-Cimino radiocephalic wrist fistula is the first choice, followed by the elbow

brachiocephalic fistula. <sup>(1-3)</sup> When cephalic vein is not suitable or is previously used, an alternative access option is required using either a transposed basilic vein to brachial artery or a prosthetic graft. <sup>(1-3,7,8)</sup> The transposed basilic vein to brachial artery which is also called the brachiobasilic arteriovenous fistula (BBAVF) or basilic vein transposition (BVT) was first described in 1976<sup>(7)</sup> During this procedure and due to the deep position of the basilic vein in the subfascial plane in the upper arm, it requires mobilization, superficialization and transposition in order to achieve a safe and adequate access. Our vascular surgery department in King Hussein Medical Center

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being a tertiary vascular surgery referral center has the highest load in Jordan regarding hemodialysis vascular access surgery with many patients requiring multiple

## Methods

This is a retrospective study between September 2009 and December 2012 in which the data was collected from patient case notes, operating room records, vascular laboratory and hemodialysis unit records, with a follow up duration of three years. During the study period, 141 patients underwent a BBAVF surgery in our vascular surgery department at KHMC. Twelve patients were lost to follow up and were excluded from the study. Demographics of the patients are shown in Table I. Choice of this procedure in those patients was based on preoperative clinical examination during a clinic visit and further duplex ultrasound examination of the arterial or venous systems whenever indicated. Based on such evaluation, BBAVF was the 1<sup>st</sup> hemodialysis arteriovenous access procedure in 31 patients who were lacking a suitable cephalic vein to perform a radiocephalic or a brachiocephalic AVF. For the remaining, it was chosen because cephalic vein had been already used in previous access procedures. During the study period, we adopted the two-stage procedure in contrast to the single-stage procedure that we perform alternately nowadays. During this two-stage procedure, local anesthesia was used for the 1<sup>st</sup> stage and regional anesthesia in the form of brachial plexus block (BPB) was our standard anesthesia method for the 2<sup>nd</sup> stage in contrast to general anesthesia that we had used more commonly in previous years. A preoperative dose of 0.5 gm ceftazidime or cefotaxime was given intravenously for all the patients. In the two-stage procedure, the basilic vein is anastomosed to brachial artery at elbow level as 1<sup>st</sup> stage, followed in 2-6 weeks time by the



**Fig. 1:** The skip incisions to dissect free the dilated elongated basilic vein, and the curvilinear subcutaneous tract in which it is tunneled.

access procedures. In this study, we will represent our most recent experience with this procedure regarding patency and complications.

2<sup>nd</sup> stage during which the dilated and elongated basilic vein is dissected free along its course through a continuous or skip incisions, then the basilic vein is either transected just distal to anastomosis and tunneled in a curvilinear subcutaneous tract to be reanastomosed to the brachial artery. If the basilic vein is of insufficient length, it is elevated from its location and the subcutaneous tissue closed beneath it with the basilic vein being tunneled under a skin flap away from the incision. Fig 1,2 The patients were discharged during the same day after the 1<sup>st</sup> stage and hospitalized for a minimum of one day after the 2<sup>nd</sup> stage.

Initial technical success was defined as the presence of a palpable thrill or an audible bruit in the fistula immediately after surgery and at 24 hours post-operatively before discharging the patients. A surgical review was done during a clinic visit 2 weeks after the 2<sup>nd</sup> stage procedure. Patients were then monitored during hemodialysis mainly by ability of their fistula to be cannulated and for changes in its function and referred back to our clinic in case of fistula failure, or any other complication. In case of access thrombosis, thrombectomy was attempted to salvage the fistula, if the patient was referred early to our clinic after thrombosis. Primary and secondary patency rates were reported according to the definitions published by the Committee on Reporting Standards of the Society of Vascular Surgery. Only those BBAVF obtaining functional patency were included in patency rate results thus excluding those in which the basilic vein failed to mature.



**Fig. 2:** The basilic vein reanastomosis after its tunneling at the end of the 2<sup>nd</sup> stage.

**Table I: Demographics of the patients**

Characteristic	Patients' %
Median Age	49.6 (9-73)
Male/Female	77/52
Hypertension	90(69.8%)
Diabetic	83(64.3%)
Smoker	33(25.6%)
Pre-HD/Post-HD	28/101
1 <sup>st</sup> HD access procedure	31(24%)
2 <sup>nd</sup> HD access procedure	52(40.3%)
3 <sup>rd</sup> HD access procedure	26(20.2%)
4 <sup>th</sup> HD access procedure or more	20(15.5%)

## Results

BPB anesthesia was used in 117 patients, with 11 patients of them requiring additional local anesthesia along the proximal part of the incision during the 2<sup>nd</sup> stage. The remaining 12 patients, who were the youngest group, underwent general anesthesia due to lack of cooperation in case of BPB. Initial technical success was 98.5 % as all patients, except two, had good function immediately after surgery and after 24 hours before being discharged from hospital. Those two patients whose BBAVF thrombosed immediately after completion of the procedure underwent unsuccessful embolectomy which was followed by a prosthetic access procedure. The average hospital stay was 1.3 days.

The time needed for vein maturation ranged between (30-87) days with an average time of 48.3 days. Twenty seven patients (21%) never used their fistula; this was due to failure of vein maturation in 16 patients, 5 patients received kidney transplant and 6 patients did not require hemodialysis during the study period but were followed up in the nephrology clinic with regular assessment of the fistula function and their fistulae remained patent throughout the study period and thus were included in the primary patency rates.

Hematoma in the immediate post operative period developed in 5 patients (3.9%), for whom reexploration and evacuation of the hematoma was performed. Bleeding related to infection was encountered in 3 patients (2.3%), for whom surgical intervention was performed and the fistula was scarified in two of them. Wound infection developed in 13 patients (10.1%). In 10 of them, it was superficial and resolved by conservative

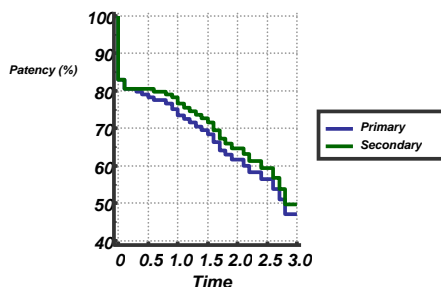
treatment consisting of wound care and antibiotics. In the other 3, it was more severe and complicated by bleeding for which surgical intervention was performed as previously mentioned. Upper limb ischemia due to arterial steal developed in 14 patients (10.9%). In 9 of them, symptoms were mild requiring only close follow up during which none deteriorated. In the other 5, symptoms were severe requiring fistula closure in 3 and banding procedure in 2 with significant improvement of symptoms. Upper limb venous hypertension developed in 12 patients (9.3%). In 8 of them, it was mild to moderate and managed conservatively. For the remaining; successful subclavian vein endovascular recanalization was performed in 3 patients and fistula closure in one. Ischemic monomelic neuropathy in the form of severe neurological deficit in the hand with preserved pulse status developed in two patients. They underwent fistula closure during the same day with reversal of the neurological deficit. Pseudoaneurysm at the site of a needle puncture developed in 12 patients (9.3%). They were all treated surgically (5 patients by primary repair, 4 using graft interposition and the remaining 3 patients by fistula closure). BBAVF thrombosis developed in 24 patients (19%), including those two patients whose BBAVF developed thrombosis immediately after completion of the procedure as previously mentioned. In 4 of them, who were immediately referred after the thrombosis to our department, successful thrombectomy was performed and hemodialysis through their BBAVF was resumed. Complications are shown in summary in Table II.

Using Kaplan-Meier analysis, the primary and secondary patency rates at (one, two and three) years were (75, 77) %, (62, 64) %, (47, 50) % respectively as shown in fig 3.

During the study period, 8 patients died. None of the deaths was related to the procedure.

**Table II:** Frequency of BBAVF complications

Complication	No. of patients (%)
Failure of maturation	16(12%)
Hematoma	5(3.9%)
Bleeding	3(2.3%)
Wound infection	13(10.1%)
Steal	14(10.9%)
Venous hypertension	12(9.3%)
IMN	2(1.6%)
Pseudoaneurysm	12(9.3%)
Thrombosis	24(19%)
Procedure related mortality	0



**Figure 3:** Primary and secondary patency rates (Kaplan-Meier plot)

## Discussion

As the population ages and the incidence of diabetes mellitus rises, end stage renal disease (ESRD) is becoming a significant health problem.<sup>(9)</sup> With improved medical care and hemodialysis efficiency, and in the absence of a cadaveric transplant program, more patients require secondary and tertiary vascular access procedures for hemodialysis. The radiocephalic and brachiocephalic autogenous fistulae are well established as the operations of first and second choice respectively. They have good long-term patency and low complication rate.<sup>(2-4,10-12)</sup>

In the absence of suitable superficial veins due to previous fistulae formation or repeated cannulation, the choice of vascular access is between prosthetic graft and BBAVF.<sup>(4,13)</sup> Prosthetic grafts can be cannulated earlier than autologous veins and have less primary failure rates, but are associated with a higher complication rate including infection, thrombosis, and require

frequent re-operations to maintain patency. Thus the BBAVF is considered increasingly the access procedure of choice when a superficial arm vein is unavailable.<sup>(4,14)</sup> Zielinski and Mittal advised a staged procedure, where the arteriovenous anastomosis was done first and BVT was delayed for 2–4 weeks later. This allowed easier dissection of an arterialized vein.<sup>(15)</sup> Reynolds reported better longer term patency for the two stage procedure.<sup>(16)</sup> Whereas Robertson was unable to find any significant difference in outcome between the single and two stage procedures.<sup>(17)</sup> Kakkos reported superiority of the two stage over the single stage regarding morbidity.<sup>(18)</sup> We used the two stage procedure during the period of our study. To avoid a long incision along the arm, endoscopic and video-assisted mobilization of the basilic vein out of its bed have been reported.<sup>(19)</sup> It may offer fewer wound problems, less trauma to the transposed segment, and less overall inflammatory changes within the arm.<sup>(20)</sup> We used one single incision or multiple skip incisions. Brachial plexus block anesthesia for upper limb hemodialysis vascular access procedures is effective and safe. Compared to general anesthesia, it offers major advantages with low rate of failure and complications.<sup>(21)</sup> Enjoying a well experienced anesthesia team in our department, we performed most of our BBAVF procedures under such anesthesia mode. Regarding risk factors affecting patency, Segal et al reported obesity, increased age, previous fistula formation and previous subclavian venous catheterization as

risk factors associated with poor patency of a BBAVF procedure.<sup>(22)</sup> Miller and Tolwani also reported that patient's age and comorbidities have significant effect on patency.<sup>(23)</sup> In our experience the median age was 49.6 with higher failure rates seen in the elderly reflecting the aging dialysis population with the possibly poorer quality of autologous veins in older patients. Other explanations of poorer patency in the elderly might be the higher incidence of atherosclerotic proximal arterial occlusive disease limiting blood inflow to the fistula in addition to the higher incidence of cardiac or respiratory dysfunction that diminishes cardiac output. On the other hand, Kawecka reported significantly better patency rates in PTFE grafts compared to BBAVF in the age group above 65.<sup>(24)</sup> This might raise the question of whether PTFE grafts should be preferred over BVT for this age group. Also most of the patients in our study (76%) had previous fistula procedures before the BBAVF was performed for them, which might also contribute negatively to its patency possibly due to the more complex surgery required. DM is also associated with impaired AVF maturation, high complication and lower patency rates.<sup>(25,26)</sup> The high incidence of DM in our experience which was 64.3% may significantly affect our BVT outcome. Still, Hakaim reported a 27% nonmaturation rate and a 78% primary patency rate for autogenous brachio basilic upper arm transposed AV access in patients with diabetes mellitus demonstrating again its superiority over PTFE grafts in those patients.<sup>(27)</sup> Our primary and secondary patency rates at (one, two and three) years were comparable to international cumulative patency rates of BBAVF which ranged between (54-90), (38-82) and (43-57) % respectively for primary patency rates and around 66, 50 and 41 % respectively for secondary patency rates.<sup>(22,28-34)</sup> By comparing this to upper arm prosthetic arteriovenous graft patency, many authors report 1 and 2-year cumulative graft patency rates of 59-90% and 50-82%, respectively.<sup>(32,35)</sup> The overall non-thrombotic complication rate in our experience which is 47.4% is also comparable to those reported in other studies (47-71) %.<sup>(14,25,33,34)</sup>

## Conclusion

Our experience shows that BBAVF remains an important and effective choice as permanent hemodialysis vascular access for chronic renal failure patients. It is a reliable secondary-access procedure when another simple procedure fails. It has the disadvantage of the longer time required for the fistula maturation as compared to the prosthetic graft. (One, two and three) year primary and secondary patency rates are acceptable and comparable to international results, with also a comparable overall complication rate. Careful access planning, close surveillance and timely interventions can improve overall results.

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