

# Upper Arm Basilic Vein Transposition for Hemodialysis: A Single Center Study for 300 Cases

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**Purpose:** The population of end-stage renal failure patients dependent on hemodialysis continues to expand with an increasing number of patients having an unsuitable cephalic vein or failed radio- and brachio-cephalic fistula. In these patients, the transposed basilic vein to brachial artery arteriovenous fistula (BaVT) provides autologous choice for hemodialysis. The results of basilic vein transposition arteriovenous fistula were assessed.

**Materials and Methods:** Three hundred cases of BaVT performed at a single center during the period of January 2005 to December 2011 were reviewed retrospectively. Data including demographics and postoperative complications were collected. Primary and secondary patency rates were determined by using Kaplan-Meier methods.

**Results:** The median age of patients was  $57.4 \pm 13.1$  years, and 154 patients were male. Renal failure was associated with hypertension in 88.7%, and with diabetes in 34.0%. The mean follow-up was  $27.4 \pm 20.0$  (12 to 72) months. There was no operation-related death. Eighteen patients required prosthetic graft interposition because of short vein. Thirty-five postoperative complications developed in 41 patients (148 cases), including thrombosis, stenosis, hematoma, seroma, arm swelling, steal syndrome, infection and aneurysm formation. Primary patency of BaVT was 69%, 60%, 53%, 52%, 44%, and 22% at 1, 2, 3, 4, 5, and 6 years, respectively. Secondary patency was 99%, 97%, 97%, 97%, 95%, and 95%, respectively.

**Conclusion:** Chronic renal failure patients with hemodialysis may benefit from BaVT, because of high patency, less radiologic procedure, and less infection rate. The BaVT fistula should be used in preference to polytetrafluoroethylene grafts for secondary access.

**Key Words:** Arteriovenous fistula, Basilic vein, Renal dialysis

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## INTRODUCTION

As Brescia et al. [1] first introduced autologous vascular access for hemodialysis in 1966, ideal hemodialysis accesses are radial to cephalic arteriovenous fistula (AVF) or brachial to cephalic AVF. As demand for autologous AVF creation increases, development of an alternative method is needed

when this autologous AVF fails or radiocephalic vessels are not adequate for AVF formation. The most frequent and easiest method is arteriovenous bridge graft (AVBG), but higher complication rates and lower patency rates have been reported in AVBG patients than in AVF patients. The 2006 Kidney Disease Outcome Quality Initiative (K/DOQI) Clinical Practice Guidelines in Vascular Access recommends

placement of autologous arteriovenous access in the following decreasing order of preference: Radiocephalic AVF at the nondominant wrist, brachiocephalic AVF at the elbow, transposed brachial-basilic vein fistula and arteriovenous graft in the upper arm in suitable patients [2].

The guidelines was first presented in 1997 and revised in 2006 for performing safer and more economical hemodialysis. It emphasized AVF formation up to 60%. AVF is preferred to AVBG for hemodialysis patients in terms of complication and cost. Transposed basilic vein to brachial artery arteriovenous fistula (BaVT) was introduced in 1976 by Dagher et al. [3] and reported again in 1996 [4] which interested many surgeons. Advantages of this method are improvement in patency rate and significant reduction in infection rate [5-8]. Its disadvantages, however, include technical difficulty, longer period of maturation to use for hemodialysis, longer skin incision size, and infection. So we plan to report the clinical outcomes of BaVT performed at our hospital with a review of literature.

## MATERIALS AND METHODS

### 1) Patient selection

We retrospectively reviewed patient's medical records of 300 cases of BaVT performed at our hospital from January 2005 to December 2011. Data including demographics, postoperative complications, and patency rate were collected. As a retrospective study, we didn't ask individual informed consent to each patient. For all patients, we performed upper arm venogram to examine the presence of central vein stenosis and condition of patient's vein,

and performed artery and vein mapping through Doppler-ultrasonogram (USG). We selected patients with no central vein stenosis in venogram, the size of basilic vein at axillary area greater than 7 mm from USG, and the size of vein around elbow expanding greater than 4 mm after tourniquet was applied. During the operation, we performed interposition using polytetrafluoroethylene in cases where length of vein was short. The study was approved by the ethics committee of Soonchunhyang University Seoul Hospital (IRB no. SCHUH 2014-11-012) and was conducted in accordance with the Declaration of Helsinki.

### 2) Operation method

Under general anesthesia, three separate skin incisions (each 4 cm to 6 cm) were made over the skin right above the basilic vein from the axilla to the medial epicondyle of the humerus, and the basilic vein was completely isolated. The isolation was carefully performed to avoid injury to the medial brachial cutaneous nerve. All branches were carefully ligated with 4-0 silk suture and divided. It was beneficial for transposition to isolate the distal aspect over as great a length as possible. The proximal aspect was dissected until the drainage area of the brachial vein. After dissection, the area near the drainage area was occluded using bulldog clamps. Heparinized saline was used to increase pressure inside the basilic vein and dilate it. Marking was made using gentian violet to make sure that there is no twisting of the vein during transposition. A longitudinal incision of approximately 2 cm was made over the cubital segment of the brachial artery, and the brachial artery was identified. Absence of twisting was confirmed as the basilic vein was



**Fig. 1.** (A) After ligation of branches of the basilic vein, the vein is mobilized, the distal end transected, and a subcutaneous tunnel constructed. (B) After the vein is delivered through a subcutaneous tunnel, anastomosis is constructed from basilic vein to brachial artery.

allowed to course from the axilla over the biceps brachii muscle. The basilic vein was guided to the wound of the dissected brachial artery. It was very important to confirm the absence of twisting in the area of the transposed basilic vein drainage into the brachial vein. After transposition and superficialization, heparinized saline was injected again and the vein was dilated. Subsequently, it was confirmed that the vein had no twisting, was easily palpable, and could be punctured. If superficialization was not problematic, end-to-side anastomosis with the brachial artery was performed. Two-layer suturing for wound closure was used, involving the subcutaneous and dermal layers and with absorbable interrupted sutures (Fig. 1).

### 3) Clinical outcomes

Presence of complication and patency rate was evaluated as clinical outcomes. Each patient was checked at outpatient examination and telephone was used when outpatient examination was unavailable. Following the K/DOQI guidelines, we defined primary failure as the event where the AVF became unusable and a new AVF was performed, radiologic intervention was performed, or surgical intervention was practiced in 30 days.

## RESULTS

For the 300 patients who underwent BaVT, follow-up examination period was 12 to 72 months. There was no follow-up loss. Within the follow-up period, 86 died from other causes after operation and 7 had kidney transplantation, so their follow-up was terminated at the time of death or transplantation. Demographic data of patients are shown in Table 1. Average age was 57.4

**Table 1.** Demographic data (n=300)

Variable	Value
Age (y)	57.4±13.1
Male (%)	154 (51.3)
Diabetes mellitus (%)	102 (34.0)
Hypertension (%)	266 (88.7)
Previous fistula history	1.3±0.7
Artery size (mm)	5.0±1.5
Vein size (mm)	6.3±1.7
Anastomosis size (mm)	7.4±1.1
Length of hospital stay (day)	8.3±5.1
Follow-up period (mo)	27.4±20.0
Total operating time (min)	116.0±35.5

Values are presented as mean±standard deviation or number (%).

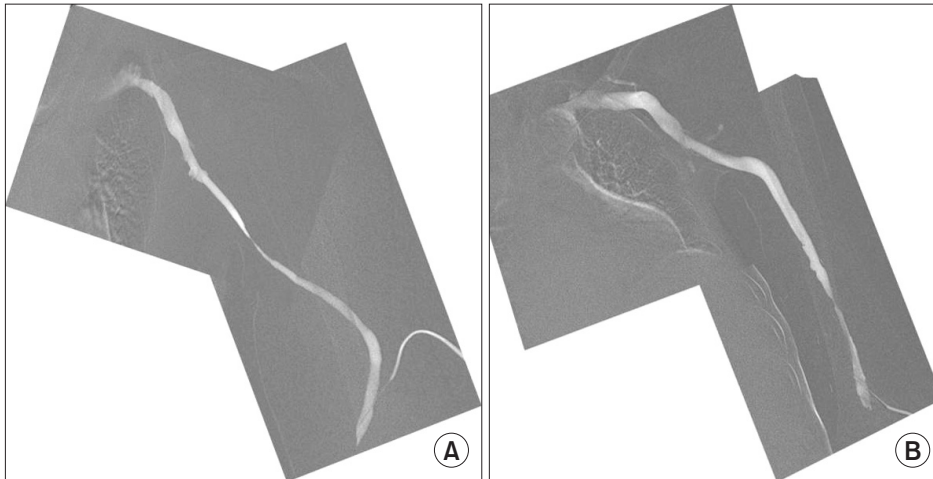
years, 154 patients were male, 102 had diabetes (34.0%), 266 had hypertension (88.7%) and 65 had cardiovascular diseases. Among the 300 cases, second stage BaVT was performed in 10 patients, and prosthetic graft interposition was performed in 18 patients due to the shortness of the basilic vein. On average, the size of basilic vein was 6.3 mm and anastomosis size was 7.2 mm. Median operating time was 116.6 minutes, and median day of hospital stay was 8.3 days. Primary failure was observed in 23 cases (7.4%), 14 cases received percutaneous transluminal angioplasty (PTA) due to venous pressure elevation from swing point stenosis, and 6 cases received PTA due to central vein stenosis. Reduction of anastomosis site was performed in 2 cases due to steal syndrome and 1 case was treated by vein transposition due to arterial anastomosis site infection.

### 1) Complications

Complications are as listed in Table 2. 1) Wound seroma and hematoma occurred in 29 cases. Incision and drainage was performed in each patient. 2) Thrombotic occlusion was identified in 19 patients. Eight were treated with PTA and 11 with surgical thrombectomy and prosthetic graft interposition. 3) Seventy-nine patients (393 cases) showed stenosis in the swing point (52 patients, Fig. 2A) and mid-graft (16 patients, including puncture site, Fig. 2B), and PTA was performed. Table 3 shows details about the stenosis site of each case. 4) Venous hypertension due to central vein stenosis was identified in 20 patients (40 cases). PTA was performed. 5) Five patients had steal syndrome. Two cases were treated with reduction of the anastomosis, and 3 were treated with distal revascularization and interval ligation. 6) One case developed a 6×7 cm-sized aneurysm at 60 months after operation, and was treated by removal of the aneurysm due to the risk of rupture. 7) One case developed rupture of a pseudoaneurysm at the puncture site and was treated by removal of the pseudoaneurysm with patch angioplasty.

**Table 2.** Postoperative complications

Complication	n (%)	Management
Hematoma and seroma	29 (9.7)	Incision and drainage
Thrombosis	19 (6.3)	8: radiologic intervention 11: surgical intervention
Stenosis	79 (26.3)	Radiologic intervention
Venous hypertension	20 (6.7)	Radiologic intervention
Infection	1 (0.3)	Surgery
Steal syndrome	5 (1.7)	3: distal revascularization and interval ligation 2: reduction of fistula
Aneurysm	2 (0.7)	Removal of aneurysm



**Fig. 2.** Proximal vein stenosis in transposed basilic vein to brachial artery arteriovenous fistula. Percutaneous transluminal angioplasty was required. (A) Swing point, (B) above fistula.

**Table 3.** Stenosis site (n=99)

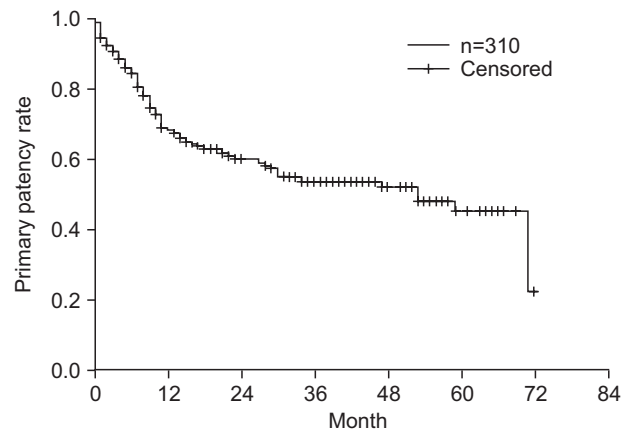
Stenosis	n (%)
Swing point	52 (52.5)
Graft-venous anastomosis	1 (1.0)
Arterial anastomosis	10 (10.1)
Central vein stenosis	20 (20.2)
Midgraft stenosis	16 (16.2)

2) Patency

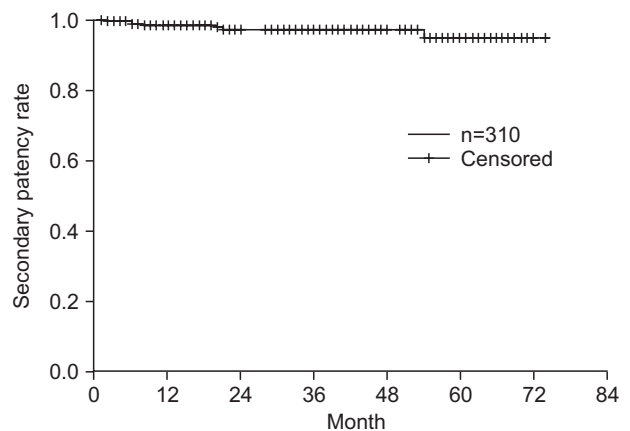
Primary patency of BaVT was 69%, 60%, 53%, 52%, 44%, and 22% at 1, 2, 3, 4, 5, and 6 years, respectively. Secondary patency was 99%, 97%, 97%, 97%, 95%, and 95% at 1, 2, 3, 4, 5, and 6 years, respectively (Fig. 3, 4).

**DISCUSSION**

Survival rate of end-stage renal failure patients has significantly increased in the past decades due to development of hemodialysis. As a result, hemodialysis patients increase by almost 8% each year. Based on the reality, NKF-DOQI guidelines [2] listed the goal of having autologous AVF greater than 65% by 2009. The recommendation was made because autologous AVF improves the patency rate and minimizes additional procedures during the usage of vascular access. Autologous AVF, however, due to its technical difficulty in some cases, increased primary failure rate and excessive maturation time of fistula, may prolong the hemodialysis period using central catheterization. BaVT in the upper arm is a transformed procedure of AVBG, first performed in 1976 by Dagher et al. [3], who reported 70% patency rate after 8 years. It is a method of forming an AVF by transposing the basilic vein from a deep location in the medial site of upper arm to a shallow position. Its advantages include prevention



**Fig. 3.** Primary patency rate.



**Fig. 4.** Secondary patency rate.

of infection, a serious complication, by avoiding the use of a prosthetic graft, and the possibility of reoperation using prosthetic grafts when AVF fails. BaVT, however, is more likely to develop seroma or hematoma in the operative wound through heavy dissection or to damage the median nerve or musculo-cutaneous nerve. Matsuura et al. [9]



reported re-performance of AVBG in 89% of patients who failed BaVT. Proper screening and selection of patients is most important in BaVT. Especially, it is important to select an optimal size of vein through mapping using Doppler USG. If the cephalic vein or basilic vein in the forearm or cephalic vein in the upper arm doesn't already exist, it is important to select the vein of optimal size after examining the basilic vein in upper arm [10]. The authors have been performing preoperative Doppler USG for all patients since 2005, and using the vein for BaVT that expands more than 1.5 times before and after using tourniquet. For patients with a history of central catheterization in the subclavian vein or internal jugular vein, presence of central vein stenosis must be checked through venogram. The authors used venogram and checked central vein stenosis for all patients. When artery complication is detected through pre-operative Allen test or Doppler USG, arteriogram in tandem is helpful. Primary failure rate has been reported in the range of 0% [8,11] and 38% [12], and the authors experienced a failure rate of 7.4%.

The basilic vein, located deep inside, is not easily accessible through simple percutaneous puncture, but can be easily used if it is transposed to near the skin. According to the literature, primary patency rates of BaVT were reported to be 23%-90% [6,11,13], and secondary patency rates 47%-96% [11,12] at first year. Our primary patency of BaVT was 69%, 60%, 53%, 52%, 44%, and 22% at 1, 2, 3, 4, 5, and 6 years, respectively and secondary patency was 99%, 97%, 97%, 97%, 95%, and 95% at 1, 2, 3, 4, 5, and 6 years, respectively. Compared with AVBG, BaVT's secondary patency rate was 62%-87% in 1 year and 75% in 2 years, higher than 65%-70% and 49%-51% for AVBG, respectively [6,9,14]. In all types of AVF, K-DOQI guidelines recommend a cumulative patency of BaVT of 70% in 1 year, 60% in 2 years, and 50% in 3 years [15]. BaVT has advantages because it does not use prosthetic graft, only one vessel anastomosis is needed, and can use a prosthetic graft in the same arm if the AVF fails. Its disadvantages include the possibility of damaging the vein when being isolated, large skin incisions, wound complication, damage to median and musculo-cutaneous nerves due to heavy dissection, and long maturation time. Comparing BaVT against AVF, we found that the primary patency rate of BaVT was significantly lower, secondary patency rate and radiologic intervention was not statistically different, and infection rate was lower. Compared to AVBG, overall patency rate was similar but infection rate and radiologic intervention rate were lower. Interestingly, BaVT's 2-year patency rate was 64% [16].

We believe AVF is the best choice if patency or structure

of vessel is optimal. If AVF is not possible, however, there's a question on the second choice. Rivers et al. [7] reported that AVBG in the same arm using prosthetic graft was possible in 67% of the cases where BaVT failed, and promoted BaVT when AVF could not be performed. Wolford et al. [13], however, opposed to the preferential use of BaVT by reporting that its primary patency rate is low at 24% and most patients returned to central catheterization for hemodialysis. Some argue that forearm loop type AVBG before BaVT may improve the result of upper arm AVF because it expands upper arm veins, but we still await a systematic research. It may be useful to re-evaluate the optimal timing of using AVBG or BaVT in order to determine the strategies for extending the period of hemodialysis through the arm. The authors believe that BaVT is the best method for patients who need long-term hemodialysis because it shows lower complication rates and higher patency than AVBG, and vein mapping through pre-operative venogram and Doppler USG will further improve the results.

## CONCLUSION

Although BaVT does not show higher patency rate than Brescia-Cimino AVF, its use as autologous AVF has been increasing. Despite its large operative wound, long hospital stay, and high primary failure rate, the usage of BaVT has been increasing because radiologic intervention rate is low once matured, patency rate is high, infection rate is low, allows the possibility of another vascular access before using prosthetic grafts to create AVF especially for young patients who need to secure veins for long-term hemodialysis, and the K-DOQI guidelines recommends primary use of autologous AVF. The authors strongly recommend this BaVT because of its primary patency rate of 69%, 60%, 53%, 52%, 44%, and 22% at 1, 2, 3, 4, 5, and 6 years, respectively and secondary patency of 99%, 97%, 97%, 97%, 95%, and 95% at 1, 2, 3, 4, 5, and 6 years, respectively, and because of the possibility of another vascular access before using prosthetic grafts to create AVF. We also recommend examination of the vein through pre-operative Doppler USG or venogram before BaVT to further improve its intended results.

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