ORIGINAL ARTICLE

BRACHIAL VEIN TRANSPOSITION VERSUS ARTERIOVENOUS GRAFT – TWO-YEAR RESULTS

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Abstract

Background: *Proper vascular access is essential for effective hemodialysis. There are three main access modalities: arteriovenous fistula (AVF), arteriovenous graft (AVG), and central venous catheter. AVF has better patency and fewer complications, with lower morbidity and mortality rates. Some patients have limited superficial venous patrimony, and the best vascular access remains undetermined, with AVG and brachial vein transposition (BVT) representing upper limb alternatives. Our aim is to investigate BVT and AVG followed by our institution regarding patency and need for intervention.*

Methods: *This paper is based on a retrospective analysis of BVT and AVG followed/intervened our center between 2014 and 2018. To primary outcome was to define and compare patency rates for each group. Primary failure and need for reintervention were considered secondary outcomes.*

Results: *There was no statistically significant difference between primary and secondary patency in both groups. BVT has a higher post-intervention primary patency and fewer interventions due to thrombosis, despite the overall number of interventions per patient similar to AVG.*

Conclusions: *Despite the absence of a statistically significant difference in secondary patency and the need for reintervention between BVT and AVG, thrombosis-free time is higher in the BVT group. Overall, BVT is a valid access option that should be considered in patients with no other autogenous access alternative in upper limbs.*

Keywords: *brachial vein transposition, dialysis access, AV fistula, catheters, prosthetic grafts.*

INTRODUCTION

Proper vascular access is essential for effective hemodialysis [1] and there are three main access modalities: arteriovenous fistula (AVF), arteriovenous graft (AVG), and central venous catheter (CVC).

Being an autologous access, AVF displays better patency and fewer complications (including infections and thrombosis), with lower morbidity and mortality rates [2] . For these reasons, AVF remains the first vascular access option.

Due to improvements in hemodialysis techniques and better management of patient comorbidities, dialysis patients have now a longer life expectancy [3] which implies the need for greater durability of hemodialysis accesses, ideally for decades.

Clinical and imagiological evaluation with du-

plex ultrasound is critical when planning vascular access. In an ideal scenario it should be established in the non-dominant upper limb, pulses should be palpable, and Allen test should be performed to evaluate palmar arch vascularization. On duplex ultrasound the access construction vein should have more than 2 mm and the artery more than 1.6 mm [4] . According to National Kidney Foundation (NKF) guidelines, vascular access construction site should be as follows: forearm, elbow, and arm [5] . Wrist AVF remains the gold standard for vascular access due to low complication incidence, excellent long-term patency rates, and not precluding the possibility of future access. Some patients, for anatomical reasons or loss of superficial and basilic veins (previous vascular access), may be candidates for more complex arteriovenous access, such as brachial vein transposition (BVT). AVG should be the second access option and is usually performed when venous patrimony is exhausted. AVG patency is shorter than AVF, essentially due to thrombotic events consequent to neointimal hyperplasia or graft deterioration. AVG infections are very serious complications and bacteremia incidence is more than tenfold higher than with AVF [6] .

Table 1 **Comparison of individual variables between the groups**

	BVT (n=21)	PAV (n=33)
Male sex (%)	13 (61,9%)	24 (72,7%)
Age(y): mean	60,9±18	6915
Nr. of previous accesses: median	2,5 (2-3,75)	2,0 (2-4)
Deaths (%)	1 (4,8%)	1 (3%)

Table 2 **Brachial vein transposition reports**

	n	Stages	Patency (12m)	Patency (24m)
Bazan, Schanzer [11]	2	1	100 %	
Casey et al [16]	17	1	40 %	
Elwakeel et al [12]	21	2	75,89 %	55.34%
Angle N, Chandra A [13]	20	2	95 %	
Dorobantu et al [14]	33	2	85 %	
Torina et al [15]	13	1 (n=11) 2 (n=2)	45 %	

When only complex autogenous access can be established, the choice of the best access for the patient is a dilemma, particularly when choosing between AVG and complex AVF, such as BVT, with no clear recommendations currently in place.

MATERIAL AND METHODS

A retrospective analysis of BVT and AVG cases followed or intervened by our vascular access center – Grupo de Estudos Vasculares (GEV) - between 2014 and 2018 was conducted. It was analyzed and compared, for each group, primary failure, interventions and patency. The concepts of primary patency, post-intervention primary patency and secondary patency were defined as described in Standardized Definitions for Hemodialysis Vascular Access [7] . Regarding AVG, only complete brachio-axilar grafts were considered; accesses with interposed grafts and grafts with loop configuration were excluded.

Statistical analysis

Analyses were performed in IBM's SPSS statistics v.25 and the 0.05 significance level was adopted. The normal distribution of data was evaluated through the analysis of the skewness and distribution of the curve. Categorical variables, such as sex, are presented as frequencies and percentages; continuous variables with normal distributions, such as age and brachial vein diameter, are presented as means and standard deviations; the standard error was below 10%; the paired-samples T-test was used for the brachial vein diameter comparison; the remaining variables had a skewed distribution and the results were reported as medians and interquartile ranges and compared using the Mann-Whitney U Test. The median follow-up was calculated with the reverse Kaplan Meier method. The primary, post-intervention primary and secondary patencies were calculated and compared using the Kaplan Meier and the Mantel-Cox log-rank test.

RESULTS

A total of 21 BVTs and 33 AVGs were performed in the considered period and included in this study with a median follow-up time of 23 months. There was a preponderance of males in both groups (61,9% in the BVT group and 72,7% in the AVG group) with a mean age of 60,9±18 and 69±15 years, respectively (p=0,061). The median number of previous accesses was also similar between both groups (2.5 vs. 2, p=1,000).

BVT was a two-staged procedure for 19 (90,5%) patients and a single-stage procedure for 2 (9,5%) patients. The 2 patients submitted to a single-stage BVT had a 6,5mm and 10mm brachial vein at the time of the procedure. Among the remaining 19 patients the initial mean diameter of the brachial vein was 5,37±1.95mm and 7,12±1.38mm at the time of transposition, with a mean increment of 1,75±1,20mm (p=0,001). The me-

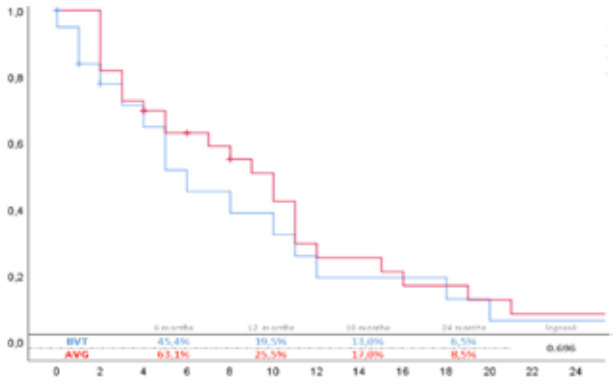

Figure 1 *Primary patency.*

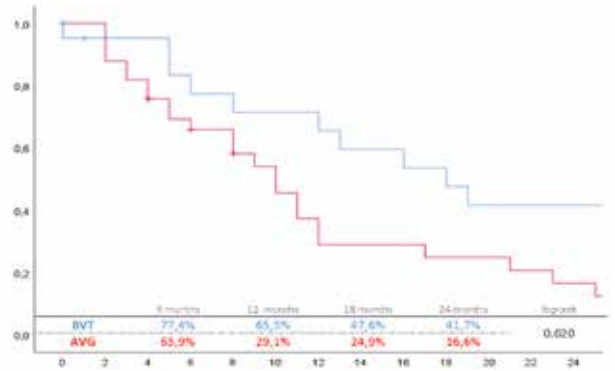

Figure 2 *Post-intervention primary patency.*

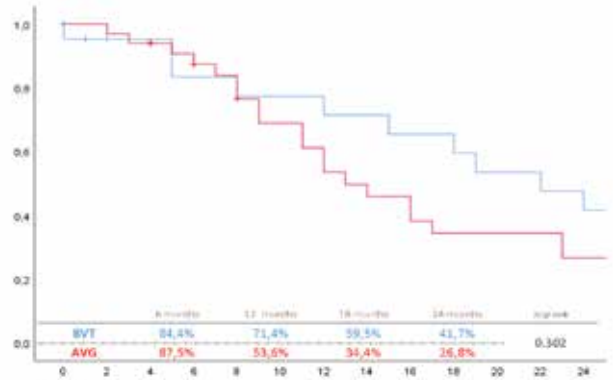

Figure 3 *Secondary patency.*

dian time to transposition was 2,7 months (1,6-3,9) and the mean access debit before the transposition was 1170 mL/min (800–1700 mL/min). In all cases, the transposition procedure was performed through three small skin incisions following the surgical technique published by Norton Matos et al in 2017 [8] . Two primary failure cases (9,5%) were reported in this group (vs. none in the AVG group).

The comparison between the BVT and AVG primary, post-intervention primary and secondary patency is shown in Figures 1 to 3, with time endpoints assigned at 6, 12, 18 and 24 months. BVT's primary patency is lower when compared to AVG but with no statistically significant difference (Figure 1. BVT: 45,4%, 19,5%, 13,0% and 6,5% vs. AVG: 63,1%, 25,5%, 17,0% and 8,5%, p=0,696). On the other hand, when comparing post-intervention primary patency, the BVT shows sustained superior results, accentuating the difference between the two from 6 months onwards (Figure 2. BVT: 77,4%, 65,5%, 47,6% and 41,7% vs. AVG: 65,9%, 29,1%, 24,9% and 16,6%, p=0,020). Similarly, the BVT's secondary patency is superior, with the AVG's patency also showing a sharp drop after 6 months, although not statistically significant (Figure 3. BVT: 84,4%, 71, 4%, 59,5% and 41,7% vs. AVG: 87,5%, 53,6%, 34,4% and 26,8% p=0,302).

The number of interventions for each group was also analysed. For this purpose, interventions were divided into two groups: those performed due to access thrombosis (requiring surgical thrombectomy) and those performed due to access dysfunction without associated thrombosis. During the follow-up, the overall median number of interventions per patient was 1 (range 0-4) in the BVT group vs. 2 (range 0-5) in the AVG group (p=0,488) while the median number of interventions due to thrombosis per patient was 0 (0-2) in the BVT group vs. 1 (0-4) in the AVG group (p<0,001).

DISCUSSION

In our study, the primary patency rates of BVT were lower than those of AVG in all time endpoints, but without a statistically significant difference (Figure 1). However, the post-intervention primary patency of the BVT was significantly higher, especially after the first 6 months of follow-up. Secondary patency follows the trend with the results favoring the BVT but with no statistically significant difference.

Autogenous access for hemodialysis is strongly supported in the literature [9]. For these reasons, growing efforts have been made to decrease catheter and graft use and surgeons will be increasingly challenged with vascular access construction. BVT has been proposed as an alternative to AVG in complex cases, with disparate results to date, specially due to its increased fragility compared to the basilic vein and shorter overall length available for superficialization[10]. Additionally, brachial vein harvest for transposition may be challenging due to adherence to the brachial artery and adjacent nerves and to the presence of many collateral veins. Nevertheless, BVT is currently considered an autogenous option when direct AVF and basilic vein transposition are not

possible. In 2004, Bazan and Schanzer reported two BVT cases, after which other reports have been published, with varying results (Table 2) 8, 11-15 .Compared to previous reports, results from the present study show 12-month patency rates similar to those reported by Elwakeel et al in 2007, but slightly lower at 24 months 12 . At 24 months, patency rates observed in this study were lower than those reported by Jennings et al 2009 9 , but patients with a basilic vein segment contributing to a portion of transposed vein were also included in that study.

These results suggest that, although BVT requires reintervention at an earlier stage, the thrombosis-free time is longer. The number of interventions per patient did not differ between the groups. However, there was a statistically significant difference in the number of interventions due to thrombosis, which corroborates the previous results, showing a greater tendency of AVGs to thrombosis despite the similar need for re-intervention.

Different results were found by Torina et al 15 in 2008, after comparing a series of 13 BVTs and 94 AVGs. At 12 months, the authors reported a secondary patency of 45% for BVT versus 78% for AVG. The authors found a statistically significant difference between one-stage brachial vein fistula and AVG. They concluded that BVT as a one-stage procedure had an inferior patency rate comparing with AVG. In our paper, only two patients underwent a single-stage procedure, not allowing a direct comparison with patients undergoing a delayed transposition. However, the superiority of BVT vs. AVG in our study when compared with the results reported by Torina et al may be indirect evidence in favor of the 2-stage BVT. Yet, more studies with prospective value would be necessary to prove the real cost-benefit of a 2-stage procedure.

CONCLUSION

Although secondary patency and the need for re-intervention did not differ significantly between the two groups, AVG seems to have a higher rate of thrombosis, which increases the complexity of the interventions and implies more costs, more aggressive procedures and sometimes the need for a temporary CVC.

Overall, BVT is a valid access option that should be considered in patients with no other autogenous access alternative in upper limbs. Although individualized treatment decisions should always be made, the authors consider that BVT should be preferred over AVG.

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