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Address: 1 Kraljice Natalije Street, 11000 Belgrade, Serbia
☏ +381 11 4092 776, Fax: +381 11 3348 653
E-mail: srparhiv@bvcom.net, Web address: www.srpskiarhiv.rs

Paper Accepted* **ISSN Online 2406-0895**

Case Report / Приказ случаја

Branislav S. Donfrid[1], Olivera B. Lozanče[2], Zvezdan B. Stefanović[1,3], Aleksandar N. Janković[4], Nada B. Dimković[4,5,†]

Two-stage forearm brachio-basilic loop arteriovenous graft for hemodialysis

Подлакатни брахио-базилични артериовенски графт за хемодијализу у два акта

[1]Faculty of Dentistry, Belgrade University, Belgrade, Serbia
[2]Faculty for Veterinary Medicine, Department for Anatomy, Belgrade University, Belgrade, Serbia
[3]Clinic for Surgery, Zvezdara University Medical Center, Belgrade, Belgrade, Serbia
[4]Clinical Department for Nephrology, Zvezdara University Medical Center, Belgrade, Serbia
[5]Medical School, Belgrade University, Belgrade, Serbia

Received: December 28, 2016
Revised: May 29, 2017
Accepted: May 30, 2016
Online First: July 7, 2017
DOI: https://doi.org/10.2298/SARH161228138D

† **Correspondence to:**
Prof. Nada DIMKOVIĆ
KBC Zvezdara, 161 Dimitrija Tucovića Street, Belgrade, Serbia
E-mail: **dim@eunet.rs**

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SUMMARY

Introduction The autologous radio-cephalic arteriovenous fistula (AVF) is the best vascular access for patients on chronic hemodialysis. In some patients with inadequate blood vessels, it is necessary to create proximal AVF, or arterio-venous grafts. High percentage of primary graft failure is noted in cases where diameters of brachial artery and basilic vein are insufficient.

The aim of this work was to introduce a new surgical technique for arterio-venous creation in patients with inadequate blood diameter.

Case Outline The authors have proposed implantation of brachio-basilic PTFE AV forearm loop graft in two acts. In first act the native brachio-basilic AVF was created in distal region of the upper arm by side-to-end anastomosis. Three to four weeks after the first act, significant dilatation of brachial artery and basilic vein was noted (confirmed by use of Color Duplex Sonography technique). During the second act polytetrafluourethylene graft was implanted by end-to-end anastomosis on dilated basilica vein.

Conclusion AV Graft that was created in two acts has sufficient blood flow without early or late complications. Primary patency was 30 months and secondary patency was 50 months. As original method in the current literature, we recommend it in different clinical settings when there are no better alternatives for vascular access.

Keywords: arterio-venous fistula, arterio-venous graft; hemodialysis; vascular access;

САЖЕТАК

Увод Аутологна радио-цефалична артериовенска фистула (АВФ) је најбољи васкуларни приступ за болеснике на хемодијализи. Код неких пацијената са неадекватним крвним судовима потребно је креирати проксималну АВФ или имплантирати артериовенски графт (АВГ). Високи проценат раног затајивања графта је најчешће услед малог пречника базиличне вене или брахијалне артерије. Циљ овога рада је био да прикаже нову хируршку технику за креирање АВГ код болесника са неодговарајућим дијаметаром крвних судова.

Приказ болесника Урађена је имплантација *PTFE* графта у виду петље на подлактици у два акта. У првом акту је у дисталном делу надлактице креирана брахио-базилична латеро-терминална АВФ под углом од 90º. После четири недеље, контролном доплер-сонографијом је констатовано знатно повећање пречника базиличне вене и брахијалне артерије. У другом акту је базилична вена попречно пресечена и са две темино-терминалне анастомозе у виду петље уметнут *PTFE* графт.

Закључак Овако креиран АВГ у два акта давао је задовољавајући проток крви без компликација. Примарна функционалност је износила 30 недеља, а секундарна 50 недеља. У доступној литератури овакав поступак није објављен, а препоручујемо код болесника без других могућности за креирање васкуларног приступа.

Кључне речи: артерио-венска фистула, артерио-венски графт, васкуалрни приступ; хемодијализа

INTRODUCTION

Adequate and functional long-term vascular access is crucial for efficient hemodialysis (HD) [1]. The new era of hemodialysis has begun thanks to the design of the native arteriovenous fistula (AVF) by Brescia & Cimino [2]. During the 60 years of application this vascular access has showed the best results and now it is considered as the "gold standard". However, in some patients native AVF can not be done due to inadequate anatomical and functional characteristics of blood vessels, damage of the blood vessels due to frequent puncturing, exhaustion of blood vessels due to repeated surgical procedures, aging of dialysis population, high prevalence of diabetics, mineral metabolism disturbances, pronounced vascular calcifications, etc. [3]. In these patients the options are proximal AVF, arteriovenous grafts (AVG) and tunneled catheters [4].

Good understanding of the anatomy and topography of the vascular system, primarily of brachial artery (A. brachialis) and the basilic vein (v. basilica) is very important for a good estimation of the possibilities for creating a vascular access for dialysis. In 80% of patients, brachial artery continues to the axillary artery, follows the medial nerve and in the cubital area gives two terminal branches, the radial and ulnar arteries [5]. Anatomical variations or deviations of the brachial artery refer to the phenomenon of double brachial arteries (superficial and deep), which occurs in 2–12% of cases [6]. Branching of the superficial brachial artery from the main brachial tree can occur at different levels. In the cubital part this artery usually extends as radial, while the brachial artery continues to the ulnar artery [7]. At the level of the elbow, basilic vein is located in front of the medial humeral epicondyle, continues along the medial side of the upper arm, in the initial part just below the skin, and in proximal part penetrating the deep fascia and stretching along the brachial artery until its confluence. In a situation when native AVF cannot be created, possible solutions are vascular graft and tunneled catheter [8]. Vascular graft has the advantage over tunneled catheter, particularly in the region of the forearm (brachio-basilic „loop graft“) [8].

CASE REPORT

We present the male patient, 23 years old, who was on hemodialysis for nine years due to severe congenital malformations of the urogenital tract. Native blood vessels (forearm cephalic vein, cubital vein, upper arm cephalic vein and radial artery, distal and proximal) on both arms were seriously damaged by repeated attempts to form an AVF. Last several months the patient was dialyzed through a central venous catheter (CVC) in various positions. Color Duplex (CDS) examination was used to measure the diameters of brachial artery (3.6 mm) and the basilic vein (2.7 mm) in the distal part of the left upper arm (Figure 1, 2). In the middle third of the upper arm basilic vein joins the deep venous system making it unfeasible for transposition and creation of native brachial-basilic AVF. Due to all mentioned, implantation of the PTFE graft in two acts was attempted. The first act of the procedure was performed under regional anesthesia (axillary block). After cross-section of the distal third of the upper arm, side-to-end anastomosis of the brachial artery and basilic

Figures 1–9. CLICK TO SEE ALL 10 FIGURES.

vein was made (Figure 3). During the formation of the anastomosis it is very important to adjust the angle of the vein to the artery which has to be between 90º–120º (Figure 4). Four weeks later, color duplex scan showed that basilic vein was arterialized (4.8 mm diameter) and brachial artery was dilated to 6.0 mm (Figure 5,6). These diameters of the blood vessels were allowing the safe graft implantation.

The second act of the procedure was also performed in regional anesthesia, through the scar tissue of the first surgery. Basilic vein near AVF anastomosis was prepared and 5 mm e-PTFE vascular graft was placed subcutaneously in the position of the ”loop” graft. Using vascular clamps, cross cut of the basilic vein was made 2 cm away from the anastomosis with brachial artery. After instillation of heparin in the both ends, second act was completed by creation of end-to-end anastomosis between vein and graft using Gore-Tex 6-0 suture (Figure 7–9). From the functional point, arterial anastomosis remained latero-terminal. Graft was ready to be used for hemodialysis after four weeks. Leaving about 2 cm of basilic vein between the arterial end of the graft and brachial artery significantly simplifies the process in the second act because the artery remains intact. This is particularly important in case of need for extirpation of graft due to infection. In that case, the remaining part of basilic vein is ligated by suture ligature and infected graft easily removes completely.

Patient has been successfully treated by hemodialysis using the implanted graft during the 30 months (primary patency) (Figure10). The partial replacement of the graft due to pseudoaneurysms at the puncturing places was done and the graft was used for additional 20 months (secondary patency 50 months).

DISCUSSION

Referral to the surgeon and waiting time for vascular access creation are important determinants of the type of the vascular access and its usability [9]. According to DOPPS V study, in the most DOPPS countries, the frequency of native AVFs is usually less than 80%, ranging from 49% in Canada up to 92% in Russia [10]. By multivariate logistic regression analysis,vein diameter was the sole independent predictor of functional fistula maturation [11].

Transposition of the basilic vein for arteriovenous fistula is the last possibility for the creation of vascular access native courts in the upper extremity. It is important to have basilic vein of sufficient length in order to obtain a sufficient conduit for the two needles-butting and to avoid recirculation.

In 66% of cases basilic vein can be used for the formation of native AVF after vein transposition and superficialization. However, in 34% of cases the basilic vein is short and cannot be used for native AVF [12]. In that case, superficialization on deep brachial vein is possible, but the primary and secondary flow of such vascular access is insuffitient. In addition, aneurysm at the puncture site for hemodialysis, axillary vein thrombosis, "steal syndrome " and other compliacations are frequent [13].

It is well known that implantation of the vascular graft requires an appropriate diameter and quality of arterial and venous blood vessels, which may be a major obstacle for this type of surgery [14]. Literature data about graft implantation vary from center to center and it is not surprising that average primary and secondary patency after 6 months were found to be 58% and 76% respectively [15].

In cases of inadequate blood vessels when there is no possibility of creating vascular access native courts we suggest arteriovenous graft implantation in two acts. Such operation should take place before the decision to create a vascular access of the lower extremities. Primary and secondary patency if this graft is excellent.

Instead of conclusion, this case report demonstrates the successful creation of a vascular graft in a two time-separated acts in patients where it was not possible to create other vascular accesses (native AVF, standard graft). This technique has excellent early results, the same as the primary implanted grafts on good blood vessels. We recommend it for patients with previously exhausted vascular accesses as well as in patients with pronounced and long-lasting hypotension (regardless of the quality of the blood vessels), diabetics and elderly who have advanced atherosclerosis. Since this method is not described in the available literature, we consider it as original contribution named ”forearm brachio-basilic AVG in two acts - Zvezdara method”.

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