CASE REPORT / ПРИКАЗ БОЛЕСНИКА

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

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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 arteriovenous grafts. High percentage of primary graft failure is noted in cases where diameters of the brachial artery and the basilic vein are insufficient.

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

Case outline The authors have proposed implantation of brachio-basilic polytetrafluoroethylene AV forearm loop graft in two acts. In the first act, the native brachio-basilic AVF was created in the distal region of the 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 the use of color duplex sonography technique). During the second act, polytetrafluoroethylene graft was implanted by end-to-end anastomosis on the 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 an 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

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 et al. [2]. During the 60 years of application, this vascular access has showed the best results and now it is considered the “gold standard.” However, in some patients, native AVF cannot 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 the dialysis population, high prevalence of diabetics, mineral metabolism disturbances, pronounced vascular calcifications, etc. [3]. In these patients, the options are proximal AVF, arteriovenous grafts, and tunneled catheters [4].

Good understanding of the anatomy and topography of the vascular system, primarily of the 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 arm, in the initial part just below the skin, and in the 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 a 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, arm cephalic vein and radial artery, distal and proximal) on both arms were seriously damaged by repeated attempts to form an AVF. Over the last several months the patient was dialyzed through a central venous catheter in various positions. Color duplex examination was used to measure the diameters of the brachial artery (3.6 mm) and the basilic vein (2.7 mm) in the distal part of the left arm (Figures 1 and 2). In the middle third of the arm, basilic vein joins the deep venous system making it unfeasible for transposition and creation of native brachial-basilic AVF. Due to all of the above, implantation of the polytetrafluoroethylene (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 arm, side-to-end anastomosis of the brachial artery and the basilic 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 90° and 120° (Figure 4). Four weeks later, color duplex scan showed that the basilic vein was arterialized (4.8 mm in diameter) and the brachial artery was dilated to 6.0 mm (Figures 5 and 6). These diameters of the blood vessels allowed for the safe graft implantation.

The second act of the procedure was also performed in regional anesthesia, through the scar tissue of the first
surgery. The basilic vein near AVF anastomosis was prepared and a 5 mm e-PTFE vascular graft was placed subcutaneously in the position of the “loop” graft. Using vascular clamps, a cross-cut of the basilic vein was made 2 cm away from the anastomosis with the brachial artery. After instillation of heparin in both ends, the second act was completed by creation of end-to-end anastomosis between vein and graft using Gore-Tex (W. L. Gore & Associates, Inc., Newark, DE, USA) 6-0 suture (Figures 7, 8, 9). From the functional point, arterial anastomosis remained latero-terminal. The graft was ready to be used for hemodialysis after four weeks. Leaving about 2 cm of the basilic vein between the arterial end of the graft and the brachial artery significantly simplifies the process in the second act since the artery remains intact. This is particularly important in case of need for extirpation of the graft due to infection. In that case, the remaining part of the basilic vein is ligated by suture ligature and the infected graft is easily completely removed.

The patient was successfully treated by hemodialysis using the implanted graft over a period of 30 months (primary patency) (Figure 10). 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 vascular access and its usability [9]. According to the Dialysis Outcomes and Practice Patterns Study (DOPPS) V, in most of the 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 vessels in the upper extremity. It is important to have the basilic vein of sufficient length in order to obtain a sufficient conduit for the two-needle butting and to avoid recirculation.

In 66% of cases, the 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 a deep brachial vein is possible, but the primary and secondary flow of such vascular access is insufficient. In addition, an aneurysm at the puncture site for hemodialysis, axillary vein thrombosis, “steal syndrome,” and other complications are frequent [13].
It is well known that implantation of the vascular graft requires 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 six 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 vessels, 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 of this graft is excellent.

REFERENCES