How I Do It

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Smooth Loop Arterio-Venous Fistula

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Rezumat

Fistula arteriovenoasă în J – tehnică chirurgicală

Numărul pacienților cu insuficiență renală cronică este într-o continuă creștere. Managementul abordului vascular întâmpină încă anumite dificultăți. Fistula arterio-venoasă rămâne prima opțiune în realizarea accesului vascular. Scopul acestei lucrări îl reprezintă prezentarea unei tehnici chirurgicale pe care o folosim în clinica noastră în crearea fistulelor arterio-venoase brahio-cefalice, și anume fistula în J. Folosind vena medio-bazilică și vena medio-cefalică dăm anastomozei brahio-cefalice forma literii J. Acest tip de anastomoză oferă un flux în fistulă cu o turbulență mai redusă, lucru ce duce la îmbunătățirea ratei de supraviețuire a fistulei.

Cuvinte cheie: fistula arteriovenoasă, abord vascular, insuficiența renală cronică, hemodializă

Abstract

The number of patients with End Stage Kidney Disease is continuously growing. There still are some difficulties in managing vascular access, creating it and dealing with all of its complications. Arterio-venous fistula is the ideal procedure in creating the vascular access. Our goal is to present a surgical technique that we consider to be feasible in creating the brahio-cephalic arterio-venous fistula: the smooth loop fistula. If anatomically possible we prefer to create the barhio-cephalic fistula by using the median-basilica vein continued with the median cephalic vein to create a smooth loop between the brachial artery and the cephalic vein. By giving this J shape to the anastomosis there will be a smoother flow through the fistula, increasing its patency rate.

Key words: arteriovenous fistula, vascular access, end stage kidney disease, hemodyalisis

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Introduction

Vascular access for patients with End Stage Kidney Disease was first introduced by Scribner who described the Scribner Teflon –Silastic arterio venous shunt (1). For the next six years, this ingenuous device was adopted and regular dialysis became possible. In 1966 the legendary article of Cimino and Brescia (2) was published and the arteriovenous fistula was born. From that day forward the radio-cefalic arteriovenous fistula became the first choice in vascular access (3). Because venous capital is often not suitable, different techniques were developed, such as the usage of grafts. May (1969) and Girardet (1970) were the first to introduce the saphenous vein graft (4,5) In 1972 Volder introduces the synthetic PTFE graft (6) which has become the recommended graft to use compared with other synthetic grafts (7).

In Europe the first choice in the creation of a vascular access is the native fistula, and according to the European Best Practice Guide (EBPG) on Vascular Access the first

choice in creating the vascular access for hemodialysis is a wrist radio-cephalic arteriovenous fistula (8,3). Due to some factors such as age, diabetes, atherosclerosis, small diameter veins, the distal venous capital is often not suitable; therefor vascular surgeons developed new vascular access such as proximal fistulas (brahiocephalic, brahiobasilic, and brahiohumeral). This meant sometimes the usage of profound veins, which had to be transposed. The first authors that introduced this technique were Carcardo (9), Dagher (10) in 1970 and Koontz in 1983 (11).

In some patients the only access for hemodialysis is possible through a central vein catheter. Sheldon in 1961 introduced the first catheter (12) and since then the development of cuffed catheters gained field, and especially in the US they are the preferred access for hemodialysis.

When hemodialysis cannot be performed, or is not indicated, peritoneal dialysis is used. In 1975 Popovich and Moncrieff describe for the first time the usage of peritoneal dialysis in ambulatory settings. (13)

The technique regarding the placement of the peritoneal catheter was improved when the laparoscopic approach was introduced. (14,15,16)

Anatomy notions

The brahio-cephalic fistula is performed in the cubital fossa. The cubital fossa located in the anterior cubital region is bounded by the brachialis muscle superiorly, by the pronator teres muscle medially, and by the brachioradialis muscle laterally. (17) The brachial artery lies in the cubital fossa in a groove between the pronator teres and brachioradialis muscle under the aponeurosis of the biceps brachii muscle. Here it divides into two branches: the ulnar artery and the radial artery. The brachial artery is accompanied by two veins and the median nerve. The median nerve lies medial to the artery in the cubital fossa. The cephalic vein is a direct continuation of the first dorsal metacarpal vein. It ascends from the back of the hand, curves round the radio-ulnar joint and runs first on the radial border of the forearm and then, at the junction of the lower and middle thirds, passes to the palmar surface and reaches the elbow. From there it stretches on the upper arm, first in the lateral bicipital groove and then in the groove between the deltoid and the pectoralis major muscles. It empties into the axillary vein.

The median vein of the forearm runs on the palmar surface of the forearm between the basilica vein and the cephalic vein. In the proximal third of the upper arm it divides into two branches,one of them is called the median cephalic vein and runs to the cephalic vein, and the other is called the median basilica vein and runs to the basilica vein. Also present in the cubital fossa is the perforating vein of the elbow which connects the superficial venous system to the profound one.

Surgical technique

Materials needed: a vascular surgery kit, sterile dressings, gowns and sheets. Good lighting. Magnifying tools are not needed.

The patient is lied in a supine position. The arm is abducted at 90 degrees and the forearm extended, with the hand in a supine position. Local anesthesia is performed using 1% lidocaine solution. A ~ 4-6 cm transverse incision is made just below the elbow crease. We prefer this type of incision because it allows access to dissect the proximal part of the median basilica vein, thus ensuring a longer fistula. Being under the elbow crease it does not affect movement of the forearm after healing. The subcutaneous tissue is dissected, controlling hemostasis and revealing the superficial veins. The bicipital fascia is dissected and the brachial artery mobilized and dissected until it reaches the bifurcation. Caution should be used in preserving the median nerve which lies medial and posterior to the brachial artery (*Fig. 1*).

The median basilica vein is dissected, ligated and sectioned at 2-3 cm proximal to its origin, thus creating a 2-3 cm loop which will be used to create the anastomosis.

The perforating vein is ligated and sectioned. The median vein is ligated and left in place in order to maintain traction on the loop, keeping its shape. Where anatomical particularities permit it the perforating vein can be kept in place whilst the median vein is sectioned, in order to maintain the loop form. The brachial artery is clamped proximally and distally and a small ~ 5-7 mm arteriotomy is performed. (*Fig. 2*) We also recommend a no more than 5-7 mm arteriotomy in order to avoid steal syndrome (18).

The anastomosis is performed end to vein lateral to artery, using a 6.0 double-armed monofilament polypropylene suture. Suturing starts on the distal end with the posterior wall of the anastomosis and ends on the middle of the anterior wall. It is performed in a continuous suture, with a 1 mm gap between suture points. The goal of the suture is to put the 2 intimas in contact, therefore the suture is performed in 2 steps. Step 1-passing the needle through the vein in an outside-inside direction. Step 2-passing the needle through the artery in an inside-outside direction. The anastomosis can also be performed with titanium clips if available (19).

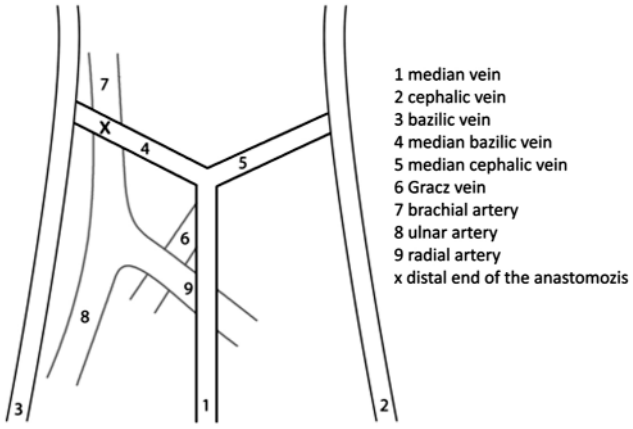

Figure 1.

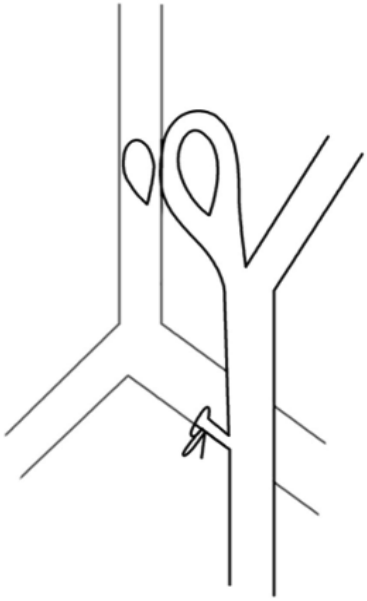

Figure 2. *Arteriotomy site*

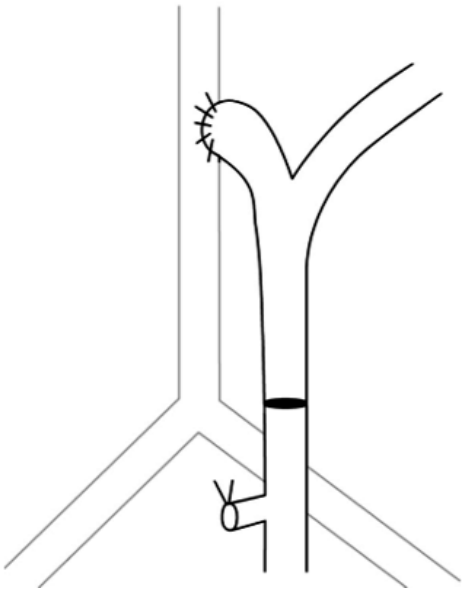

Figure 3. *Final aspect*

Before the anastomosis is complete, the distal clamp is removed from the artery and the hemostasis is controlled. Finally the proximal clamp is removed from the artery (*Fig. 3*).

The vein should dilate and a pulse and thrill should be felt right away, and also a less turbulent flow should be felt. Next we suture the wound and apply sterile dressing. Routinely we do not use heparin after the anastomosis is performed sharing the opinion that "Surgical errors cannot be corrected by pharmacotherapy" (20). Antibiotics are not routinely recommended.

Discussion

A few steps of this technique require attention.

When performing surgery we believe that although we start with perfection in mind you always have to consider the complications that may arise and the necessary steps to correct them. That is why we perform the transverse incision just below the elbow crease, because in cases of hematoma or infection we have access to all the important vessels in the region, and by performing the incision near the bifurcation of the brachial artery, the brachial profound artery and the elbow arches are left in place, providing blood flow to the limb in case we need to ligate the brachial artery. Also, if infection or hematoma or even keloid scar develop, this will not limit the movement of the forearm in the future.

Perfect hemostasis must be obtained, because after the fistula is performed venous pressure will rise, increasing the risk of hematoma, which on the long term can cause stenosis and fistula failure.

We recommend the usage of only one double armed suture when performing the anastomosis. First we start from the distal end of the anastomosis, performing the posterior wall of the suture in one continuous string and ending it on the proximal 1/3 of the anterior wall. Then use the second needle to perform the rest of the anterior wall. This way we have enough mobility of the posterior wall when suturing it, opposite to the technique with two double armed sutures, where you fix both ends of the anastomosis limiting the movement of the vein whilst suturing it.

Elbow fistula secondary patency according to literature data has a median value of 80% in the first year and 50% at 3 years (21,22,23).

Henricus JT reports the results of a multicenter prospective study, regarding 491 fistulas, in which the secondary patency median rate is 88% for the first year and 86% for 18 months with a primary failure median rate of 40%.(24)

Timmy Lee et al, in a study comparing the patency of upper arm fistula after failed forearm fistula versus graft fistula had the following results: 1.3 median value for intervention/year/patient in native fistula compared to 2,6 for grafts (25). The primary reason for fistula failure is thrombosis caused by stenosis (26). Stenosis is most frequent at the anastomosis site on the lateral wall of the vein (27).

Literature data has proven that turbulence and shear stress are responsible for stenosis, which is responsible for thrombosis and access failure (28,29,30). The localization of low and oscillating hemodynamic shear in the post-operative flow condition may explain the preferential localization of stenosis (31). Another factor that is responsible for fistula failure is of course the surgical technique. When performing a vascular access the surgeon must know that nothing less than perfection is acceptable.

Reducing the factors that aggravate stenosis will lead to a reduced rate of vascular access failure.

Conclusion

Reducing turbulence and sheer stress will reduce the factors that lead to intimal hyperplasia and consequently stenosis. Reducing stenosis also reduces thrombosis which causes fistula failure.

Our opinion is that by creating the anastomosis this way, we reduce perianastomotic turbulence, thus increasing the fistula's patency. That is why, when anatomical situations permit it, we recommend the usage of this technique, which has proven to be feasible.

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