

Case Report

Enhancing the Patency Rates for Native Arteriovenous Access for Dialysis: A Classical Two-Step Superficialization of a Deep Brachiocephalic Arteriovenous Fistula in a Normal Weight Patient

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REZUMAT

Creșterea ratei de succes a accesului arteriovenos nativ în dializă: tehnică clasică de superficializare în 2 timpi a unei fistule arteriovenoase brahiocefalice la un pacient normoponderal - prezentare de caz

Fistula arteriovenoasă reprezintă soluția optimă de abord vascular pentru hemodializați. La o anumită categorie de bolnavi cu insuficiență renală (vârstnici, diabetici, pacienți renali cronici cu inițiere tardivă a dializei), la care frecvent se pot asocia afecțiuni cardiovasculare cu impact direct asupra patului vascular, se impune adaptarea tehnicii chirurgicale de creare a unui acces vascular funcțional pentru a preîntâmpina eventualele complicații asociate patologiei conexe. Particularitatea cazului nostru este reprezentată de necesitatea superficializării fistulei arteriovenoase brahiocefalice (venă cefalică profundă) la un pacient normoponderal (indicele de masă corporală = 18,6 kg/m²). La momentul creării abordului vascular nativ, datorită statusului nutrițional precar (malnutriție moderată – albuminemia = 2,9 g/dL), dar și a grosimii inadecvate a pereților venei implicate, s-a impus realizarea accesului vascular în 2 timpi: inițial crearea și apoi transpoziția fistulei. Datorită prezenței a două vene colaterale, s-a practicat ligaturarea celor două vase tributare, permițându-se astfel o maturare eficientă a fistulei. După superficializare, nu s-au evidențiat leziuni vasculare, complicații (inflamatorii / infecțioase) sau vreun impediment în momentul canulării fistulei arteriovenoase. Important de reținut este faptul că algoritmul

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creării abordului vascular presupune luarea în considerare a mai multor aspecte: statusul clinic al pacientului, comorbiditățile asociate, particularitățile anatomice și modalitatea optimă de asigurare a unei fistule funcționale de lungă durată. De aceea, trebuie folosite toate opțiunile posibile chirurgicale de realizare a unei fistule arteriovenoase viabile.

Cuvinte cheie: fistula arteriovenoasă nativă, venă cefalică profundă, superficializare, hemodializă

ABSTRACT

Native arteriovenous fistulae (AVF) are the best options for chronic hemodialysis (HD) access. In elderly, diabetics or patients with late initiation of HD we need to adapt surgical procedures, taking advantage of any opportunity to overcome shortcomings and create a native dialysis access. The case that we present has the particularity of a deep cephalic vein that required superficialization of the acquired brachiocephalic AVF in a normal weight patient (body mass index = 18.6 kg/m²). At the intervention for fistula formation, the poor nutritional status (moderate malnutrition – albuminemia = 2.9 g/dL) and the thin walls of the vein obliged us to perform the two-step procedure: first the creation, then the transposition of the fistula. The presence of two collateral veins imposed a classical intervention that allowed the ligation of these tributary vessels for a better fistula maturation. There were no injuries of the vessels or inflammatory / infectious complications, no impediment for cannulation due to overlapping scar after superficialization. In the dialysis vascular access planning algorithm we must consider all the conditions of the patient, anatomical particularities and the best way to ensure the longevity of the AVF. All the techniques available must be considered as options.

Key words: native arteriovenous fistula, deep cephalic vein, superficialization, hemodialysis

INTRODUCTION

Native arteriovenous fistulae (AVF) are the best options for chronic hemodialysis (HD) access. Unfortunately, not every patient fulfills the requirements necessary for this type of vascular access: the artery and the vein implicated in dialysis fistula creation must accomplish some criteria which makes them suitable for this procedure. If these criteria are not fully met, the chances to a successful intervention and a quick and qualitative maturation of the fistula are dropping [1-5]. An artery that is suitable for AVF creation has an inner diameter > 2 mm, optimal initial flow and elastic walls allowing dilatation to accommodate a supplementary 10 – 20 fold blood flow increase after the AVF is performed [1,2,5-11]. The participating vein must be superficial enough (less than 5 mm from the skin surface), wide enough (a caliber bigger than 2.5 mm) and its walls must allow important dilatation (without fibrosis, injuries, and thickenings). In elderly, diabetics or patients with late initiation of HD some of these demands are frequently absent; we need to adapt surgical procedures, taking advantage of any oppor-

tunity to overcome shortcomings and create a native dialysis access [1,2,5,9].

CASE REPORT

We present the case of a 64-years-old woman with end-stage renal disease (ESRD) secondary to chronic pyelonephritis which deliberately delayed hemodialysis initiation for 2 years and has set herself a severe hypoproteic diet. The glomerular filtration rate (GFR) was kept at a constant value of 15 – 13 mL/min/1.73 m² for the last 2 medical exams. An episode of respiratory tract infection triggered the exacerbation of chronic kidney disease (CKD) and, with the patient's consent, emergency hemodialysis on a temporary jugular catheter was initiated; intestinal diverticulosis with diverticulitis episodes contraindicated peritoneal dialysis. After several dialysis sessions and improving her general condition, we performed a vascular clinical examination in order to create a chronic access for hemodialysis.

At inspection, the forearm veins were injured and showed fibrosis due to previous puncturing (placement of numerous peripheral venous lines for

medication administration) and poor nutritional status (moderate malnutrition – albuminemia = 2.9 g/dL, but normal weight – body mass index = 18.6 kg/m²); in contrast, the brachial artery had a strong pulse and the tourniquet test revealed a good response of the cephalic vein in the lower 1/3 of the upper arm. We performed Doppler ultrasonography and diagnosed a particular anatomical disposition of the cephalic vein in the proximal 2/3 of the upper arm – far too lateral from the border of the biceps and placed deep in the subcutaneous tissue. Nevertheless, we decided to approach the cephalic vein and we successfully created a brachiocephalic left arm fistula by using the side-to-side type anastomosis. The transposition of the deep vein in a one-step procedure was not possible because of the thin and fragile walls and therefore, the two-step technique was performed.

After 1 week the control showed good thrill and no complications; at 6 weeks the patient presented with a mature but profound AVF. The dialysis center performed a Doppler ultrasonography that showed a well-functioning AVF placed too deep to allow safe cannulation for dialysis: brachial artery with a normal parietal status, a 7 cm long straight segment of arterialized vein with an inner diameter of 6.6 mm, situated 1.6 cm under the skin surface, no stenosis and no thrombus in the examined vessels; in the upper third of cephalic vein there are 2 collateral venous branches – 1.5 and 2 mm diameter, respectively (Fig. 1).

We decided that a classical approach for the AVF superficialization was indicated in order to ligature the tributary vessels in the same procedure –

the minimal incision and liposuction technique were not suitable for this case.

TECHNICAL DESCRIPTION

After local anesthesia with lidocaine 1%, we performed a long incision in the skin and subcutaneous tissue, following the path of the fistula and localizing the vein; the cephalic vein was mobilized and elevated; then, proximally, the two collateral branches described in the Doppler ultrasound were ligatured; the skin was sutured over a thin layer of subcutaneous tissue covering the vein (Fig. 2).

At 1 week the suture was clean, the subcutaneous tissue and the skin without inflammation, the thrill was present and the fistula palpable. The ultrasound exam emphasized a cephalic vein without thrombosis or stenosis, with a 7.32 cm length and a depth of 0.22 cm from the skin surface (Fig. 3). The AVF was successfully cannulated at 4 weeks after the elevation procedure and offered a good flow for dialysis.

DISCUSSIONS

AVF superficialization is an important procedure that enhances the patency rates for the native hemodialysis accesses. For the dialyzed patient with poor vascular capital we should consider every feasible intervention and adapt to its anatomical variants. In patients with compromised forearm vessels we are forced to perform anastomosis between the brachial artery and the cephalic or basilic vein. Brachio basilic resultant AVF is often profound and in most cases, it needs to be superficialized [5,12].

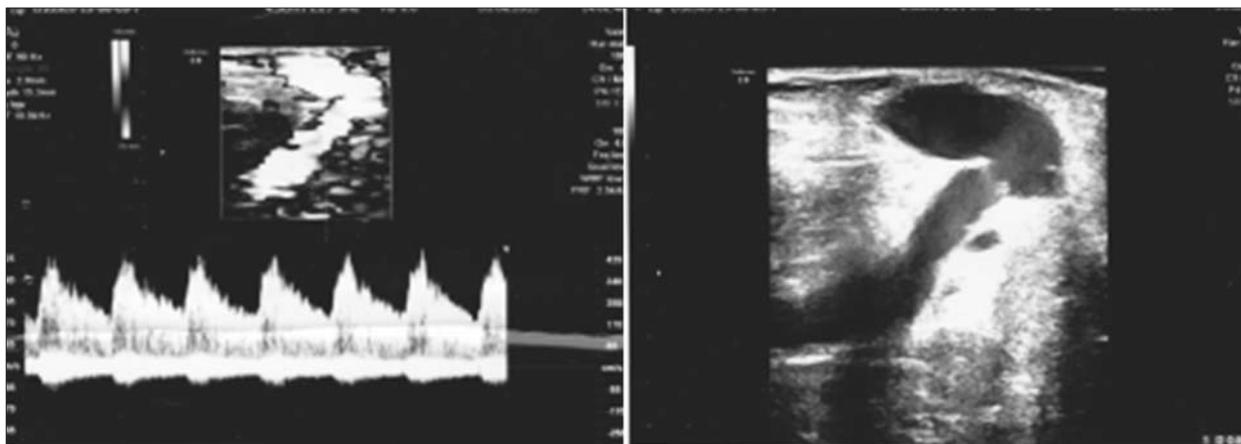


Figure 1. Mature brachiocephalic upper-arm AVF with optimal flow



Figure 2. Stages of superficialization surgery

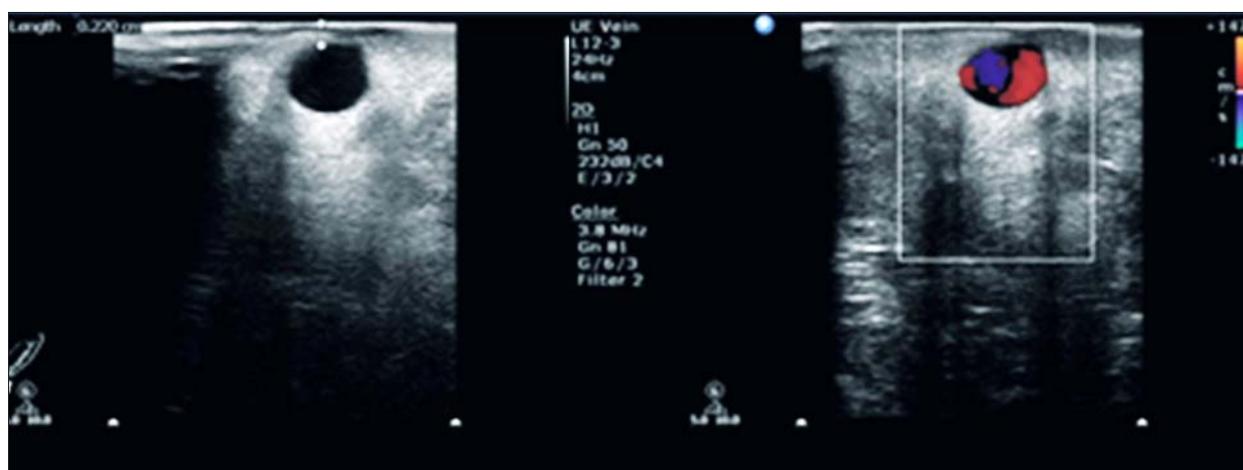


Figure 3. Cephalic vein: transversal section and color Doppler post-superficialization

The cephalic vein is usually superficial and easy to approach; brachiocephalic AVF requires superficialization in less than 4% of cases, mostly in obese patients [5,13-15]. In this latter condition (cephalic vein situated deep in a thick fat subcutaneous tissue), several specific techniques of superficialization were developed – minimal incisions technique and liposuction technique [5,14-16].

Our case has the particularity of a deep cephalic vein that required superficialization of the acquired brachiocephalic AVF in a normal weight patient. At the moment of the intervention for performing the fistula, the poor nutritional status and the thin walls of the vein obliged us to approach the two-step procedure: first the creation, then the transposition of the fistula. This is in agreement with other authors who recommend that superficialization must be postponed in a second stage intervention because it has a lower rate of complications [5,12,17]. It is

important to advise the patient and the dialysis medical team not to attempt needle cannulation of the AVF unless this is fully accessible – too deep AVF can be easily disrupted by imprecise needle maneuvers, making the elevation procedure more complicated [12]. The presence of two collateral veins imposed a classical intervention that allowed the ligation of these tributary vessels for better fistula maturation.

The evolution was favorable, without any injury of the vessels or inflammatory / infectious complications. Doppler ultrasound examination demonstrated an optimal depth of the AVF after the elevation procedure, under 6 mm distance from the skin surface. There was no impediment for cannulation due to overlapping scar. We managed to obtain a suitable native vascular access for hemodialysis in a patient with poor venous capital: compromised superficial veins of the wrist and much too deep arm

veins – both the cephalic and the basilic veins. We chose the type of anastomosis and the surgical technique after a careful clinical examination and Doppler ultrasound exam.

In most of our patients we rely on clinical examination and recommend ultrasound mapping only in those with inconclusive clinical data. Routine Doppler has not proved itself as a statistically significant tool in decreasing early fistula failure rates and it is an ongoing debate regarding the cost-effectiveness of performing this procedure for all the patients [1,2,5,18,19]. A well-trained practitioner surgeon must examine the patient and decide the best way to ensure the optimal vascular access for dialysis [3,4].

CONCLUSIONS

“There are no diseases but patients.” In the dialysis vascular access planning algorithm, we must consider all the conditions of the patient, anatomical particularities and the best way to ensure the longevity of the AVF. We must take into consideration and value every vessel that can participate in the development of a native fistula. All the vascular techniques available must be considered as options.

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REFERENCES

1. Vascular Access 2006 Work Group. Clinical practice guidelines for vascular access. *Am J Kidney Dis.* 2006; 48(Suppl 1):S176-247.
2. Vascular Access 2006 Work Group. Clinical practice guidelines for vascular access. *Am J Kidney Dis.* 2006; 48(Suppl 1):S248-73.
3. Fistula First. National Vascular Access Improvement Initiative; <http://esrdncc.org/ffcl/>.
4. Lok CE. Fistula first initiative: advantages and pitfalls. *Clin J Am Soc Nephrol.* 2007; 2(5):1043-53.
5. Beathard GA. Creating an arteriovenous fistula for hemodialysis. *UpToDate.* 2014; <http://www.uptodate.com/contents/creating-an-arteriovenous-fistula-for-hemodialysis.com>.
6. Napoli M, Antonaci AL, Martella V. Preoperative sonographic mapping. In: Napoli M (editor). *Echo Color Doppler & Vascular Accesses for Hemodialysis.* Milano, Italy: Wichtig Editore, 2011, p. 16-45.
7. Shenoy S. Surgical anatomy of upper arm: what is needed for AVF planning. *J Vasc Access.* 2009; 10(4):223-32.
8. Davidson I, Chan D, Dolmatch B, Hasan M, Nichols D, Saxena R, Shenoy S, Vazquez M, Gallieni M. Duplex ultrasound evaluation for dialysis access selection and maintenance: a practical guide. *J Vasc Access.* 2008; 9(1):1-9.
9. Besarab A. Vascular access: issue and management. In: Ronco C, Levin NW (editors). *Hemodialysis Vascular Access and Peritoneal Dialysis Access.* Contrib Nephrol. Basel, Germany: Karger, 2004, 142:29-46.
10. Owens CD, Wake N, Kim JM, Hentschel D, Conte MS, Schanzer A. Endothelial function predicts positive arterial-venous fistula remodeling in subjects with stage IV and V chronic kidney disease. *J Vasc Access.* 2010; 11(4):329-34.
11. Dixon BS. Why don't fistulas mature? *Kidney Int.* 2006; 70(8):1413-22.
12. Hossny A. Brachio basilic arteriovenous fistula: different surgical techniques and their effects on fistula patency and dialysis-related complications. *J Vasc Surg.* 2003; 37(4):821-6.
13. Niimi M, Ikeda Y, Kan S, Takami H. Superficialization of hemodialysis access using a video-assisted procedure. *Surg Endosc.* 2002; 16(1):218.
14. Krochmal DJ, Rebecca AM, Kalkbrenner KA, Casey WJ, Fowl RJ, Stone WM, Chapital AB, Smith AA. Superficialization of deep arteriovenous access procedures in obese patients using suction-assisted lipectomy: A novel approach. *Can J Plast Surg.* 2010; 18(1):25-7.
15. Evans RP, Meecham L, Buxton P, Jafferbhoy S, Legge J, Papp L, Ehsan O, Pherwani AD. Vascular access in the obese: superficialization of native radio-cephalic and brachio-cephalic fistulae. *J Vasc Access.* 2015; 16(2):126-9.
16. Roberts C. Saving a brachiocephalic fistula using lipectomy. *Nephrol Nurs J.* 2005; 32(3):331.
17. Francis DM, Lu Y, Robertson AJ, Millar RJ, Amy J. Two-stage brachio basilic arteriovenous fistula for chronic haemodialysis access. *ANZ J Surg.* 2007; 77(3):150-5.
18. Wong CS, McNicholas N, Healy D, Clarke-Moloney M, Coffey JC, Grace PA, Walsh SR. A systematic review of preoperative duplex ultrasonography and arteriovenous fistula formation. *J Vasc Surg.* 2013; 57(4):1129-33.
19. Wells AC, Fernando B, Butler A, Huguet E, Bradley JA, Pettigrew GJ. Selective use of ultrasonographic vascular mapping in the assessment of patients before haemodialysis access surgery. *Br J Surg.* 2005; 92(11):1439-43.