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Kasuistika | Case report

Treatment of symptomatic popliteal artery aneurysms with venous bypass by the AESA (asymmetric end-to-end spatulated anastomosis) technique

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SOUHRN

Popisujeme šest případů kritické ischemie končetin u čtyř pacientů na podkladě symptomatického aneurysmatu popliteální tepny a představujeme metodu AESA (asymmetric end-to-end spatulated anastomosis) pro provádění autologních žilních bypassů v lýtkových cévách. Jde o modifikovanou metodu klasické end-to-end spatulated anastomózy s výslednou asymetrickou konfigurací bočních stěn anastomózy. Při použití této modifikované metody se dosahuje větší plochy anastomózy, přičemž protilehlé boční stěny anastomózy se vždy nacházejí na jiné úrovni řezu. V případě vzniku intimální hyperplazie by tak tato asymetrická konfigurace mohla zamezit vzniku výrazné stenózy anastomózy a následně i neúspěšnosti výkonu. Asymetrická end-to-end anastomóza byla ve všech případech vytvořena ve snaze o revaskularizaci jediné průchodné lýtkové tepny. Všechny byly úspěšné a všechny cílové tepny dosud zůstávají po sledování s mediánem 15 měsíců průchodné.

Keywords:
Asymmetric peripheral anastomosis
Autologous venous graft
Graft patency
Intimal hyperplasia
Myointimal hyperplasia

ABSTRACT

We report 6 cases of critical limb ischemia in 4 patients due to symptomatic popliteal artery aneurysm and we present the AESA (asymmetric end-to-end spatulated anastomosis) technique for use in autologous vein bypasses in crural vessels. This is a modified technique of conventional end-to-end spatulated anastomosis, which results in an asymmetric configuration of the anastomotic lateral walls. Using this modified technique the anastomosis' area is greater and the opposite lateral anastomotic sites are always at different inclined levels. Therefore, in cases of intimal hyperplasia formation this asymmetric configuration may avoid the marked stenosis of the anastomosis and consequently the procedure's failure. In all cases, the asymmetric end-to-end anastomosis was used for revascularization of a single patent crural vessel. All procedures were successful and all target vessels remain patent for a median follow up of 15 months so far.

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Introduction

Lower extremity aneurysms are relatively uncommon and in 70% of cases the affected vessel is the popliteal artery. Typically, a popliteal artery aneurysm (PAA) affect a male (m : f ratio is approximately 7.4 : 1) aged over than 65 year--old. In this population the prevalence of PAA larger than 15 mm in diameter is approximately 1% [1]. PAAs are usually asymptomatic, while clinical manifestations include symptoms from compression of adjacent nerves and veins as well as chronic or acute leg ischemic symptoms due to distal crural thromboembolism. Occurrence of symptoms has been associated with the PAA's size and those with diameter > 26 mm have been found to be prone for distal ischemia. In this clinical setting the PAA's exclusion with autologous vein bypass has significantly greater primary patency compared with synthetic grafts and still remains the gold standard [2]. Endovascular repair is justified only for anatomic suitable cases in the elderly and in very high--risk patients [3].

Early (< 30 days) thrombosis of an autologous vein graft (AVG) is usually associated with operative technical errors, while restenosis and AVG's thrombosis due to recurrent atherosclerotic process represents the leading cause of failure in the mid-term and long-term [4]. Pathophysiological adaptation and structural changes of an implanted AVG in the arterial circulation includes mainly a proliferative neointima formation. Further and excessive progression of this proliferative response results in intimal hyperplasia (IH), which narrows the vessel's lumen especially at the anastomotic sites and represents the primary cause of AVG's thrombosis and failure in the short- and mid-term [4,5].

Surgical technique plays an important role in prevention of AVG's failure due to IH in crural bypasses and especially in cases with poor run-off vessels [6]. Herein, we report a small series of 4 patients with 6 PAAs treated by the AESA (asymmetric end-to-end spatulated anastomosis) technique, and we describe this technique, which represents a modification of conventional end-to-end (ETE) anastomosis for use in bypasses to the small in caliber and with poor run-off peripheral arteries.

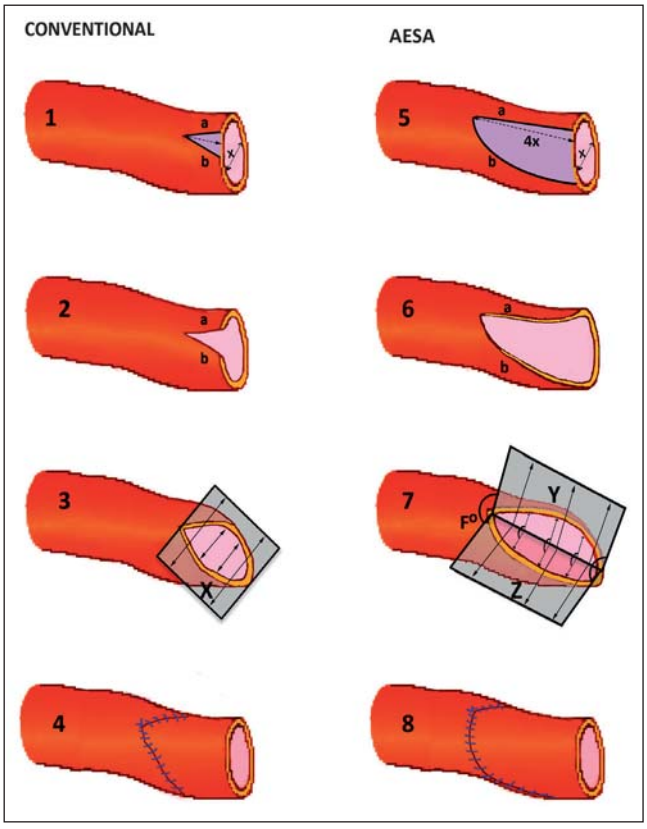

Fig. 1 – Differences between conventional (1, 2, 3, 4) and AESA (5, 6, 7, 8) anastomosis technique. 1.1: small longitudinal arteriotomy at the anterior wall of recipient artery, followed optionally by two small, triangular and equal lateral vascular wall excisions (a and b). 1.2: the two lateral anastomotic walls excisions (a and b) are symmetric. 1.3: both lateral anastomotic walls lie at the same inclined level (X) according to the vessel's axis. 1.4: conventional spatulated end-to-end anastomosis. 1.5: longitudinal arteriotomy with length at least 4 times the artery's diameter (x). Obligational and unequal excisions of the two lateral vascular walls. One of them (b) is significantly greater than the other (a). The width of excision b should be at least 3 times the width of excision a (b > a). 1.6: the two lateral anastomotic walls are asymmetric and one of them lies lower than the other (a and b). 1.7: the two lateral walls are not at the same inclined level according to the vessel axis and the two levels (Y & Z) have an obtuse angle between them (Fº). 1.8: the area of AESA is significantly greater than the conventional one.

Material and methods

Technique description

Performing a vascular ETE anastomosis by a simple circular suture line results in some narrowing. In conventional technique this narrowing can be overcome by cutting the ends obliquely. Accomplishment of an oblique anastomosis necessitates a small longitudinal arteriotomy at the anterior wall of recipient artery, and optionally two small and equal lateral vascular wall excisions, triangular in shape (Fig. 1.1 [a and b]). Following this technique the recipient artery's vascular end has two symmetric anastomotic lateral walls (Fig. 1.2), and both of them lie at the same inclined level according to the vessel's axis (Fig. 1.3 [X]). The same technique is used at the posterior wall of graft's distal end. This configuration, using a running suture, results in an oval shape, spatulated end-to-end anastomosis (Fig. 1.4).

Contrary to this conventional anastomosis, the proposed AESA technique has the following modifications: the length of arteriotomy should be at least 4 times the diameter of recipient artery (Fig. 1.5). The excision of the two lateral vascular walls is obligational and the two excisions are not equal, with one of them being significantly greater (Fig. 1.5 [a & b]). Ideally and depending on the target vessel's diameter the width of the one lateral wall excision should be at least 3 times the width of the other one (Fig. 1.5, b > a). This modification results in two asymmetric lateral walls and one of them lies lower than the other (Fig. 1.6 [a and b]). The two lateral walls are not at the same inclined level according to the vessel axis and the two levels (Fig. 1.7 [Y and Z]) have an obtuse angle between them (Fig. 1.7, Fº). With analogous technique for the venous graft's distal end, and using a running suture this modification results in an asymmetric,

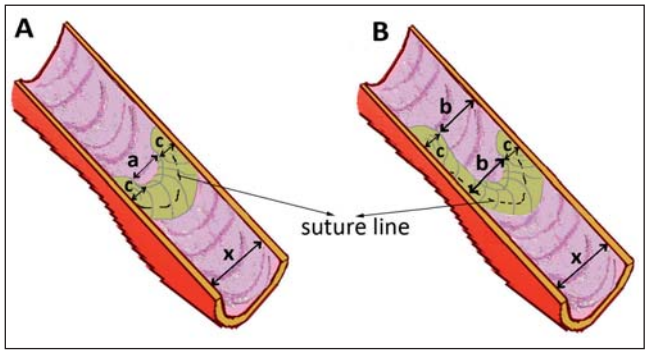

Fig. 2 – Schematic depiction in vascular cross-section of conventional (A) and AESA (B) techniques. (A) All opposite lateral points of the suture line are at the same inclined level and in case of anastomosis' IH (c) formation the remaining true lumen a = x – 2c. (B) The opposite lateral points of the suture line are in different levels. Under the same extend of IH formation (c) the remaining true lumen b is x – c. Obviously in image B the lumen is greater than in A (b = a + c → b > a).

oval in shape, spatulated ETE anastomosis. The area of asymmetric anastomosis is significantly greater than the conventional one (Fig. 1.8).

The potential benefit of this modification in the short- and mid-term is expected to be shown in cases with IH. In these cases, the conventional anastomosis has an increased possibility for severe narrowing at the anastomosis site (Fig. 2A), because all opposite lateral points of the suture line are at the same inclined level. In our modified technique the lumen after IH is larger because the opposite lateral points of the suture line are always in different levels (Fig. 2B).

Fig. 3 – MRA at 12th month of follow-up of an AVG for treatment of a thrombosed popliteal aneurysm. The reversed saphenous vein bypass was performed with medial approach.

Patient series – results

The period between January 2011 and January 2014 we treated with this technique four consecutive male patients (median age 72 years, range 60–77) with six symptomatic PAAs (median diameter 27 mm, range 22–31). All patients signed an informed consent prior to operation and suffered from critical limb ischemia due to distal thromboembolization with only one patent crural artery. In all cases we performed a reversed autologous saphenous vein bypass. Proximal anastomosis was a conventional ETE anastomosis at distal superficial femoral artery, while the distal anastomosis was performed at P3 segment of popliteal artery or to the single patent crural artery by the AESA technique.

The median length of follow-up of this small series of patients is 15 months (range 12–30). So far, all target vessels are patent and the limb salvage rate is 100%.

Perioperative management and surveillance

Adjunctive medication included dual antiplatelet (acetylsalicylic acid – ASA – 100 mg/daily and clopidogrel 75 mg/daily) treatment for the first postoperative month and lifelong ASA 100 mg/daily thereafter. The surveillance protocol included clinical and duplex ultrasound (DUS) examination at patients' discharge, at 1 and 3 months and every 6 months thereafter. Angiographic confirmation of AVG's patency was based on magnetic resonance (MRA – Fig. 3) or computed tomographic angiography (CTA) at 12th postoperative month (Fig. 4).

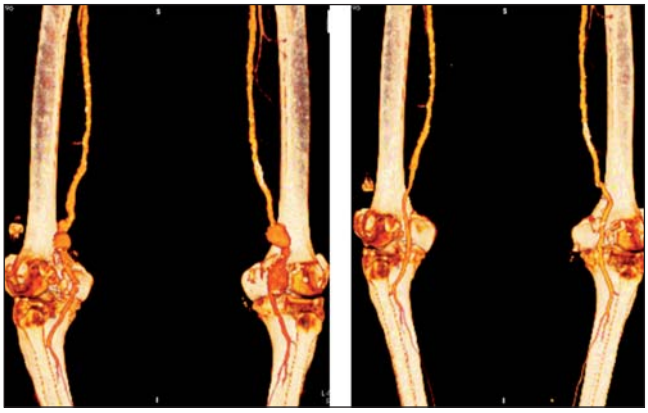

Fig. 4 – Left image: Preoperative CTA showing bilateral popliteal aneurysms with patency of a single runoff crural vessel. Right image: Postoperative CTA at 12th month of follow-up showing the patency of venous bypasses in both sides. The reversed saphenous vein bypasses were performed with posterior approach.

Discussion

Failure of distal bypasses and arterial reconstructions, especially in cases with poor run-off, has been correlated to several risk factors. Among them, the IH with medial thickening plays the most important role, at least for the short- and mid-term period [5,6]. The adaptive mechanisms of a venous graft in the hemodynamic environment of arterial flow results in the proliferation of smooth muscle and endothelial cells. This proliferation can become excessive and might lead to significant

narrowing of the lumen and finally to graft's occlusion [7]. Additionally, experimental study of Berguer et al. demonstrated early in literature the importance of low flow velocity and shear stress in the development of IH [8]. The high peripheral resistance of an arterial bypass due to poor run-off results in low arterial flow at distal anastomosis and represents another important factor for reduced graft patency. The coexistence of these two key factors, the low flow and the narrowed anastomosis by IH increases dramatically the possibility of graft failure.

In literature a prospective, randomized and multicenter trial [9] compared the ETE with the end-to-side (ETS) peripheral arterial anastomosis. Results of this study showed that there were no benefits in performing the conventional ETE anastomosis instead of the ETS. In methods of this classic study as well as in routine femoropopliteal bypass surgery, the ETS anastomosis has three significant advantages that make this technique far more popular than the conventional ETE. ETS is less technically demanding and has greater anastomotic area. Furthermore ETS preserves some collateral network flow, which might be crucial for the viability of the limb, especially in cases of revascularization's failure. Contrary to this concept, in a less frequent case scenario like a thrombosed popliteal aneurysm or a heavy atherosclerotic popliteal artery obstruction, two of these three ETS's advantages might not exist at all. Oftentimes, in these cases there is only one patent crural artery and the collateral genicular flow can't reach the crural vessel through an ETS anastomosis because the popliteal artery is already completely occluded. Additionally, in that case the popliteal artery can be divided and the single patent crural vessel can be extensively mobilized. This maneuver might facilitate the performance of an ETE anastomosis. In these cases the only remaining drawback in a comparison between ETE and ETS anastomosis might be the size of anastomosis' area.

In this context, the proposed modification of the conventional ETE spatulated anastomosis results in an asymmetric configuration of the anastomosis and a significantly greater lumen diameter at the anastomotic site compared to the conventional one. Our main purpose developing the AESA technique was to eliminate the factor of anastomotic narrowing in the equitation of graft thrombosis and failure. So far, angiographic and DUS evidence during surveillance support our theory that AESA might results in better configuration of the distal ETE anastomosis in technically demanding arterial peripheral bypasses.

Conclusion

We believe that the AESA anastomotic technique is feasible and easy to perform, requiring the same level of technical skills with the conventional one. However, the number of reported cases is too small and this technique should be validated and studied more extensively in order to straighten and support our initial conclusion that the AESA technique might result in improved patency of venous bypasses to the small in caliber and with poor run-off crural vessels.

Conflict of interest

Authors have no potential conflicts of interest to report.

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Ethical statement

This research was done according to ethical standards.

Informed consent

The patients agreed to participate in the research and signed an informed consent document.

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