

A technical alternative for the endovascular treatment of popliteal artery aneurysms

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J Vasc Bras. 2008;7(1):44-8.

ABSTRACT

Popliteal artery aneurysm is relatively rare, but represents around 85% of all peripheral arterial aneurysms. It is usually presented with ischemic complication and high risk of limb loss. For that reason, its elective treatment is indicated and currently carried through with satisfactory results using endovascular techniques. We describe our experience with the use of an ePTFE-covered nitinol self-expandable stent graft - Fluency (Bard, Germany), reinforced internally with the nitinol self-expandable Zilver stent (Cook, USA) for the treatment of a popliteal artery aneurism.

Keywords: Aneurysm, popliteal, endovascular technique.

RESUMO

O aneurisma de artéria poplíteia é relativamente raro, porém representa cerca de 85% de todos os aneurismas arteriais periféricos. Apresenta-se geralmente com um quadro de complicação isquêmica e elevado risco de perda do membro acometido. Em função disso, preconiza-se seu tratamento eletivo, atualmente realizado com resultados satisfatórios pela técnica endovascular. Relatamos nossa experiência com a utilização do stent de nitinol auto-expansível revestido com PTFEe - Fluency (Bard, Alemanha), reforçado internamente com o stent de nitinol auto-expansível Zilver (Cook, EUA) no tratamento de um aneurisma de artéria poplíteia.

Palavras-chave: Aneurisma, poplíteia, técnica endovascular.

Introduction

Aneurysmal disease of the popliteal artery is relatively rare, but it accounts for about 85% of all peripheral arterial aneurysms.¹ High rates of thromboembolic complications, often being its first manifestation, grant it a significant risk of limb loss and vascular bed destruction. For that reason, surgical treatment is currently recommended for aneurysms larger than 2 cm.² Despite that fact, surgical indication based on aneurysm diameter is still controversial. Some recommend clinical follow-up for those up to 3 cm in diameter, but, on the other hand, some are more focused on smaller aneurysms (< 2 cm), but presenting intraluminal thrombi or symptoms of microembolization, claiming that they should be repaired due to a high risk of ischemic complications.³

Atherosclerosis, which probably has multifactorial origin, seems to be the main cause in the elderly.⁴

Popliteal artery aneurysm is the most common peripheral aneurysm. Its prevalence is 1% in the general population, and it is often bilateral. Occurrence of associated aneurysms in other sites is observed in 35% of patients, with prevalence for the abdominal aorta, ranging between 27-50% in the literature. There are reports stating that such association is more frequent in patients with bilateral popliteal aneurysm, reaching up to 70%.⁵

In asymptomatic patients, 14-24% develop symptoms over a 1-year period, and acute ischemia is the first symptom in 20-50% of cases. In 5 years, untreated aneurysms will have complications in 70% of cases, leading to limb loss in 30-40%.⁶

As to rupture, a review of MEDLINE and LILACS data between 1953 and 2003 found a total of 4,109 popliteal artery aneurysms, 120 being ruptured (2.92%).⁷

There are two historic landmarks in the surgical treatment of popliteal aneurysms: the first, around 1785, when Desaut, in France, and Hunter, in England, proposed ligation of the superficial femoral artery in the adductor canal, inaugurating the so-called Hunterian era of popliteal aneurysm surgery. That technique resulted in 10.5% of cases progressing with limb gangrene. And the second, when Matas, in 1888, developed the technique of endoaneurysmorrhaphy, only published in 1903, which primarily aimed at preserving collateral circulation. That method caused a 5.2% reduction in amputation rate. Lumbar sympathectomy before endoaneurysmorrhaphy proposed by Bird and adopted and recommended by Linton also showed improvement in results regarding limb loss.⁸

With the advent of the modern age of arterial surgery, popliteal aneurysms started being treated by resection of the aneurysmal sac and reestablishment of arterial continuity, using autogenous vein or stent graft as arterial substitutes. In 1969, with the aim of simplifying this surgery, Edwards introduced the technique of aneurysm exclusion by arterial ligations performed above and below it, with reestablishment of circulation through a bypass graft, being the first choice of many vascular surgeons, with success rate of 90% or more.^{9,10} More recent studies by some renowned centers have claimed that posterior approach with graft interposition could bring even better results.^{10,11}

Dawson et al. calculated the possibility of formation of new aneurysms in 6% by the end of 1 year and 49% 10 years after initial surgery, that tendency being prevalent in men older than 65 years, hypertensive, who had bilateral aneurysmal dilatation of the popliteal artery in initial examination.⁵

Throughout these years, treatment of this pathology oscillated between stages of extreme interest and others marked by a lack of research and medical innovations. Since 1994, when the first endovascular treatment was reported by Marin et al.,⁶ who used a stent graft produced based on the suture of two Palmaz stents inside a 6-mm PTFEe, again placed on an angioplasty balloon, it has once again become an issue, even with reports of bilateral treatment, such as that by Medeiros & Gaspar.¹²

Case report

A 78-year-old male patient, Caucasian, with hypertension and dyslipidemia, previously submitted to bilateral carotid artery endarterectomy and with concomitant abdominal aortic aneurysm smaller than 5 cm. On physical examination, there were asymptomatic pulsatile masses in popliteal topographies. Angiographic tomography was requested, confirming presence of bilateral popliteal artery aneurysm ([Figure 1](#)).



Figure 1 - A) Three-dimensional reconstruction (Angio-CT); B) axial section (Angio-CT)

Use of covered Fluency stent was proposed for the treatment of right lower limb rupture, which affected proximal and medial popliteal segment and had around 2.7 cm in its largest diameter. Since this stent had a higher tendency to form kinking when flexed, we decided to use a nitinol self-expandable stent with more flexibility inside it and also enough radial force to maintain the system free of kinking, even in the region behind the knee, potentially having higher risk of complication of this type ([Figure 2](#)).

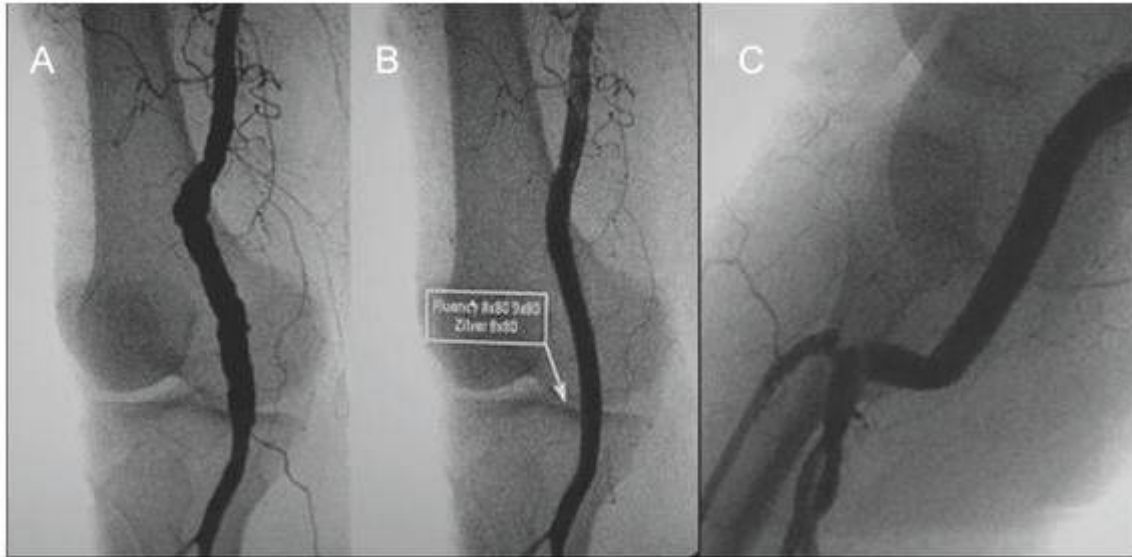


Figure 2 - A) Preoperative angiography; B) postprocedure control angiography; C) control angiography with flexed knee at 90°

The technique consisted of:

1. Anterograde puncture of the ipsilateral common femoral artery, exposed by dissection.
2. Introduction of a 9Fr 27-cm sheath (Cook, USA).
3. Angiography with digital subtraction (Figure 1A).
4. Implantation of covered Fluency stents, one 8x80 mm distal and one 9x80 mm proximal, with an *overlap* of approximately 3 cm.
5. Implantation of two Zilver 8x80 mm stents internally, with an *overlap* of 1 cm, extending for about 1 cm beyond distal and proximal ends of covered stents.

Control angiographic tomography on the 7th postoperative (PO) day showed total aneurysm exclusion and graft patency with proper placement. Angio-CT after 2 months confirms good outcome.

Discussion

Endovascular treatment requires special attention for some anatomic details. Some studies based on ultrasound assessments estimated mean diameter of the normal popliteal artery ranging between 0.90 ± 0.11 cm, while other authors reported smaller diameters, ranging between 0.47-1.1 cm.³

Mean diameter of the normal popliteal artery is larger in men, and in both genders its diameter is not uniform; proximal and medial popliteal arteries are similar and the distal popliteal artery is smaller.³ In a study by Cury et al. including 27 men with 45 patent fusiform aneurysms, the medial segment was the site with the most dilatation (39 cases), and the proximal segment had six cases.

Distal popliteal artery was not the site of higher dilatation in any case, and it had diameter > 10 mm in only one.²

The first published articles reported use of Wallgraft (Boston Scientific, USA) as an endovascular alternative for popliteal artery aneurysms. Due to its design, based on Wallstent (Boston Scientific, USA), it was subject to shortening/widening according to vessel caliber. Such characteristic made its placement imprecise, making its connections unstable, especially in the retropatellar area, subject to intense movements, especially flexion. Howell et al., in 13 cases using that graft, observed thrombosis in 31% of cases in 12 months.¹³

With the introduction of ePTFE-covered nitinol stents, such as Viabahn (Gore, USA), interest on this therapeutic option was once again renewed. Since Viabahn has more flexibility and is subject to a lower shortening/widening effect than Wallstent (Boston Scientific, USA), it has better results in areas containing folds and much knee movement. Tielliu et al., in 57 cases using Viabahn (Gore, USA), had technical success in 100% of cases, with primary and secondary patency in 2 years of 77 and 87%, respectively. Acute ischemia at intervention was present in 9% of cases.^{14,15}

Despite promising initial results using this device, use of Viabahn stent graft (Gore, USA) had the disadvantage of not assimilating external compressions (Figure 3A). Considering the conical shape of the normal popliteal artery (2-4 mm difference between proximal and distal diameters), which is exacerbated when there is an aneurysm in its proximal and medial segments, there may be an incomplete expansion of the Viabahn (Gore, USA) distal segment, with consequent clamping of the device (Figure 3B) and likely occurrence of type IB leakage, which would maintain blood flow inside the aneurysmal sac, as well as formation of an irregular internal bed, causing embolic complications and thrombosis in the long term (Figure 3C).

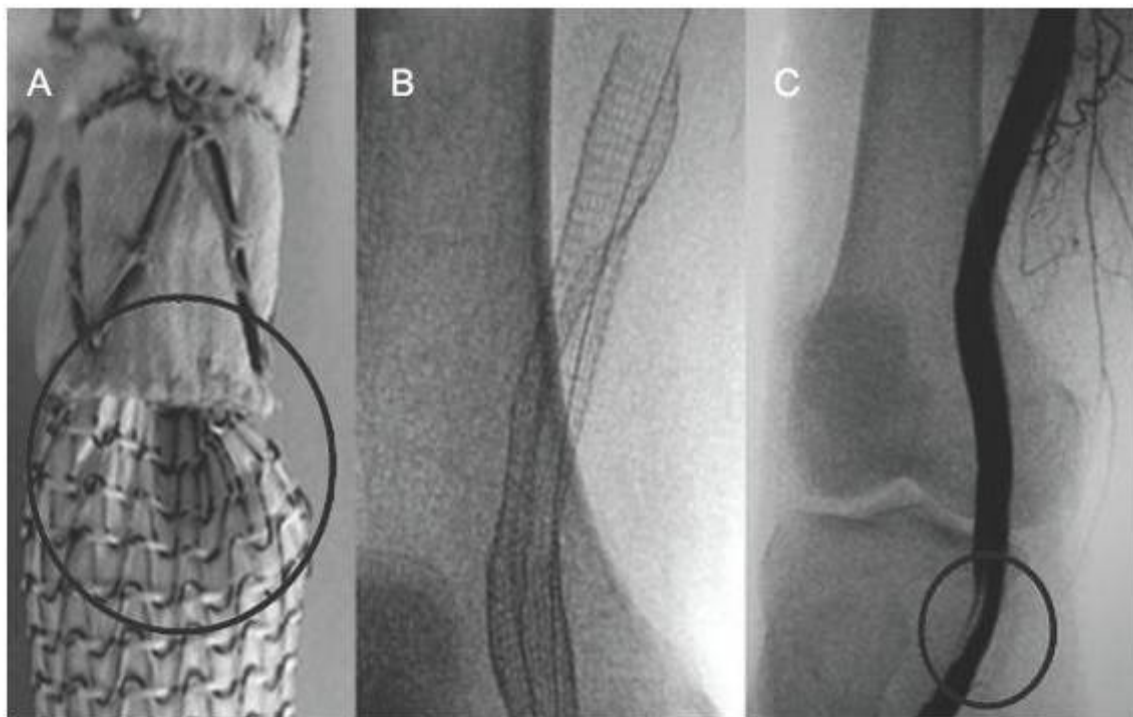


Figure 3 - A) Viabahn submitted to external compression (*in vitro*); B) radioscopy showing clamping of the Viabahn graft after its release; C) control angiography showing failure in filling secondary to stent clamping

Considering endovascular devices currently available in the market, a feasible alternative is using the covered Fluency stent (Bard, Germany), associated with use of self-expandable Zilver stent (Cook, USA) inside the covered Fluency stent, and advancing 1 cm beyond its ends, with the aim of stabilizing junction between covered stents and avoiding their kinking when submitted to knee flexion forces.

We believe the following are advantages of the proposed option:

1. The ePTFE-covered nitinol Fluency stent (Bard, Germany) does not have the phenomenon of shortening and widening, making its implantation more precise in the popliteal artery.
2. Clamping resulting from irregularity in popliteal artery diameter is reduced, since the design of the Fluency stent allows better placement using stents of varied diameters, besides performing a self-expandable Zilver stent, which has more radial force, internally to the covered stent, reinforcing sealing and preventing occurrence of device kinking.
3. Chance of disconnection of covered stents as a consequence of repetitive movement of the retroapatellar territory, as well as the possibility of terminal popliteal artery rectification during knee flexion movements, are solved by placing a self-expandable stent inside it, advancing 1 cm beyond the ends. This results in a final graft with good flexibility, avoiding folds or fractures, besides ensuring better fixation and a stable union between covered stents.

As negative points, we can mention the need of device overlapping, especially over the joint line. Until the case was performed, the largest length available for the covered Fluency stent was 8 cm, which caused limitation due to the tendency of using more stents. Models of that stent measuring up to 12 cm in length have been recently launched in the Brazilian market, which reduces such limitation.

Good outcome reported in this case, although in the short term, draws attention to the possibility of using the covered Fluency stent associated with internal reinforcement with self-expandable stent in the treatment of popliteal artery aneurysms.

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Manuscript received August 24, 2007, accepted November 30, 2007.