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Endovascular treatment of popliteal artery aneurysm. Early and midterm results

Tratamento endovascular de aneurisma de artéria poplítea: resultados em curto e médio prazo

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A B S T R A C T

Objective: to evaluate the efficacy of endovascular repair of popliteal artery aneurysms on maintaining patency of the stent in the short and medium term. **Methods**: this was a retrospective, descriptive and analytical study, conducted at the Integrated Vascular Surgery Service at the Hospital da Beneficência Portuguesa de São Paulo. We followed-up 15 patients with popliteal aneurysm, totaling 18 limbs, treated with stent from May 2008 to December 2012. **Results**: the mean follow-up was 14.8 months. During this period, 61.1% of the stents were patent. The average aneurysm diameter was 2.5cm, ranging from 1.1 to 4.5cm. The average length was 5cm, ranging from 1.5 to 10 cm. In eight cases (47.1%), the lesion crossed the joint line, and in four of these occlusion of the prosthesis occurred. In 66.7% of cases, treatment was elective and only 33.3% were symptomatic patients treated on an emergency basis. The stents used were Viabahn (Gore) in 12 cases (66.7%), Fluency (Bard) in three cases (16.7%), Multilayer (Cardiatis) in two cases (11.1%) and Hemobahn (Gore) in one case (5.6%). In three cases, there was early occlusion (16.6%). During follow-up, 88.2% of patients maintained antiplatelet therapy. There was no leakage at ultrasound (endoleak). No fracture was observed in the stents. **Conclusion**: the results of this study are similar to other published series. Probably, with the development of new devices that support the mechanical characteristics found on the thighs, there will be improved performance and prognosis of endovascular restoration.

Key words: Endovascular Procedures. Popliteal Artery. Aneurysm. Peripheral Vascular Disease.

INTRODUCTION

The popliteal artery aneurysm (PAA) is the most common peripheral aneurysm, accounting for 70% of all aneurysms. Its highest incidence occurs in males. It is bilateral in 50% of cases, and is associated with abdominal aortic aneurysms in 60%. The pathogenesis is multifactorial[1-3]. Popliteal aneurysms are often asymptomatic and the diagnosis is usually made by physical examination, when palpating a wide arterial pulse in the popliteal fossa region, and possibly by imaging examination performed for other purposes. Although there is a risk of rupture, it is rare. Symptomatic patients have complaints resulting from acute ischemia, caused by thrombosis of the aneurysm, or chronic ischemia by distal embolization. Both presentations are related to a significant risk of limb loss[1-3].

Complementary tests used to confirm the diagnosis are eco-color-Doppler, angiography and CT angiography. Despite the controversy on surgical indication, it is reserved for aneurysms more than 2cm in diameter or smaller sizes, when there is a mural thrombus, which is considered a significant risk factor for thrombosis or microemboli[2,4].

Conventional surgical treatment is the exclusion of the aneurysm and in-bridge graft limb revascularization or partial or total resection of the aneurysm sac and interposition of a bypass graft. Despite the well-established conventional surgical treatment, the development of endovascular techniques has brought a new alternative to correct this disease.

The first report of endovascular popliteal artery aneurysm was from Marin *et al* in 1994[5]. This treatment modality has gained importance in recent years due to the several advantages over open surgery, such as: less surgical time, shorter hospital stay, less blood loss, less morbidity, and possibility of treatment at the same time when the aneurysm is bilateral. However, since this is an innovative therapy, the findings on mid and long term evolution are still controversial[6-10].

The objective of this study was to evaluate the efficacy of the endovascular repair of popliteal artery aneurysm on short and mid term stent patency.

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METHODS

This was a retrospective, descriptive and analytical study, conducted at the Integrated Vascular Surgery Service at the Hospital da Beneficência Portuguesa de São Paulo. We revised the medical records of 15 patients treated by endovascular technique diagnosed with popliteal aneurysm from May 2008 to December 2012. In total, 18 limbs were operated, since the aneurysm was bilateral in three patients. The study group consisted of 12 men (77.7%) and three women (23.3%), with mean age of 67.1 years.

We analyzed the following variables: presence of ischemia, elective or emergency surgery, affected limb, examination conducted for diagnosis, aneurysm relation to the knee joint line, diameter and length of the aneurysm, patency of distal arteries, type of stent used, mode of antiplatelet therapy in the postoperative period and the patency in the follow-up period.

The procedure was performed under spinal anesthesia or local anesthesia with sedation. Postoperatively, patients were kept in the intensive care unit for 12 to 24 hours.

Three types of stents were considered suitable for endovascular treatment of popliteal artery aneurysms: Hemobahn® (Gore), then replaced by Viabahn®, Fluency® (Bard) and Multilayer® (Cardiatis).

The reevaluation of the patients was made in one month, three months, six months and one year after year the procedure. After the first year, the follow-up was every six months. To assess the patency of the prostheses, we used both sonographic criteria and clinical evaluation, defined by palpation of distal pulses and maintenance of the ankle-brachial index (ABI). In this case, where there was substantial change in clinical examination, palpation loss of distal pulses or decrease in ABI, the patient underwent examination with echo-color-Doppler.

After the procedure, dual antiplatelet therapy was initiated. The antiplatelet model was 75mg clopidogrel associated with acetylsalicylic acid (ASA) 100mg, once a day, both oral drugs, during the first month. From the 30th day on, the ASA was maintained indefinitely and clopidogrel was discontinued.

We defined a 0.05 significance level (5%). All confidence intervals were built with 95% statistical confidence. We decided to use non-parametric tests due to the small sample (less than 25 subjects). In the characterization of the qualitative variables with more than two response levels, we used the equality test of two proportions. To compare the amount of patent distal arteries for evolution result, we used the Mann-Whitney test. To evaluate the result of the relationship and / or association of the evolution with antiplatelet therapy, compared with joint line and urgency, we used the chi-square test for independence.

RESULTS

The mean follow-up was 14.8 months. As a diagnostic examination, angiotomography was used in 55.6%, followed by the echo-color-Doppler in 27.8% and arteriography in 16.7%. The average aneurysms diameter was 2.5cm, ranging from 1.1 to 4.5. The average length found was 5cm, ranging from 1.5 to 10. In eight cases (47.1%), the lesion crossed the joint line. In 12 cases (66.7%) treatment was elective; six (33.3%) patients had ischemia and were treated on an emergency basis. One of the three patients with bilateral aneurysm had the two sides operated in the same surgery. In eight cases we found the three distal arteries patent; in seven cases, two; in one case, only one artery was patent; and two cases presented with occlusion of all arteries; these patients underwent emergency procedure and received thrombolysis during surgery.

The stents used were Viabahn® (Gore) in 12 cases (66.7%), Fluency® (Bard) in three (16.7%), Multilayer® (Cardiatis) in two (11.1%) and Hemobahn® (Gore) in one case (5.6%).

In the follow-up period, 88.2% of patients maintained antiplatelet therapy according to the aforementioned. There were no intraoperative complications.

Early occlusions (30 days) were found in three cases (16.6%). One patient developed acute arterial obstruction on the first day after surgery and was treated successfully with thrombolysis. This patient had been submitted to an elective procedure and received a Viabahn® (Gore) stent. The other two cases occurred in patients operated on an emergency basis: the first, undergoing treatment with Multilayer® stent, presented with occlusion in the 12th day after surgery, with moderate intensity symptoms. There was a satisfactory clinical improvement, with disappearance of symptoms at rest and residual mild intermittent claudication, for which he was treated medically; the second showed thrombosis of the Hemobahn® prosthesis and ischemia of moderate to severe intensity on day 30 postoperatively, undergoing a successful femoropopliteal bridge with polytetrafluoroethylene prosthesis.

There were four late obstructions, identified clinically and confirmed by echo-color-Doppler. A patient who had two patent distal arteries at the elective treatment, whose aneurysm did not cross the joint line and used the Viabahn® stent, evolved with obstruction of the endoprosthesis three months after the procedure. He had not used the double antiplatelet therapy as directed. The other obstruction occurred five months after the procedure on a patient who also had two patent arteries at the elective treatment, received the Viabahn® endoprosthesis, but the aneurysm crossed the joint line. There was another obstruction, six months after the procedure, on one patient submitted to elective surgery,

whose aneurysm did not cross the joint line, had three patent arteries and received Viabahn®. Another occlusion was identified 12 months after the elective procedure. He had three patent distal arteries, the aneurysm crossed the joint line, he did not use double antiplatelet therapy and had received Viabahn®.

All patients who developed late occlusion of the endoprosthesis were treated clinically, ie without the need for surgical approach, since they evolved with moderate to mild ischemia.

There was one arteriovenous fistula between the fibular vessels, identified 12 months after the procedure on a routine reassessment. The fistula was corrected by endovascular approach, with good results. We did not find any leakage (endoleak) on follow-up ultrasound. No fracture was observed in the stents. The patency assessed at the end of the 24 months period was 61.1% (Figure 1). There were two deaths, one early and one late.

Statistical analysis showed no significant association in the variables studied, especially with regard to stents' patency.

DISCUSSION

The popliteal artery aneurysm is the most common peripheral aneurysms. Unlike the abdominal aortic aneurysm, for which the main concern is the failure, the popliteal artery aneurysms is distinguished by the risk of thrombosis, with significant risk of limb loss[11,12].

While some patients experience intermittent embolization of distal arteries, causing chronic ischemia, others evolve with acute arterial obstruction, with imminent risk of limb loss. These complications justify the broader indication of surgical correction, even for small aneurysms that present thrombi[12].

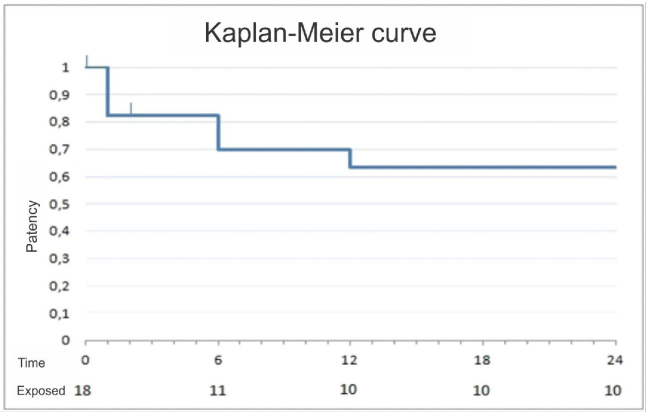

Figure 1 - *Kaplan-Meier curve for stent patency.*

Source: Medical records of patients of the Integrated Vascular Surgery, Hospital da Beneficência Portuguesa de São Paulo, São Paulo State, Brazil.

The classical treatment of popliteal artery aneurysm is the exclusion of the aneurysm with interposition of autologous or synthetic graft or bypass[13,14]. The results of several series show satisfactory results. However, the operation time is an important factor for the success of surgical treatment, and the patients operated on acute ischemia have a worse prognosis due to the involvement of distal vessels[15,16].

Although the popliteal artery can be surgically treated by posterior approach, this makes it difficult to use the internal saphenous vein as an autologous replacement. Therefore, medial approach by the Szilagyi technique is more common. However, this incision is susceptible to complications related to healing, especially when the lesion crosses the joint line and there is need of section of the muscles that attach to the medial aspect of the knee structures. Sometimes, prolonged healing and pain delays patient recovery[2,3].

As in other vascular diseases, the endovascular technique is an alternative that has been experienced in the correction of popliteal artery aneurysms. The first endovascular treatment was performed by Marin *et al.*[5], In 1994. Since then, this technique has become a feasible option for the treatment of this disease. With the growing experience and advances in the endovascular technique, this procedure is no longer exceptional and went on to compete with conventional surgery for the preference of surgeons[6-9].

Among the advantages of the endovascular treatment of the popliteal artery aneurysm, there are the following: minimally invasive procedure, requiring only small incisions or catheterization by the Seldinger technique; reduced operative time; less postoperative morbidity; and early mobilization, thus shortening hospital stay[5,7,15].

Despite the promising scenario, there are still many concerns about problems observed in the short and long term. These problems are the result of the variables that were considered in this study.

Considering the pathophysiology of silent microembolization quoted above, the evaluation of the distal arterial territory is deemed an important topic for the durability of the endovascular repair, because the greater the presence of patent distal arteries, the lower the chance of stent occlusion[17]. Garg *et al.*[18] reported that patients with only one patent distal artery had a higher incidence of thrombosis than those with two or more patent vessels. In our study we observed that in eight cases three patent arteries were found and in seven cases, there were two patent arteries. In one case, a single artery was patent and, in two cases, all three arteries were occluded, addressed in urgency. Statistical analysis did not show significance of the success of the procedure in relation to these findings.

The femoropopliteal axis is a region subject to continuous stress and twisting forces that can compromise the performance and durability of stents. These

characteristics may determine kinking of the graft and stent fracture, and consequently its closure. Tiellui *et al.*[19] studied 64 cases of endovascular repair of popliteal artery aneurysm and identified 13 (16.7%) cases of fracture. They observed that most of these fractures were related to the treatment of aneurysms crossing the joint line. Other possible complicating factors are the placement of multiple stents and the treatment of younger patients, since they are subject to more intense mobility, emphasizing the role of physical and mechanical stress. In our study, we did not identify any cases of stent fracture; however, there was no active search protocol by radiographs of the treated region. In eight cases the correction exceeded the joint line, of which four (50%) developed stent graft occlusion during follow-up. However, due to our modest sample, this finding was not statistically significant. Nevertheless, this finding corroborates the impression that the extension of the aneurysm beyond the joint line is a problem that must be considered when opting for the endovascular technique[6,19].

In our study, there was no leakage (endoleak). In a retrospective study, Midy *et al.*[6] found six endoleaks (10.5%) in 57 aneurysms corrected by endovascular approach in 50 patients, one being of type I, two type II and three type III. All patients were instructed on the use of dual antiplatelet therapy at the time of hospital discharge. Despite repeated requests, the guidance was not met in 11.8% of patients for several reasons. With the work of Tielliu *et al.*[19], it became evident that the antiplatelet therapy is of fundamental importance in the upper behavior of stents with respect to patency. Particularly in our study, there was no statistically significant difference between patients who adhered properly or not, to antiplatelet therapy.

There was no amputation, regardless of patients being operated in elective mode or in emergency situations. Lowell *et al.*[12] mention an amputation rate of 8.7%, more frequent in patients operated on during acute arterial obstruction. Although one cannot say from the obtained data, it is believed that shortening the time between diagnosis and treatment should influence the results of patency associated with intraoperative fibrinolysis, important to restore patency of the distal bed. Our study observed three cases in need of intra-arterial fibrinolysis by catheter, since these patients developed acute arterial occlusion, two in urgency and in the immediate postoperative period. One of these patients died during the early follow-up. Despite fasciotomies performed and the clinical support measures adopted, the patient developed severe metabolic changes, probably determined by reperfusion syndrome. The death occurred two months after the procedure due to an abdominal focus of sepsis, unrelated to the procedure.

In our study there were three early occlusions, but without leading to limb loss. It is possible that these occurrences are related to technical failures of the endovascular procedures, which are influenced by the material and the indication. It is important to monitor these patients for early identification of failure and rapprochement. One patient underwent successfully fibrinolysis in the first postoperative day, and the other underwent a femoropopliteal bypass. The third patient recovered successfully, although the occlusion involved the distal arteries. In this specific case, the patient was discharged two days after the procedure, with all distal pulses present and returned with occlusion one week later. The use of Multilayer® (a stent of greater rigidity) across the joint line may have affected this outcome. Tielliu *et al.*[7] reported 12 patients (21%) who developed occlusion, and none of them required femoropopliteal bypass or amputation, five of them occluded within the first month of follow-up. According to the authors, these early occlusions occurred before it was established a strict protocol of dual antiplatelet therapy[7], which may have influenced results.

In our study, 61.1% of the grafts were patent in two years, results comparable to those found in the literature, with 65% of patent prostheses[7]. Among the studies that describe conventional surgery[12,15], patency in five years ranges from 82 to 92%, with even better results in elective patients.

The failure to show in this study the importance of some variables recognized for their impact on the results is due to the small number of cases, which did not allow a more detailed statistical analysis. We believe that the incorporation of the endovascular technique is important and should be encouraged, taking care of proper patients' selection, the correct choice of material to be used, and the use of antiplatelet therapy. However, conventional surgery must not be abandoned and certainly will still be the best choice for many patients. It can be said that this treatment produces satisfactory results, despite the published studies accusing a lower patency rate when compared with conventional treatment.

The results of this study are similar to other published series. There is no denying the allure of endovascular treatment, particularly with regard to more comfortable postoperative recovery. However, the placement of a stent in that location is a challenging measure, both from a technical point of view and from a careful evaluation of the results in the medium and long term. For this, it is necessary to follow a strict protocol for the early identification of complications and to monitor the attitudes of patients, especially in relation to the accuracy of antiplatelet therapy.

It is believed that with the development of new devices that support the mechanical characteristics found on the popliteal region, there will be improvement in the performance and outcome of endovascular restoration in the near future.

R E S U M O

Objetivo: *avaliar a eficácia da correção endovascular do aneurisma de artéria poplítea quanto à manutenção da perviedade da endoprótese, em curto e médio prazo.* ***Métodos:*** *trata-se de estudo retrospectivo, descritivo e analítico, realizado no Serviço de Cirurgia Vascular Integrada do Hospital Beneficência Portuguesa de São Paulo. Foram acompanhados 15 pacientes com aneurisma de poplítea totalizando 18 membros tratados com endoprótese, no período de maio de 2008 a dezembro 2012.* ***Resultados:*** *o tempo médio de seguimento foi 14,8 meses. Nesse período, 61,1% das endopróteses estavam pérvias. A média de diâmetro dos aneurismas foi 2,5cm, variando de 1,1 a 4,5cm. A extensão média encontrada foi 5cm, variando de 1,5 a 10cm. Em oito casos (47,1%), a lesão cruzava a linha articular e, em quatro destes, ocorreu oclusão da prótese. Em 66,7% dos casos, o tratamento foi eletivo e apenas 33,3% eram pacientes sintomáticos, tratados em caráter de urgência. As endopróteses usadas foram a Viabahn (Gore) em 12 casos (66,7%), Fluency (Bard) em três casos (16,7%), Multilayer (Cardiatis) em dois casos (11,1%) e Hemobahn (Gore) em apenas um caso (5,6%). Em três casos, ocorreu oclusão precoce (16,6%). Durante o seguimento, 88,2% dos pacientes mantiveram a antiagregação plaquetária. No seguimento ultrassonográfico não foi observado nenhum vazamento (endoleak). Não foi verificada nenhuma fratura nos Stents.* ***Conclusão:*** *Os resultados obtidos nesse estudo são semelhantes aos de outras séries publicadas. Provavelmente com o desenvolvimento de novos dispositivos que suportem as particularidades mecânicas encontradas na região poplítea, haverá como melhorar o desempenho e prognóstico da restauração endovascular.*

Descritores*: Procedimentos Endovasculares. Artéria Poplítea. Aneurisma. Doenças Vasculares Periféricas.*

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