

Graft aneurysm as long-term complication of a polyester prosthesis – short review based on a systematic review of literature

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ABSTRACT

Introduction: A material-associated non-anastomotic aneurysm after previous use of a vascular prosthesis for arterial reconstruction mostly in peripheral arterial occlusion disease (PAOD) is considered a rare but serious complication.

Aim & method: The aim of the compact short review was – based on selected topic-related references from the medical literature as – to describe the rare finding of prosthetic non-anastomotic aneurysm and its diagnosis-specific care.

Results (complex patient- & clinical finding-associated corner points): Twenty articles were finally evaluated out of initially 321 references found in the literature search, which had been published since 1995. Most frequently, pseudoaneurysms of knitted polyester prostheses at the femoro-popliteal segment occurred after approximately 12.9 years in average. In one third of cases, two or more non-anastomotic aneurysms of Dacron prostheses were described. Histological and electron-microscopic investigations revealed mainly breakings of filaments and foreign body reactions. In more than half of the patients, the non-anastomotic aneurysm was resected and for reconstruction, a novel vascular prosthesis used as inter-positioned vascular segment was implanted. Complete removal of the prosthesis and endovascular therapy were only 2nd choice.

Conclusion: Development of prosthetic non-anastomotic aneurysms has not been satisfyingly clarified yet. It belongs to the late complication profile – even it occurs rarely – and should be controlled after a postoperative interval of approximately one decade if the arterial recanalization/reconstruction was performed using prosthetic material after previously – in the sequential approach – endovascular intervention and venous bypass could not be used.

Introduction

In long-term use of Dacron vascular grafts in the periphery, degeneration of the prosthetic material is possible. Reasons can be multifactorial: hydrolysis, erosion, clamping or damage during the manufacturing process¹⁴.

In rare cases, this can lead to prosthetic non-anastomotic aneurysms with the following complications such as a rupture or a bypass occlusion by thrombus migration.

By means of the following compact mini review, the long-term use of Dacron bypass with the complication of a non-anastomotic aneurysm and its appropriate therapy will be presented along with the analysis of the relevant literature since 1995.

Material and methods

On the occasion of the scientific compact review, a systematic literature search was carried out from 1995 to 2016 in PubMed® under the terms:

- aneurysm
- Dacron,
- polyester,
- graft.

This resulted in 321 sources. In addition, a hand search in the bibliography of the selected publications was performed.

Priority was given to English and German publications on aneurysms of polyester prostheses, which were used in the peripheral area (femoro-popliteal, axillo-femoral or prosthetic limb of aortobifemoral bypasses). Studies were excluded that reported aneurysms in aortic and native vessels. Due to the rarity of the prosthetic aneurysms, case reports and retrospective studies were favored, so that a total of 20 publications on non-anastomotic aneurysms in peripheral aorto-femoral/-bifemoral Dacron prostheses were finally included in the review.

Epidemiological, medical history, clinical, (differential) diagnostic, therapeutic, early-postoperative “outcome” characteristics, morphological and histological data as well as “follow up”-based, recorded prognostic aspects were considered. A total of 32 cases of prosthetic aneurysms (n=31 patients) were elucidated.

The statistical analysis was carried out in the recording of the absolute and percentage frequencies of the characteristics as well as mean time of the prostheses in situ until the reliable proof of an aneurysm.

Results (extracted key points from the literature) and discussion

The statistical analysis of the literature supports the results of other studies. Structural changes of the fibers in the form of filament alterations of various kinds were described in 11 cases, resulting in a pseudoaneurysm. Knitted polyester prostheses with single velour and double velour properties were at the forefront of aneurysm formation. The importance of foreign body giant cells and inflammatory cells has been reported in 6 publications^{6, 10,}

^{13, 16, 20, 22}. The occurrence of 2 ruptures in the “guideline”^{7, 16} seems to confirm the theory of weaknesses in this guideline of Dieval *et al.*⁴. The location of the aneurysms varies, most often in the middle of the prosthesis (n = 8; 25 %) ^{3, 8, 9, 11-13, 20, 21}, which is actually not a typical clamping area.

A prosthesis in the thigh area, such as the native femoral artery, is subject to particular mechanical stress when anatomically implanted. The influence of external compression due to strong musculature and the fibrous aponeurosis of the adductor canal affecting the superficial femoral artery crossing as already been identified as the cause of restenosis of stents in the superficial femoral artery¹⁵. This complex mechanical stress could explain the accumulation of prosthesis degeneration in the femoro-popliteal area.

The number of surgical revisions at the bypasses (n = 7; 21.9 %) ^{1, 7, 10, 16, 20, 21} also indicate an iatrogenic influence of the aneurysm formation, as Miyake *et al.*¹⁰ postulated in their publication.

The reconstruction possibilities of non-anastomotic aneurysms in Dacron prostheses range from complete removal and new creation through resection to interventional and endovascular therapies. In the majority of cases, the corresponding aneurysm was resected and replaced with a new Dacron prosthesis.

Also, the complete removal of the Dacron prosthesis with subsequent implantation of a new bypass enjoys its importance, as in the damaged prosthesis, the formation of further aneurysms is likely, and the patient can be prevented from further recurrent interventions. The surgical effort with potential complications such as blood loss and soft tissue trauma is significantly higher.

The endovascular repair of the aneurysms also provides an elegant and patient-friendly alternative. In the researched cases^{2, 11}, a Talent® stent-graft prosthesis (Medtronic, Minneapolis / MN, USA) was used. Offer *et al.*¹¹ used a 16x130 mm stent-graft, which was placed into the native femoral artery with a 22-Fr. introducer after arteriotomy. The oversizing was calculated with 15%, so the aneurysm was excluded without endo-leak. In the case of Alexandrescu *et al.*², the aneurysm was successfully sealed with a tapered aorto-uni-iliac 24x14 mm stent graft due to an isolation and punctuation of the femoral artery.

Author/Year	Kind of prosthesis	Localization	Therapy
Orii <i>et al.</i> (13) (1995)	Knitted Dacron, velour, ringed, femoro-popliteal	Middle segment of the prosthesis	Resection of the aneurysm & ilio-popliteal knitted Dacron-bypass
Abu Rahma <i>et De Luca</i> (1) (1995)	Knitted Dacron, velour, ringed, femoro-popliteal	2 cm above the popliteal anastomosis	Resection of the prosthesis, replacement by PTFE

Vrancken Peeters <i>et al.</i> (21) (1996)	Knitted Dacron, femoro-popliteal	middle of the prosthesis	Dacron interponate
	Knitted Dacron, femoro-popliteal	5 cm distal from the proximal anastomosis	Dacron interponate
	Knitted Dacron, femoro-popliteal	Middle segment of the prosthesis	Replacment of the bypass
Irace <i>et al.</i> (6) (1999)	Knitted Polyester, aorto-bifemoral	Right prosthetic branch	Dacron interponate
Arvaniti <i>et al.</i> (3) (2001)	Knitted Dacron, double-velour, femoro-popliteal	Middle third of the right thigh	Removal of the prosthesis, replacement with PTFE
	Knitted Dacron, femoro-popliteal	10 cm below the proximal anastomosis	Dacron interponate
Ofer <i>et al.</i> (11) (2001)	Dacron, aorto-bifemoral	middle left prosthetic leg	Stent graft
Illuminati <i>et al.</i> (5) (2001)	Dacron, aorto-bifemoral	Above the femoral anastomosis	PTFE interponate
Khaira <i>et Vohra</i> (8, 9) (2001/2002)	Knitted Dacron, femoro-popliteal	Middle segment of the prosthesis	Dacron interponate
Opsommer <i>et Fastrez</i> (12) (2002)	Knitted Dacron, iliaco-femoral	Middle segment of the prosthesis	Dacron interponate
Shingu <i>et al.</i> (17) (2005)	Knitted Dacron, aorto-bifemoral	Both prosthetic branches	Dacron interponate
Van Damme <i>et al.</i> (20) (2005)	5x Knitted Dacron, doubles velour, 1xWoven-Knitted Dacron, 4 x femoro-popliteal, 1x femoro-femoral, 1x aorto bifemoral	Middle segemtn of the thigh, supra pubic, right lower quadrant of the abdomen	2x partial removal, 4x complete removal
Alexandrescu <i>et al.</i> (2) (2008)	Dacron aorto-bifemoral	Right prosthetic branch	Stent graft
Ryogo <i>et al.</i> (16) (2011)	Knitted Dacron, doubles velour, aorto-bifemoral	Left prosthetic branch	ePTFE interponate
Shirashi <i>et al.</i> (18, 19) (2012)	Woven Dacron, axillo-bifemoral	Below the proximal anastomosis	Dacron interponate
Kawajiri <i>et al.</i> (7) (2014)	Knitted Polyester, double velour, aorto-bifemoral	Left prosthetic branch	Ringed and woven Dacron interponate
Yamamoto <i>et al</i> (23) (2014)	Knitted Dacron, axillo-femoral	Chest-abdomen	Complete replacement
	Knitted Dacron, double velour, subclavio-aortal	Thoracic cavity	Complete replacement
	Knitted Dacron, Single velour, aorto-femoral	Inguinal	Partial Replacement
	Knitted Dacron, double velour, femoro-popliteal	femoral	Complete replacement
	Knitted Dacron, double velour, femoro-femoral	Lower abdomen	Partial replacement
	Knitted Dacron, double velour, femoro-femoral	Lower Abdomen	Partial replacement
	Knitted Dacron, double velour, aorto-iliac	Retroperitoneal cavity	Partial replacement
Woźniak <i>et al.</i> (22) (2016)	Knitted Dacron, femoro-popliteal	Left mid-thigh	Replacement with venous graft
Miyake <i>et al.</i> (10) (2016)	Ringed Dacron prosthesis, axillo-bifemoral	Left abdomen 10 cm below the costal arch	ePTFE interponate

Table 1: List of complications and derived measures of vascular reconstruction-associated aneurysms (chronological order)

The type of therapy must certainly be adapted to the condition and comorbidities of the patient. However, in the literature review on the morphological changes of the Dacron prostheses in the long- term run, the explantation of the entire prosthesis and the creation of a new prosthesis seem to be the most appropriate approach. In this context, the exploration effort with a distinct wound area has to be balanced with possible complications (such as hematoma and wound infection). The endovascular procedures with the possibility of therapy under local anesthesia are most suitable for patients with severe comorbidities and high surgical risk. In general, an exact evaluation of a full-length prosthetic bypass (by means of clinical examination and duplex ultra-sonography, possibly as complementary measures to CT/MR angiography) is recommended after more than 10 years of implantation. Consequently, detected aneurysms should be treated early.

Summary

Non-anastomotic aneurysms of Dacron-prostheses in the periphery are rare and occur most often after more than 10 years after its previous implantation, so this complication should be seriously considered after this period of time. The cause is usually the formation of a pseudoaneurysm by structural defects in the Dacron "tissue" (such as multiple filament alterations). The complex mechanical stress of bypasses in the femoro-popliteal area could explain the accumulation of prosthesis degeneration with formation of prosthetic aneurysms here. Revision surgery and iatrogenic surgery-related influences seem to play rather a minor role. The occurrence of several aneurysms in the structurally weakened Dacron tissue is probable, which should be taken into account in the choice of the reconstruction method. Endovascular therapy offers a patient-friendly alternative, especially in cases of significant comorbidities.

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