

PATHOLOGICAL CONSIDERATIONS OF REOPERATIVE VASCULAR PATIENTS

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ABSTRACT

Since vascular disease is always progressive and a perfect vascular prosthesis has yet to be developed, postoperative complications are almost inevitable. In this paper, case histories of those who had to have a second operation or, in other words, re-operated patients, have been examined to ascertain the current problems in vascular surgery.

Of 176 vascular reconstructive operations performed between January 1, 1980, and December 31, 1986, 29 re-operations were performed on 19 patients (mean age: 64 years; 15: male). The incidence of late graft failures was 8.4% and, of these, anastomotic aneurysms seemed to be the most serious complication (3.1% incidence rate).

Late graft failures included intimal hyperplasia, occurring within two years in five cases, and four cases of progressing atherosclerosis, which appeared three years after the initial operation.

In all cases of anastomotic aneurysm, arterial wall failure, possibly combined with the changing of implanted grafts, was considered to be related to the false aneurysmal formation. Knitted Dacron demonstrated susceptibility to atherosclerotic progression, whereas the major fault of polytetrafluoroethylene (PTFE) grafts was the insufficiency of the anastomotic diameter.

In conclusion, it was revealed that many factors can provoke late graft failure. Improvement of long-term patency seems to be achieved by a more increased understanding of the pathological meaning of these factors, along with the proper application of medical techniques suited to the causes of vascular obstruction.

Key words: Late graft failure, Intimal hyperplasia, Progressing atherosclerosis, Anastomotic aneurysm.

INTRODUCTION

After vascular reconstructive operations, various complications inevitably occur. The reasons why these complications occur so late in certain cases is that the vascular disease, especially atherosclerosis, always progresses and that no ideal prosthesis has yet been developed. Recent improvements in surgical instruments, vascular grafts and postoperative medications, such as anti-platelet agents, have made the incidence of complications de-

cline. Still, various late complications that often develop can cause problems for both the patients and their vascular surgeons.

In this paper, we reviewed the cases that required a re-operation, assessing by post-operative angiographies, intra-operative findings and pathological observations to reveal the etiological factors involved in late graft failure.

MATERIALS AND METHODS

One hundred and seventy-six vascular reconstructive operations were performed

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at Tokyo Medical and Dental University Hospital between January 1, 1980, and December 31, 1986. Of these, 109 operations involved arteriosclerosis obliterans (ASO); three involved thromboangiitis obliterans (TAO); 51 involved aortic or peripheral aneurysms; and 13 other diseases. The initial operations were as follows: bifurcated graft replacements in 49 cases; ilio-femoral bypasses in 27 cases; femoro-popliteal bypasses in 18 cases; extra-anatomic bypasses in 40 cases; and ilio-femoral thromboendarterectomies (TEA) in 13 cases.

When some of these patients, later being treated on an outpatient basis, complained of intermittent claudication or their ankle pressure index became lower, angiography was performed to reveal the causative factors. The angiographic appearance of atherosclerosis consisted of an irregularity of the luminal surface, located at the proximal or distal site of the grafts, or on the opposite leg. Intimal hyperplasia showed a smooth narrowing of the lumen at the anastomotic site.

Out of a total of 176 vascular reconstructive operations, 29 re-operations had to be performed on 19 patients. Their mean age was 64 years and 15 were male. We analyzed these re-operations in the light of the following major etiological factors: atherosclerotic progression, intimal hyperplasia and anastomotic breakdown. When

two or more factors were involved in a given case, only the major complication was considered as a cause.

Of 29 re-operations, one thrombosed polytetrafluoroethylene (PTFE), one dilated Dacron and one autovein graft were harvested at the time of the re-operation. Specimens were embedded in paraffin and dyed with Elastica van Gieson and hematoxylin eosin stains.

RESULTS

Fifteen re-operations were performed because of late graft failure and 14 other re-operations because of anastomotic aneurysm. The incidence of late graft failure was 8.4% (15/178 cases) and that of anastomotic aneurysm represented 3.1% (14 anastomotic aneurysms/453 anastomoses).

Late graft failure occurred because of intimal hyperplasia (IH) in five cases, progressing atherosclerosis (PA) in four and other various factors in the remaining cases.

I. Intimal hyperplasia (IH)

All five cases of intimal hyperplasia occurred within the first two years (Table 1). Four cases suffered from IH at the distal anastomotic site and one case at the proximal site. The forms of anastomosis were end-to-side in four cases and end-to-end anastomosis in one case. Three operations were performed with Dacron graft

Table 1. Etiological Factors of Late Graft Failure in Reoperative Patients

Etiological factor	Total No. of cases	Time of onset (months)
Anastomotic neointimal fibrous hyperplasia	5	16
Progressing atherosclerosis	4	57
Dissection of intimal plaque	1	8
Intimal thickening of vein grafts	1	5
External compression of musculofascial bands	1	3
Others (including unknown cause)	3	10
Total	15	23

prostheses and two with polytetrafluoroethylene (PTFE) grafts. The angiographic appearance consisted of a smooth narrowing of the lumen at the anastomotic site.

II. Atherosclerotic progression

Progressing atherosclerosis produced late graft failure in four cases. In all these cases, signs of PA began to appear more than three years after the initial operation. PA in two cases developed in the opposite unoperated leg, and in the other cases it occurred at the distal site of the graft insertion. Angiographically, this PA showed an irregularity of the luminal surface.

III. Anastomotic breakdown

During the same above-mentioned period, 453 anastomoses were performed resulting in 14 cases of anastomotic aneurysms, which represent a 3.1 percent rate of incidence. The initial operations are shown in Table 2 and the thromboendarterectomies (TEA) at the anastomotic site were done in seven of these cases of anastomosis (50%). The graft materials

used were as follows: knitted Dacron in 12 anastomoses, PTFE in one and autovein in one. None of the fabric prosthesis used, such as knitted Dacron and the PTFE graft, deteriorated.

The time from the initial operation to the anastomotic aneurysm repair ranged from one month to 79 months (mean: 28 months). With the exception of patient number three, this span ranged from 25 months to 79 months (mean: 55 months). With regard to this patient, the aneurysmal formation appeared within eight months after the original operation. An abnormal reaction to the fabric prosthesis and a graft infection were considered to be the etiological factors of this patient's early aneurysmal formation.

All patients reconstructed with fabric prostheses formed false aneurysms due to arterial wall failure. In the case of patient number six, in which patch angioplasty and TEA had been performed with an autovein, the endarterectomized arterial wall deteriorated and dilated, thus a true aneurysmal formation resulted.

Table 2. Anastomotic Aneurysmal Formation in Reoperative Patients

Case	Initial operation	Graft material	Suture material	Time after 1st ope.	Location
1	Axillo-femoral bypass TEA	Dacron	Ethibond	73 mon.	Groin
2	Y-graft replacement TEA	Dacron	Ethibond	27	Left groin
				42	Right groin
3	Y-graft replacement	Dacron	Ethibond	2	Abdominal
	Axillo-bifemoral bypass	Dacron	Ethibond	4	Groin
	Axillo-bifemoral bypass	Dacron	Ethibond	5	Groin
	Femoro-femoral bypass	Dacron	Ethibond	1	Groin
	Axillo-femoral bypass	Dacron	Ethibond	1	Groin
	Axillo-femoral bypass	PTFE	Ethibond	8	Axillary
4	Aortorenal bypass	Dacron	Ethibond	25	Abdominal
					Renal
5	Iliofemoral bypass TEA	Dacron	Ethibond	70	Groin
6	Patch angioplasty TEA	Autovein	Ethibond	79	Popliteal
7	Y-graft replacement TEA	Dacron	Ethibond	33	Bil. groin

1. TEA: Thromboendarterectomy.

2. PTFE: Polytetrafluoroethylene.

IV. Other various factors

Other various factors in graft failures included dissection of intimal plaque, intimal thickening of vein grafts and the external compression of musculofascial bands, which frequently occurred earlier than the manifestation of either IH or PA, appearing in three to eight months after the initial operation.

CASE REPORTS

Case 1: A 58-year-old male was admitted, complaining of intermittent claudication (300m). We performed a right femoro-popliteal bypass with a PTFE graft and thromboendarterectomized the right common femoral artery. Six months later he again visited our hospital, complaining of numbness in his right lower extremity. Examination revealed proximal and distal anastomotic stenoses and a thrombosed graft. We resected the proximal stenosis, replacing it with a new PTFE graft, and inserted a new autogenous vein graft from the thrombectomized graft to the distal part of the popliteal artery. After reoperation, he seemed to be free from further symptoms. Histological examination of the resected material from the proximal anastomotic area showed a

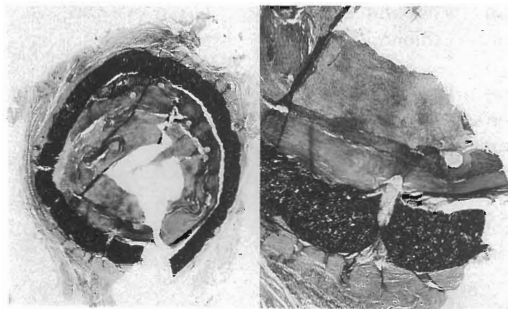


Fig. 1. Left photograph shows the intimal thickening of the proximal anastomotic site by the low-magnified microscopic view. At the right side, intimal thickening is composed of myofibroblasts and collagen fibers (Elastica van Gieson staining $\times 21$).

marked intimal hyperplasia, which had decreased the luminal size to 25% or less. The intimal hyperplasia was composed of myofibroblasts and collagen fibers, which were oriented parallel to the internal contour of the grafts. (Fig. 1)

Case 2: A 61-year-old male was admitted because of coldness in the left lower limb. A left aorto-femoral bypass using knitted Dacron was performed without early post-operative complication. Five years later, he discovered a pulsating mass in the left groin. Angiography showed that the distal anastomotic region was dilating irregularly. Diagnosed as having an anastomotic aneurysm, he underwent re-operated surgery. It turned out to be a false aneurysm due to arterial wall failure, which showed dehiscence of the anastomosis with the suture material having broken free from the host artery (Fig. 2). A resection of the false aneurysm and a replacement with a PTFE graft with rings were performed. After this re-operation, the patient became asymptomatic. Histological findings revealed many foreign body-type giant cells clustering at-and small vessels proliferating around-the vascular

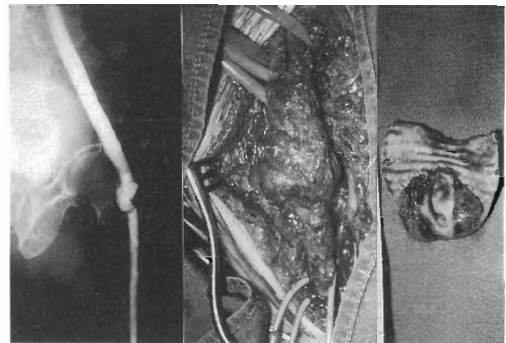


Fig. 2. Left: Angiography shows the anastomotic aneurysm in the groin. Middle: Intraoperative photograph demonstrates the false aneurysm at the distal anastomotic site. Right: Resected specimen reveals that false aneurysm resulted from the arterial wall failure, in which the suture material became free from the host artery.

prosthesis, and an intimal hyperplasia of the luminal region as well.

DISCUSSION

Bernhard [1] defined ordinary late graft failure as an occlusion that occurs more than 30 days following surgery. He also stated that late graft failure can be classified into various types: intimal hyperplasia (IH), progressing atherosclerosis (PA), dissection of intimal plaque, intimal thickening of vein grafts, external compression of musculofascial bands, etc.

The most common cause of late graft failure seems to be IH, which appears within the first two years. Szilagyi [2] described a 2.7% incidence of late anastomotic stenosis caused by intimal thickening in 561 Dacron bypass graftings. Imparato [3] also reported that IH was the cause of at least one-third of all late failure of various types of bypasses and endarterectomies. According to LoGerfo [4], IH is significantly greater at the distal anastomosis; his discovery was made during an experimental study in which 28 femoro-femoral Dacron Grafts were implanted in dogs.

Further, Sottiurai [5] studied the distal anastomoses of thrombosed grafts in humans. IH was found in six of 11 vein grafts and in all prosthetic grafts. IH was found predominantly at the heel and toe of the distal anastomoses and in the floor of the host arteries opposite to the anastomosis. The sites of the formation of IH can be correlated with the boundary layer separation zones, according to a study of LoGerfo [6]. The pathologic changes were found to be myocyte degeneration, myofibroblast proliferation and fibrous matrix accumulation beneath the endothelium. Complete endothelial coverage was routinely found in the vein grafts but only evidenced at the anastomotic site when prosthetic grafts were used.

Progressing atherosclerosis advances insidiously and most commonly occurs after two years. Warren [7] has shown that the restoration or hypertensive pulsatile arterial flow into the previously-protected vascular bed beyond the obstructed artery may accelerate progressing atherosclerosis in the distal run-off circulation. Our case evidence agrees with these findings.

Other important factors include hyperlipidemia [8], cigarette smoking [9] and obesity. Dissection of intimal plaque, intimal thickening of vein grafts and the external compression of musculofascial bands occurred earlier than either IH or PA [10]. Therefore, these latter three factors do not seem to be the result of atherosclerotic change, but rather, seem to be related with the operation technique and vein graft harvesting.

In this paper, the incidence of anastomotic aneurysm was 3.1%. Szilagyi [11] reported an incidence of 1.7% in 9561 arterial anastomoses and Evans [12] described an incidence of 2.8% in approximately 2500 femoral anastomoses. The cause of anastomotic false aneurysm can be divided into three types, according to the site of failure: 1) arterial wall failure, 2) graft failure and 3) suture material failure. Evans [12] revealed that 71% of anastomotic femoral false aneurysms resulted from arterial wall failure. These arterial wall failures showed dehiscence of the anastomoses in which the suture material freed itself from the host artery. In our study, all cases in which a fabric prosthesis has been used formed false aneurysms. In addition, marked atherosclerosis, aortitis and thromboendarterectomized arteries may have aggravated the arterial wall failure. However, graft shortening, mechanical stress on the anastomotic site and compliance difference in delayed healing of the graft also may be responsible for the anastomotic breakdown. In the suturing of

the TEA area, Dacron sutures seem to be too strong for the arterial wall and, therefore, the use of a more elastic suture material might be advised.

The most common site of anastomotic aneurysm is the common femoral artery, probably because of the mechanical stress caused by the hip joint movement. The mechanical stress to the anastomotic point seems to become appreciably greater when the thigh is moved into the position of flexion greater than 60 to 70 degrees [11]. In order to prevent the tension on the suture line in the groin region, the patient should be prohibited from over-flexing the hip joint for at least several years.

CONCLUSION

Of 176 vascular reconstructive operations during the last seven years, 29 re-operations were necessary for 19 patients. Fifteen re-operations were performed because of late graft failure and 14 because of anastomotic aneurysm. The incidence of late graft failure was 8.4% (15/178 cases) and that of anastomotic aneurysm amounted to 3.1% (14 anastomotic aneurysms/453 anastomoses).

Late graft failure occurred because of intimal hyperplasia (IH) in five cases and progressing atherosclerosis (PA) in four. All five cases of IH occurred within the first two years. IH seemed apt to occur at the distal anastomosis and in end-to-side anastomosis. PA usually appeared three years after the initial operation.

The time from initial operation to anastomotic aneurysm repair ranged from one month to 79 months (mean: 28 months). All patients that had been reconstructed with fabric prostheses formed false aneurysms due to arterial wall failure. Marked atherosclerosis, aortitis and thromboendarterectomized arteries may have aggravated this arterial wall failure. However, graft shortening, mechanical

stress on the anastomotic site and the compliance difference in delayed healing of the graft may be responsible for the anastomotic breakdown as well.

Other various factors, such as dissection of the intimal plaque, intimal thickening of vein grafts and the external compression of musculofascial bands, occurred earlier than either IH or PA. Therefore, these latter three factors do not seem to be the result of atherosclerotic change but would seem to be related to the operation technique and the vein graft harvesting.

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