Limb salvage by femoral profundaplasty

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Summary

One hundred and seven profundaplasties have been performed for rest pain or gangrene due to advanced arterial degeneration below the inguinal ligament. Local anaesthesia was used for 78 operations. There were 19 early failures (2 deaths and 17 amputations) and 16 later amputations. During 4.5 years of follow-up, 25 other patients have died. The results for diabetic gangrene were worse than for other indications.

Introduction

An isolated occlusion of a main artery in the lower limb may cause no symptoms or, at most, intermittent claudication controllable without operation. Limb-threatening ischaemia is usually due to a combination of femoropopliteal occlusion, and stenosis or obstruction of iliac, tibial, or pedal arteries. The most important collateral in the lower limb is the profunda femoris and inadequate blood flow through this artery aggravates ischaemia due to main vessel disease. Sometimes the upper end of the profunda is narrowed, or even occluded, by thrombo-atheroma. In other cases there is no obvious stenosis of the common profunda junction on arteriography or at operation and yet, if the blood flow through the profunda can be increased, the supply to the foot may be improved.

Waibel (1966) published an early account of reconstruction of the origin of the profunda femoris using a patch taken from the occluded superficial femoral artery. Martin, Renwick and Stephenson (1968) described the operation of vein-patch profundaplasty and Cotton and Roberts (1975) found that a longer incision into the profunda, and closure with either a vein or a Dacron patch, was also successful in relieving ischaemia.

Since 1973, the author has preferred venous or arterial patch profundaplasty to femoropopliteal bypass grafting for patients with rest pain or gangrene. If preliminary clinical or arteriographic investigation revealed significant additional aorto-iliac disease he combined it with another procedure, usually an aorto-iliac or femoro-femoral bypass graft. These patients are not further considered in this paper.

Definitions

Patients with **rest pain** presented with pain which interfered with sleep, together with ischaemic changes in the foot. When skin loss was present in addition, **gangrene** was diagnosed.

The **pulse index** was the ratio of ankle to brachial systolic pressure, both measured ultrasonically.

Fluid discharging from any wound was classified as serosanguinous, lymph or pus, and **sepsis** (usually secondary) was further divided into **major** (which required surgical intervention) and **minor** (which healed spontaneously).

Obesity was a thickness of subcutaneous fat, measured with a sterile ruler at the site of incision, of 2.5 cm or more.

Failure was classified as early (death or major amputation within 3 months) or late (major amputation after this time).

Patients and methods

One hundred patients presenting with rest pain or gangrene have had 107 profundaplasties, 78 under local anaesthesia. All patients are seen at 6-monthly intervals until their death. Sixty-six men and 34 women underwent operations. Their ages ranged from 48 to 94 years, 50% being over the age of 70 years. Eighty-eight per cent of the men and 23% of the women smoked; 25% were diabetic.

The patch to enlarge the common femoral bifurcation and the upper profunda artery was taken either from the superficial femoral (46 operations) or the saphenous vein (60 operations). In one case a piece of Dacron was used.

Infective gangrene with spreading cellulitis was treated conservatively until the infection was contained. If antibiotic treatment failed, major amputation was performed. Of 120 patients presenting with gangrene during this time, 50% were treated by profundaplasty.

In the early stages, the author relied on arteriographic evidence of profunda stenosis to indicate the probability of improvement from the operation. He found, however, that an apparently normal profunda origin on an arteriogram was no guarantee that the vessel would be normal at operation, and

only 44 of the 107 were subjected to aortography or femoral arteriography.

The technique of the operation has evolved gradually, but is now as follows:

Following cardio-respiratory assessment and estimation of the pulse index, the patient receives 5000 u. of heparin in 0.2 ml subcutaneously 2 hr before operation (and then twice daily for 6 days). At the same time, a total of 2 ml of a mixture of Disulphine Blue (I.C.I. Ltd) and 2% lignocaine is injected subcutaneously in divided doses into the webs between the toes on the affected side, avoiding areas of gangrene. The dye stains lymph vessels and nodes in the groin, making them easy to recognize and avoid, thus abolishing the risk of postoperative lymph fistulae. In patients with gangrene, penicillin one megaunit is injected twice daily for 5 days as a prophylactic agent against endogenous clostridial infection.

Premedication is by an i.m. injection of papaveretum 20 mg, and further sedation is given immediately before operation by intravenous diazepam 10 mg. Arterial clotting is reduced by i.v. heparin 5000 u. Local infiltration anaesthesia is by injection of up to 40 ml of 1% lignocaine.

The common, superficial and profunda femoris arteries are exposed by a vertical incision 10–15 cm long and lymphatic structures avoided, ligated or sealed by surgical diathermy. The upper 4–7 cm of the profunda is exposed by dividing veins (including the profunda vein) and opened longitudinally. In nearly all cases a soft segment of artery can be found several centimetres below the common femoral bifurcation and below at least two of the major circumflex branches.

If the superficial femoral is totally occluded it is divided near the lower end of the incision, incised longitudinally, and used (after removal of thrombus and intima) for the profundaplasty patch, without detaching it from the common femoral artery. If the superficial femoral is patent, a segment of the long saphenous vein is removed from the inner side of the incision, opened and used reversed for the patch.

Gross atherosclerotic compromise of the common or profunda femoris is dealt with by limited endarterectomy, and the arterial or vein patch sutured to the sides of the profunda incision to enlarge its upper 4–7 cm. The incision is closed, with suction drainage for 48 hr.

Results

One hundred patients (12 of whom had previously had lumbar sympathectomies) underwent 107 profundaplasties. The pre-operative ankle systolic pressure index did not correlate consistently with the clinical state. In patients with rest pain alone the mean resting ankle systolic pressure index ($\pm$ s.d.)

was 0.35 ± 0.24 and in patients with gangrene 0.23 ± 0.26 . The difference is not statistically significant.

There were 19 early failures (2 deaths and 17 amputations) and 16 later amputations. Twenty-five other patients (28 operations) have died, 23 of cardiovascular disease and 2 of carcinomatosis, during the 4.5 years of follow-up. The results in the remainder are satisfactory so far.

The worst outlook was for diabetic patients presenting with gangrene (group I). There were 17 of these, only 3 of whom are alive after 2 years. Eight required major amputation within 3 months (47% failure rate); 2 who had an initially favourable result needed amputation later and 4 other patients died of cardiovascular disease within one year.

Forty-four non-diabetic patients presented with gangrene (group II). One patient died on the twenty-first day of a cardiac infarct, and eight required major amputation within 3 months (total failure rate 21%). Ten patients with an initially good result came to amputation later, 12 died within one year and one died later. Twelve patients survive – the longest being 4.5 years – their gangrene having healed either spontaneously or after conservative amputation.

The results in group III, who presented with rest pain without gangrene (9 diabetics and 37 non-diabetics), were better. The initial failure rate was 4% (one patient dying of a secondary haemorrhage on the twenty-fourth day and the other requiring a major amputation within 3 months). Of the remaining 44 patients with an initially satisfactory result, 4 required amputation later, 4 died within one year and 7 died later. Twenty-nine patients survive, 7 of whom have been followed-up for at least 4.5 years.

In groups I and III, the presence or absence of stenosis of the profunda femoris lumen made little difference to the results. There were 3 early amputations after 5 operations for diabetic gangrene in which the lumen was compromised (60%) compared with 5 early amputations after 12 operations (42%) in which no compromise was found. In the rest pain group there was only one early amputation and this was on a patient without stenosis of the profunda. In non-diabetic patients with gangrene (group II), on the other hand, the results of profundaplasty were worse in those in whom there was no compromise. Three patients out of 29 with a stenosing lesion (10%), compared with 5 out of 15 (33%) without, came to early amputation ($\chi^2 = 3.5$, $P < 0.10$).

The length of patch influenced the outcome of profundaplasty for gangrene. The ideal length of patch was 4–7 cm. Longer and shorter patches had higher rates of primary failure, although the differences were not statistically significant.

All 12 patients who had previously had a lumbar sympathectomy enjoyed good immediate results from profundaplasty, although 4 later needed major amputation and 3 others died.

Changes in ankle systolic pressure index after profundaplasty were found to be a good guide to the initial success or failure of the operation (Fernandez *et al.*, 1976). Of 8 patients who came to early amputation the index rose in only one, whereas of 36 patients who had an immediately satisfactory result the index rose in 33 ($\chi^2=23.4$, $P<0.001$).

The vertical groin wound discharged fluid in 34 cases (32%). Before the introduction of colour lymphography, 5 wounds discharged lymph but this complication has not been seen since. Of the 34 wounds which discharged, 18 (17%) acquired a secondary infection from the ward environment resulting in minor sepsis in 15 and major sepsis in 3. Small sloughs formed in the middle of two wounds which were probably due to the use of self-retaining retractors. Secondary wound sepsis was not related to the use of local anaesthesia but was more common in diabetics and the obese.

Discussion

Many of the patients in this series were elderly and infirm with multiple arterial occlusions, often poor cardiac and respiratory function (which is why the author now prefers local anaesthesia) and the alternative for most of them was a major amputation.

Despite 2 early deaths and 17 amputations, it is clear that arterial or vein-patch profundaplasty has salvaged many limbs and postponed amputation in others. The results in diabetic patients with gangrene were much worse than those in non-diabetics, and this may reflect the higher incidence of small vessel disease in the former.

Hill and Jamieson (1977) studied a somewhat different group as 38 of their 45 operations were combined with proximal aorto-iliac reconstructive surgery. Seven of their patients died early and 9 of the limbs subsequently came to amputation.

Modgill *et al.* (1977) reported the results of profundaplasty in 13 patients with gangrene and 24 with rest pain, only 3 of whom were diabetic. Seven of the 13 operations for gangrene, and 20 of the 24 for rest pain, were successful.

The place of profundaplasty vis-à-vis femoropopliteal bypass grafting has not been defined, and a controlled trial of the two operations for patients who might otherwise require amputation needs to be undertaken before the question can be answered. That the good results of profundaplasty do not depend on the 'peri-arterial sympathectomy' incidental to the dissection of the femoral arteries is shown by the improvement in the 12 patients who had previously had a lumbar sympathectomy.

In the present series, profundaplasties were done even in the absence of obvious stenosis of the profunda origin, and the results in this group were not much worse than those done when stenosis was present. The ability of this operation to improve the circulation in some patients without arteriographic or operative evidence of compromise of the profunda has also been mentioned by Ward and Morris-Jones (1977) although they were able to relieve rest pain in only 10 of 25 patients.

Conclusion

Profundaplasty is a viable alternative to major amputation for gross ischaemia and gangrene in the elderly and infirm.

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