USE OF GRAFTS IN TREATMENT OF ATHEROSCLEROSIS OF LOWER LIMBS*

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The problem of arterial obstruction due to atheroma is an exceedingly common one and the present communication describes the results of a small series of cases in which arterial grafting was employed in an effort to restore the circulation in the legs.

Present Series of Cases

Twenty-nine segmental obstructions due to atheroma have been treated by grafting. Twenty-five grafts consisted of homologous adult arteries, two were of homologous foetal aorta, and two were of autogenous saphenous veins. The homologous arteries were mostly prepared by quick freezing and stored at $-79^{\circ}\text{C}.$, but a few were freeze-dried.

The operations were performed for intermittent claudication severe enough to keep a man from his work and for rest pain associated with minor degrees of necrosis. In advanced gangrene the segmental obstruction is always associated with widespread occlusive disease in the small arteries, and although grafting the femoral block was tried in a few cases the distal disease prevented significant improvement in the circulation.

Mortality.—Two patients with generalized disease and advanced gangrene died of coronary thrombosis, and one patient died of haemorrhage due to a leak from the suture line of an iliac graft while on heparin. This gives a mortality of 10%; however, patients with generalized disease and gangrene would now be regarded as unsuitable, and heparin was used only in a few early cases. With proper selection the mortality should be negligible.

Early Thrombosis

No case of iliac artery or proximal femoral graft was complicated by early thrombosis. However, in the lower femoral and popliteal arteries the reduced flow and increased technical difficulties combine to give a high initial failure rate. Rate of flow is the most important factor in post-operative thrombosis, and narrowing of the artery proximal or distal to the site of the proposed graft is an absolute contraindication. One important exception is the patient with blocks in the iliac and femoral arteries. Here an iliac graft is likely to succeed because the profunda femoris flow will be sufficient to keep the graft patent. On the other hand, to graft the femoral artery in such a case would be to invite certain failure. In the present series there was an immediate thrombosis rate of 50% in grafts of the lower femoral and popliteal arteries, but no graft of the iliac or proximal femoral artery thrombosed in the immediate post-operative period. Provided scrupulous care is taken to avoid injury to the collateral vessels, the price of failure is small. Indeed, some patients claim subjective benefit, though I have not seen objective improvement in the limb after excision of a segment of artery which was thrombosed secondary to atherosclerosis.

The end-to-end technique was used in all cases. Theoretical considerations suggest that the end-to-side operation may be less liable to immediate thrombosis. A patch of host artery free from disease can usually be found on which to

do an anastomosis, but it is rare to find a piece of artery in which the whole circumference is free enough of disease to permit accurate suturing. In addition, when the graft is sutured to the side of the host artery no collaterals at all need be jeopardized, and should early thrombosis of the graft take place the circulation will not be reduced.

Late Results

In seven patients the peripheral pulses became impalpable 6 to 17 months after a successful grafting operation (Fig. 1). In three of these the original operation had been done for rest pain. Two returned to their pre-operative status and amputation was eventually necessary. The third has only mild intermittent claudication and still believes he has

FIG. 1.—Late results of grafting.

derived benefit. In four patients the graft was done for claudication; these have returned to their pre-operative status and have had to find restricted employment. In only two patients were further arteriograms considered advisable, and in these the grafts were found to be thrombosed.

Case 1.—A milk roundsman aged 58 was prevented from working by intermittent claudication. Examination showed that his symptom was due to an atheromatous obstruction of the left superficial femoral artery, and this was confirmed by an arteriogram (Fig. 2, a). There was no evidence of severe generalized atheroma, and he was otherwise healthy. A homologous graft 6 in. (15 cm.) long was inserted on December 16, 1953. There was an immediate return of the posterior tibial pulse, and he returned to work as a milk roundsman walking 10 miles a day. Six months later the symptom of claudication recurred and he had returned to his pre-operative status. An arteriogram (Fig. 2, c) showed that the graft had thrombosed and that the femoral artery had thrombosed up to its profunda branch.

This extension of the thrombus is due to the fact that only tiny branches came off the proximal femoral artery, and once the graft is thrombosed the main artery flow is determined by the amount of blood which can get away in the branches. The main collateral supply is carried on through the profunda femoris artery and thrombosis never extends above its origin.

Case 2.—A man aged 64 had calf and thigh claudication. The clinical diagnosis of obstruction of the external iliac artery was confirmed by aortography and the patient was successfully treated on August 19, 1952, by the insertion of an arterial graft. This case was described in detail in an account of aortography (Horton and Nanson, 1953). In February, 1954, 17 months after operation, he noticed a numb feeling in the foot on rising. Clinical examination and aortography showed that the graft had thrombosed (Fig. 3).

This is the only case in which thrombosis of an iliac artery graft has taken place. The thrombosis was confined to the length of the graft because the flow in the internal iliac artery proximally and the profunda femoris artery distally

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FIG. 2.—Case 1. (a) Pre-operative arteriogram. (b) Post-operative arteriogram. (c) Arteriogram six months later, after recurrence of symptoms.

prevented spread. The aortogram shows that during the 17 months of patency of the graft no regression of the collaterals took place. There was some increase of disease in the common iliac artery, which is narrowed by comparison with the pre-operative film, and the reduced flow occasioned by this may have determined the thrombosis.

Discussion

Such poor results make it necessary to reconsider what place arterial grafting has in the treatment of arterial obstruction due to atherosclerosis. It is certain that early hopes that it would have an important place have not been realized. Grafts should be employed only in patients with claudication severe enough to prevent them from working and in patients with minor degrees of ischaemia associated

with severe rest pain. In each group a very careful assessment is required before a graft is attempted. The patient must be free from atheroma in the coronary and cerebral circulations as judged by symptoms and E.C.G., and with careful selection the mortality should be negligible. In addition, the local situation must be suitable for a graft. When the results of iliac and proximal femoral artery grafts are compared with those of distal femoral and popliteal artery grafts a striking difference is apparent (see Table).

The high rate of initial thrombosis in this series may be explained in part by technical inexperience and by the selection of cases now known to be unsuitable. In spite of this an immediate thrombosis rate of some 30% may be expected in grafting femoral and popliteal arteries which are atheromatous, and to this must be added a further failure due to late thrombosis, which increases with the length of the follow-up period.

This failure rate leads to the inevitable conclusion that grafting of the distal femoral and popliteal arteries by this technique is not worth while, though it is possible that the end-to-side operation will give better early results. On the other hand, the results of grafting the proximal femoral and iliac arteries were much more satisfactory. There were no immediate thromboses and only one late one.

It is perhaps not surprising that the results of surgery are so poor in a disease which is so relentlessly progressive.

Comparison of Results

	No.	Early Thrombosis	Late Thrombosis
Iliac and proximal femoral artery grafts	7	Nil	1
Distal femoral and popliteal artery grafts	19	10 (50%)	6 (30%)
Died	3		

Summary

A series of 29 patients with atherosclerotic obstruction of the arteries to the lower limb have been treated by grafting and followed for periods of up to 3 years. The immediate and late results of grafting the iliac and proximal femoral arteries are compared with those of grafting the distal femoral and popliteal arteries. Excellent results have been achieved by proximal grafts, but a high initial rate of thrombosis follows grafts of the distal femoral and popliteal arteries. In addition there is a high rate of delayed thrombosis in the distal arterial grafts, and it is concluded that grafting by the end-to-end technique is not worth while beyond the proximal part of the femoral artery.

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REFERENCE

Horton, R. E., and Nanson, E. M. (1953). *British Medical Journal*, **2**, 969.

FIG. 3.—Case 2. Aortogram after thrombosis of external iliac artery graft which had been patent for 17 months.

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