

Revascularization or amputation*

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Introduction

The choice between revascularization and amputation is of great practical significance for patients with threatening ischaemia of a limb. Medical and surgical efforts should focus primarily on prevention of loss of the limb by various conservative measures and by revascularization, either by direct arterial reconstruction (disobliteration or a bypass procedure) or by indirect lumbar sympathectomy.

In spite of progress that may have been made in the technique of amputation and in prosthetics, a natural leg is in principle to be preferred to a prosthesis. Moreover, an amputee runs a fair risk of losing the other leg as well: 17% of our amputees between 1972 and 1977 had a bilateral amputation. On the other hand, efforts to save the limb should not excessively prolong the time spent in hospital. When limb salvage seems impossible, one has to opt for the less lengthy procedure of amputation followed by rehabilitation. To determine the indication for primary amputation or revascularization, numerous factors have to be taken into account (Table 1). Fixed rules about indications cannot be given, but the various considerations which play an important role in the choice between revascularization and amputation are presented and discussed.

Table 1

Factors determining the choice-revascularization or amputation

- 1) Extent of the gangrene.
- 2) Progression or regression of the ischaemia.
- 3) General condition of the patient.
- 4) Angiography.
- 5) Skill and judgment of the vascular surgeon.
- 6) Effect of revascularization.
- 7) Motivation of the patient.
- 8) Life expectancy.
- 9) Economic factors.
- 10) Quality of the limb-fitting centre.

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Fig. 1. Cases for amputation. Top, severe ischaemia with marked discoloration. Bottom, extensive gangrene.

Extent of gangrene

If there is severe irreversible ischaemia with marked discoloration of the foot and lower leg and complete loss of sensory and motion functions, it is evident that primary amputation is the only choice (Fig. 1, top). The same applies to a patient with marked and extensive gangrene (Fig. 1, bottom). In such extreme cases, the choice of amputation is not difficult.

Progression or regression of the ischaemia

Revascularization is generally unsuccessful when the gangrene extends far on the plantar or dorsal aspect of the foot, but the choice can be difficult in patients with limited gangrene

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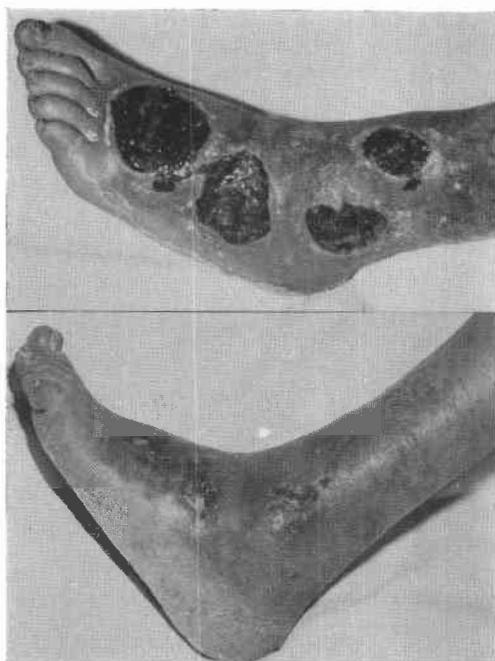


Fig. 2. Top, multiple defects and marked discolouration. Bottom, following conservative treatment, no amputation was necessary.

because it is often difficult to evaluate and predict the severity and course of ischaemia of the leg in patients with rest pains (stage III in the usual Fontaine classification of arteriosclerosis obliterans) or with limited gangrene (stage IV). It is generally advisable to continue observations on such endangered limbs for at least a few days before deciding whether revascularization can be attempted or amputation is the only choice. Figure 2, top, shows a patient with multiple defects and marked discolouration. Conservative measures were taken and the result indicates that amputation is quite unnecessary (Fig. 2, bottom).

As regards these conservative measures: elevation of the head of the bed is sometimes helpful when a patient has rest pains although analgesics are usually necessary. To improve the circulation, patients with rest pains and limited gangrene should be given Dextran by intravenous drip. The effect of a Dextran drip is often striking and dramatic. Local treatment of the gangrene is required as well. Efforts should be made to change a wet gangrene into a dry necrosis. Ointments are to be avoided in favour of a dry sterile dressing, perhaps with

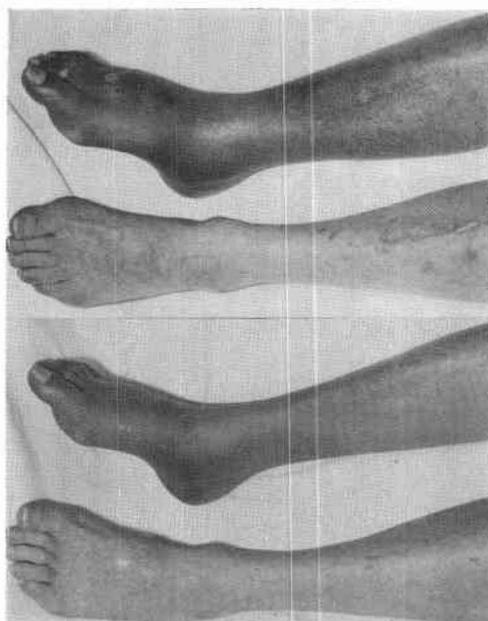


Fig. 3. Top, severe ischaemia of lower leg and foot. Above-knee amputation indicated. Bottom, following conservative treatment, below-knee amputation possible.

some neutral powder. Local surgical interventions such as incision and drainage may be required, particularly when there is infection. The infectious component of the gangrene may be as prominent as the ischaemic features especially in patients with diabetes mellitus. But in all these cases one should be very reluctant to amputate one or several toes. Physiotherapy is likewise important, to prevent and control flexion contractures. Finally one must bear in mind that, in many patients with severe ischaemia of the leg, these conservative measures can reduce the manifestations of the ischaemia (discolouration or cyanosis, oedema or lymphangitis) to a more distal level. Not infrequently it is thus possible to perform a below-knee amputation on a patient who initially seemed to require an above-knee amputation. Figure 3, top gives an example, the circulation of the lower leg is seriously impaired with violent rest pains, but after conservative treatment a below-knee amputation would appear to be suitable (Fig. 3, bottom).

General condition of the patient

The general condition of the patient also has to be evaluated and, often, improved. Ninety

per cent of all major leg amputations are performed as a result of circulatory disorders resulting from arteriosclerosis obliterans. Most of these patients are in fact of more advanced age, suffer from generalized atherosclerosis, and usually show multiple disorders. Cardiovascular and cerebrovascular disorders are common, and many patients suffer from diabetes mellitus. Operative morbidity and mortality are therefore by no means negligible. Disorders of cardiac and pulmonary function must be controlled. Dehydration, found in many older patients, must be dealt with. Diabetic patients have to be stabilized.

All in all, the operative risk must be estimated and the vascular surgeon, aided by advice from the internist or neurologist, must decide whether a patient is a suitable candidate for reconstructive vascular surgery. The risk entailed by such a vascular operation is generally not too grave (Table 2), the mortality does not exceed a few percent, and lumbar sympathectomy also carries a very low risk. The operative mortality after a major amputation is significantly higher. In some cases with a markedly increased operative risk, conventional arterial reconstruction can be replaced by an alternative procedure with a reduced operative risk (femoro-femoral bypass or axillo-bifemoral bypass).

Table 2
Operative Mortality

Arterial reconstruction	
aorto-iliac	3%
femoropopliteal	1%
Lumbar sympathectomy	1%
Amputation (BK and AK)	19%

Acceptance of a given operative risk depends not only on the severity of the ischaemia of a leg but also on the skill, philosophy and experience of a given vascular surgeon. The decision can therefore never be entirely objective, but must of necessity encompass some subjective factors.

Angiography

Angiography is used to determine technical operability in a patient considered for vascular surgery. This angiography, preferably translumbar aortography, is necessary to determine the localization and extent of the arterial obstruction, so that an operation can be properly planned. Its results determine whether a patient requires a more or a less

extensive reconstructive operation. With regard to the technical operability of an arterial obstruction, moreover, two criteria have to be fulfilled. To begin with, there should be no inflow obstruction caused by a more cranially localized obstruction, if so, latter must first be dealt with. Secondly, there should be no marked outflow obstruction, which would destroy the

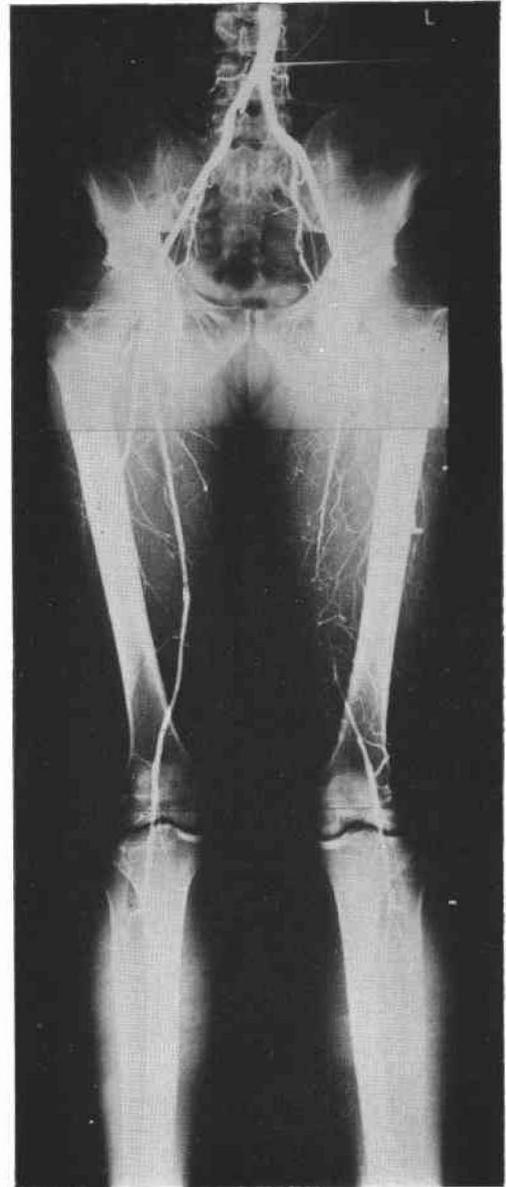


Fig. 4. Translumbar aortography showing occlusion of left superficial femoral artery with a good outflow tract.

result of an arterial reconstruction by early thrombosis.

In the presence of an aorto-iliac obstruction, revascularization to the deep femoral artery is often successful even when there are more distal obstructions. But, particularly when there is a femoro-popliteal obstruction, occlusions of several lower leg arteries may be such that circulation-improving reconstruction is impossible.

Figure 4 shows an angiogram with an occlusion of the left superficial femoral artery, but with a good popliteal artery and three lower leg arteries. In this case with a good outflow tract reconstruction is feasible. However, a superficial femoral arterial occlusion with no outflow at all is inoperable. There are only a few collaterals, but no lower leg arteries.

Skill and judgement of the vascular surgeon

Determination of technical operability in each case considered for arterial reconstruction

depends also on the experience, skill and surgical judgement of the vascular surgeon. An example of a common surgical technical problem can illustrate this. On the angiogram shown in Figure 5, there is an occlusion of the superficial femoral artery, an irregular popliteal artery and complete occlusion of two of the three lower leg arteries, only the distal segment of the anterior tibial artery still being patent. One might be ready to declare such a patient inoperable, but in this case a bypass procedure was successfully carried out, the bypass extending from the common femoral artery in the groin subfascially along the knee to the ankle, there to anastomose with the anterior tibial artery. The limb was salvaged.

The effect of revascularization

After opting in favour of a circulation-improving procedure, be it direct arterial reconstruction or a palliative lumbar sympathectomy, its effect must of course be awaited. One should bear in mind that the effect is not always immediately visible or discernible. After successful revascularization, rest pains disappear fairly quickly but necrosis cannot immediately be abolished. One must wait and see whether the necrosis is progressive or not and whether spontaneous demarcation and healing will occur. If the gangrene is progressive after a reconstruction then amputation is after all unavoidable. In all other cases however, the necessity of waiting for spontaneous demarcation of the necrosis must be emphasized. Amputation of one or several toes is in principle contra-indicated in this situation. If one waits sufficiently long (and in some cases this may mean several months), then such a mummified toe is shed spontaneously leaving no defect. A toe amputation is required only in some cases of a purely diabetic angiopathy, where there is no obstruction of the arteries of the leg and when the infection has been controlled, or after successful arterial reconstruction or effective lumbar sympathectomy when intra-articular involvement is noticed.

A few examples can illustrate the effects of revascularizing procedures. The livid discolouration of a big toe (Fig. 6, top) disappeared completely fairly soon after lumbar sympathectomy (Fig. 6, bottom). A patient with severe ischaemia of the toes and the anterior part of the foot (Fig. 7, left) had a marked improvement of



Fig. 5. Angiogram showing an occlusion of the superficial femoral artery, stenosis of the popliteal artery with only the distal part of the anterior tibial artery patent.

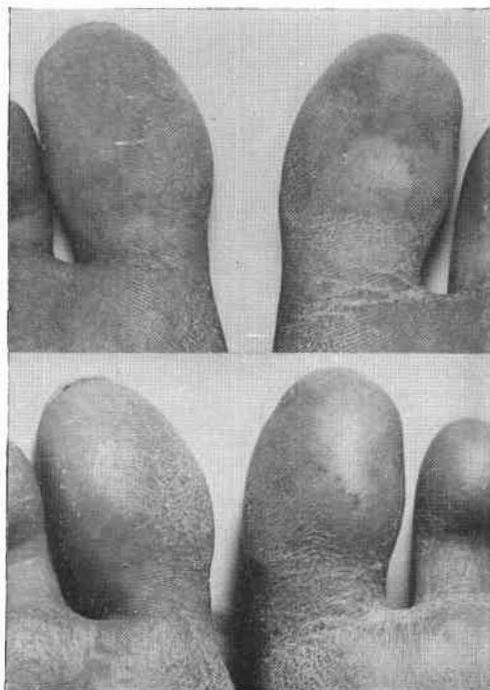


Fig. 6. Top, livid discoloration of the left big toe. Bottom, improvement following lumbar sympathectomy.



Fig. 7. Left, severe ischaemia of the toes and foot. Right, two months after femoro-popliteal arterial reconstruction. Marked improvement of circulation with necrosis confined to two toes. The limb was salvaged.

the circulation after femoro-popliteal arterial reconstruction. Necrosis was only confined to two toes and the limb was salvaged (Fig. 7, right).

Motivation of the patient

It should be realized that a limb-saving policy after arterial reconstruction or lumbar

sympathectomy cannot be continued indefinitely. A patient with limited necrosis cannot be confined to bed for an unlimited period. A time may come when protracted conservative postoperative treatment will have to be abandoned in favour of amputation with less time-consuming rehabilitation. The prospect of a long confinement in bed after successful arterial reconstruction for necrosis is accepted by some patients, but totally rejected by others. There are also patients who reject an arterial reconstruction with a risk of failure and rather opt in favour of an amputation with a relatively certain prognosis of rehabilitation. This also depends, of course, on the need of the patient for normal use of his leg which is determined not only by his previous confinement to bed (if any), but also by his age (particularly physiological age) and by his occupation and hobbies. Another important factor is the patient's willingness and ability to contribute to quick rehabilitation and limb-fitting, which is dependent on his mental attitude and the presence or absence of mental disorders. The physical capabilities of the patient also determine whether rehabilitation will be successful. Poor cardiac function or severe arthrosis can interfere with limb-fitting. And of course the patient's family plays an important role; the family can contribute to successful rehabilitation and give the patient proper support in his own environment.

Life expectancy

If severe ischaemia exists in a patient whose life expectancy is extremely short, for example due to metastatic carcinoma, then arterial reconstruction is in principle not indicated. In such cases one may decide to do a primary amputation or even no amputation at all.

Economic factors

Economic factors may also play a role in the selection of patients for revascularization or amputation. What is less expensive: arterial reconstruction followed by a fairly prolonged confinement to bed until demarcation of the necrosis occurs, or amputation followed by rehabilitation and limb-fitting? Should we, and may we in fact, take these economic aspects into account when we consider indications?

Quality of the limb-fitting centre

Finally, the patient's fate, or rather, that of his ischaemic limb, depends not only on the vascular surgeon who evaluates his case but also on the facilities available at the limb-fitting centre and the results obtained there.

Conclusion

The factors which determine the choice, revascularization or amputation of an ischaemic leg are very numerous, variable and sometimes also related. They are concerned with the extent and course of the gangrene, the general condition of the patient and the risk of operation, the technical operability in terms of arterial reconstruction, the skill and judgment of the vascular surgeon, the motivation and life expectancy of the patient, as well as the facilities at the limb-fitting centre.

In principle, arterial reconstruction should be the primary consideration in all patients

with severe ischaemia of a leg, and threatened with loss of the limb. This implies the need for evaluation by a vascular surgeon. If arterial reconstruction is impossible or undesirable and if lumbar sympathectomy is not indicated either, then if amputation is necessary it must be decided, when is it necessary, and whether a below-knee or an above-knee amputation is possible.

The patient with severe arterial circulatory disorders is best served when the vascular surgeon who is responsible for the arterial reconstruction, also assumes responsibility for determining the timing and the level of an amputation, and in some hospitals even for doing the amputation.

In other words, the same doctor, preferably the vascular surgeon, has to be responsible for the selection of the patients and the judgement whether the patient is a candidate for revascularization or amputation.