SENILE PERIPHERAL ARTERIOSCLEROSIS CLINICAL ASPECTS AND MANAGEMENT

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The pathology of senile arteriosclerosis has been discussed elsewhere and in this article we are concerned more with the effects of occlusive arterial diseases in the limbs and their management rather than the underlying causes. These effects are greatly influenced by the site of commencement of the disease in the arterial tree and by its rate and direction of spread. Senile arteriosclerosis commonly presents with intermittent claudication due to atheroma and thrombosis of a major artery, the severity and extent of peripheral ischaemia depending on the site and distal spread of thrombosis. Thrombo-angiitis obliterans may or may not be a distinct pathological entity but its typical clinical picture only differs from that of arteriosclerosis by virtue of its early onset and its peripheral origin and episodic spread in the limb.

For convenience the upper and lower limbs will be considered separately, although of course the disease may occur coincidentally in both.

Lower Limb

Onset of Symptoms

Thrombosis of a major artery, e.g. popliteal or superficial femoral, may be sudden with an abrupt onset of pain in the limb associated with pallor, coldness, paresis or paralysis. This condition is indistinguishable from arterial embolism except for the presence of cardiac irregularities in the latter. Although gangrene rarely develops in these cases, recovery is incomplete and the patient is left incapacitated by severe symptoms of intermittent claudication and skin ischaemia.

More commonly, however, the onset is gradual with intermittent claudication in the calf and/or thigh, with coldness, colour changes and, in severe cases, rest pains in the feet or with incipient gangrene. A peripheral onset is sometimes seen in the old with cold feet or a gangrenous digit, the ankle pulses till being palpable. In thrombo-angiitis obliterans the onset is before the age of 35, with intermittent claudication in the calf or feet and with painful ulceration or gangrene of a digit.

Physical Signs

The physical signs depend on the situation and

extent of the block and the efficiency of the collateral circulation around it. In general the higher the block the better the nutrition of the limb below it. The superficial femoral artery has a rich collateral circulation and there may be no physical signs other than absence of ankle pulses; whereas around a thrombosed popliteal artery the collaterals are poor and there are likely to be severe symptoms and signs of peripheral ischaemia particularly if extension of the thrombosis into the tibial arteries takes place.

Coldness, pallor and venous collapse on elevation with delayed return of colour and venous filling on dependency are typical of arterial insufficiency in the foot. Dependency may also show the typical 'rubor.' Dryness, absence of hairs and brittleness of the nails are evidence of skin atrophy. Pain is a common feature and is likely to be severe, particularly at night, if ulceration or gangrene is present.

Peripheral pulses may be absent, but the popliteal pulse is often difficult to feel and the dorsalis pedis artery is normally absent in 8 per cent. of patients (Allen, *et al.*, 1946), its place being taken by the peroneal. Intermittent claudication may occur in generalized atheroma without thrombosis even though the pulses are normal. The muscles may be wasted and tender to palpation.

This is a generalized disease and the rest of the cardiovascular system must be investigated carefully. X-rays of the limbs may show calcification in the arteries but this, although it may be widespread, is in itself of no significance for calcification alone does not necessarily narrow the lumen.

Investigation

Much has been written on the investigation of peripheral arterial diseases but it is still true to say that for practical purposes, a careful clinical examination provides all the information required to determine treatment, except when a direct attack on the artery is contemplated; in this case arteriography is essential. Special investigations are more appropriate to the special centre.

Measurement of Potential Skin Blood Flow

This depends on the production of full peripheral vasodilatation by one means or another and measurement of its degree by skin temperature reading and plethysmography. These methods have their limitations; a special room with controlled temperature is needed; it is difficult at times to obtain full vasodilatation; failure to obtain vasodilatation may be due to unsatisfactory technical conditions. Furthermore, of the methods of obtaining vasodilatation—reflex heating, spinal anaesthesia, paravertebral block, peripheral nerve block and general anaesthesia—only general anaesthesia results in vasodilatation comparable with the results of lumbar sympathectomy (Cranley, *et al.*, 1953).

Bearing this limitation in mind, if an increase in toe temperature of at least 2° C. is obtained by one of these methods lumbar sympathectomy is indicated.

Measurement of Muscle Ischaemia

Many forms of claudicometer and ergometer have been designed but are only suitable to the special centre. Radioactive tracers have also been used for this purpose with equivocal results (Cooper, *et al.*, 1949; McGirr, 1952). The patient's own estimate of his claudication distance is unreliable.

Arteriography

This is the best ancillary method of investigation but should not be used as a routine, as it is not without its dangers. Positive indications for its use are: As a preliminary to a direct surgical attack on the artery; as an aid in the diagnosis of early disease; and as a guide to the level of amputation.

Oscillometry

The Pachon type of oscillometer is of use in estimating the upper level of a block, but its value in estimating peripheral blood flow is limited to comparison between the two legs of the same patient (Messent, *et al.*, 1953).

Treatment

The Acute Incident

The treatment of ischaemia of acute onset is the same whether it is the first warning of disease, the sudden extension of previous thrombosis or the effect of arterial embolism. Rest in bed is essential with the head of the bed raised 9 in. to promote mild venous congestion in the legs. Pain must be controlled with morphia and sedation maintained—sleep is an excellent vasodilator. Extension of the thrombosis is prevented by anti-coagulant therapy. Indirect vasodilatation is

encouraged by all possible means; the affected limb is exposed to room temperature (20° C.) whilst the body is heated gently with an electric blanket, or electrically-heated gloves as suggested by Learmonth (1950) may be used. Vasodilator drugs should be given by mouth on intra-arterially. Alcohol is a useful vasodilator. The value of lumbar sympathectomy at this stage is a matter of conjecture, but repeated paravertebral block with procaine is of use; care must be exercised, however, if the patient is already heparinized. Morrissey (1954) suggests that if there is no improvement after 12 hours of this treatment arteriography should be performed to decide whether immediate grafting is likely to be possible or profitable.

Occlusive Arterial Disease of Gradual Onset

Gangrene in arteriosclerosis is precipitated by an incident, infective or climatic, which taxes beyond the limit a circulation only just sufficient to maintain the resting needs of the limb. The patient must therefore be carefully instructed in the care of his limbs. Advice should be given on the cutting of toe nails, the treatment of small cuts and abrasions; fungus infection should be controlled. The limb should be kept warm with woollen socks although overheating aggravates the condition and must be avoided.

Rest pains are treated with analgesics and the patient may find it easier to sleep with the leg dependant outside the bed clothes. If the leg is left in this position too long, however, troublesome oedema develops. Infection is controlled with antibiotics. Gangrene is best dressed with moist dressings of a bland nature. Patients should be advised to give up smoking particularly in Buerger's disease.

Active measures are directed to the improvement of the blood supply of the limb to increase its chance of survival and relieve claudication. These include the following:

Non-Operative Treatment

Vasodilator Drugs

Many vasodilator drugs are now available and are suitable for patients who are unfit for, or awaiting, operation, or in whom the symptoms are too mild to warrant operation. Elkin and Cooper (1951) have stated that since the dilatation produced by these drugs is general there is a danger of precipitating a crisis in the affected limb by diversion of the blood away from that limb.

Intra-Arterial Drugs

Repeated intra-arterial injections of histamine were advocated by Mufsan (1948) and used by Mackey (1950) with subjective improvement.

Betts (1954) used intra-arterial papaverine and tolazoline ('priscol'); he found these of no value in intermittent claudication but a valuable adjunct to local treatment of ischaemic necrosis.

Alpha-Tocopherol

Boyd, *et al.* (1949) have claimed good results in the treatment of intermittent claudication with alpha-tocopherol (vitamin E), but Hamilton, *et al.* (1953) were unconvinced of its value. The dosage is 400 mg. daily for three months.

Anticoagulants

These have no place in the treatment of senile arteriosclerosis of the limbs except during an acute incident.

Buerger's Exercises, Intermittent Venous Occlusion, Oscillating Beds, etc.

These have been used for many years but there is no positive evidence that they produce other than temporary improvement if any at all.

Check Irons for Claudication

Learmonth and Slessor (1952) recommended the use of check irons in the treatment of intermittent claudication.

Paravertebral Block

Repeated paravertebral block with procaine may be used in an acute incident. Haxton (1949) has used 10 per cent. phenol block in patients unsuitable for, or awaiting, operation with good effect.

Surgical Methods

Lumbar Sympathectomy

Sympathectomy still remains the surgeon's great standby although its results are somewhat unpredictable. It is, however, the best method of obtaining a small permanent increase in foot blood flow which is beneficial and may result in a warm foot, improvement in rest pain and, at times, healing of ulceration.

It is usual to consider contra-indications rather than indications. Old age in itself is no bar, if the general condition permits, but the operation is usually contra-indicated in the acute phase of the disease or in the presence of rapidly spreading gangrene. Failure to obtain an increase in toe temperature after reflex vasodilatation is stated to be a contra-indication but it is so only if the attempt to obtain vasodilatation has been made with the most careful attention to environment and technique.

If adequate sympathetic denervation of the thigh is to be obtained then the first lumbar ganglion must be removed along with the second and

third, even though this may result in sterility in the male.

The operative approach is a matter of conjecture, but a loin approach is probably the best if the first lumbar ganglion is to be reached; a more anteriorly placed muscle cutting or splitting incision in the line of the 12th rib may be adequate in patients of spare build. Both approaches are extraperitoneal.

Restoration of the Arterial Channel

Restoration of blood flow through the 'normal' channel is obviously the ideal method. However, these diseases are progressive and generalized, the peripheral lesions being only their more obvious manifestations. Many of these patients shortly die of coronary disease and it is of little avail to improve a patient's exercise tolerance only for him to develop angina or coronary thrombosis as a result of his increased activity. This must be borne in mind in the selection of cases for a direct attack on the artery.

Vascular Grafting

This is the best method of restoring the 'normal' channel, but only 20 per cent. (Rob, 1953) of patients are suitable either for anatomical reasons obvious on the arteriogram or because of the general condition of the patient. Venous autographs (saphenous vein) or arterial homografts may be used. In traumatic surgery it is accepted that the former are the most suitable and are more readily available, but in the surgery of arteriosclerotic disease there is some disagreement. Rob and Eastcott (1953) prefer arterial homografts; Fontaine, *et al.* (1954) have used both with similar results and are of the opinion that veins should be used where possible, but an arterial homograft should be available for use if required.

Arterial homografts may be stored in nutrient fluid (Gross, *et al.*, 1949), frozen and stored at -20°C . (Rob and Eastcott, 1953) or freeze dried and stored at room temperature (Rob and Eastcott, 1953).

Selection of patients for arterial grafting is by arteriography. This may be carried out in those patients whose general condition is satisfactory and in whom the local physical signs do not suggest such extensive arterial obliteration as to make grafting an obvious impossibility. Localized blocks of the femoral and popliteal arteries are most suitable for grafting procedures but grafts may extend from the iliac arteries to the popliteal artery. The lower end of the popliteal artery must be patent for anastomosis with the graft as the tibial arteries are too small and unsatisfactory for this purpose.

Resection and end-to-end anastomosis is the best method of insertion of the graft although

Kunlin (1949) has used an end-to-side technique in order to preserve major collateral vessels.

The results of grafting in arteriosclerotic disease are not good. Fontaine, *et al.* (1954) in their series report that one-third of the grafts were thrombosed in the immediately post-operative period, one-third within a year of operation and one-third still permeable beyond that time.

Endarterectomy

'Endarterectomy disobliterans' described by Reboul and Laubry (1950) has not found general favour in this country although Forty (1953) has reported encouraging results from it.

Tenotomy of the Tendo Achillis

When response to sympathectomy has been poor, subcutaneous tenotomy of the tendo achillis has proved of value in severe claudication, particularly when this symptom is limited to the soleus and gastrocnemius muscles. Bilateral operation may result in unsteadiness of gait and an interval of three months between sides is desirable.

Myoneurectomy

Denervation of the gastrocnemius and soleus muscles through an incision over the lower part of the popliteal fossa may be of value in improving claudication limited to these muscles.

Amputation

These patients are often old, unlikely to manage a prosthesis and may finally end by losing both legs. Amputation, therefore, must be very carefully considered; definite indications are intolerable pain and spreading gangrene, but localized gangrene is not in itself an indication for immediate amputation if, for example, one leg has already been lost.

The modern tendency is to conserve, with local amputation of the toes of transmetatarsal section. These are only likely to succeed if the plantar and dorsalis pedis arteries are patent—arteriography is invaluable to demonstrate this. Gangrene spreading upwards on to the foot requires amputation at a higher level; if the collateral circulation is good and the tibial arteries are patent, below-knee amputation is best, but if in the presence of major arterial blocks these conditions do not prevail then above-knee amputation is required. The chances of primary healing are increased if sympathectomy is performed on the same day.

Arteriosclerosis with Diabetes

Patients suffering from diabetes mellitus are undoubtedly more prone to arteriosclerosis and the disease in them is manifest at an earlier age.

Diabetic gangrene is usually arteriosclerotic gangrene in a diabetic, but occasionally an infected toe is seen associated with a plantar tenosynovitis even though peripheral pulses are present. These patients respond well to local amputation but the arteriosclerotic usually requires amputation of a major nature. Control of diabetes is essential at any stage.

Arteriosclerotic Disease of the Upper Limb

Apart from Mönckeberg's sclerosis, which may exist without occlusive vascular disease, senile arteriosclerotic disease of the upper limb is rare. Thrombosis of a major artery (axillary or brachial) may occur with secondary Raynaud's phenomenon and claudication in the small muscles of the hand. Thrombo-angiitis on the other hand is relatively common in the upper limb and indeed may present with painful ulceration of a finger.

As regards investigation, tests of vasodilatation are more reliable as a guide to the results of sympathectomy in the upper than in the lower limb.

Cervical sympathectomy is indicated in these cases; if the thrombosis is in the subclavian axillary artery a per-axillary approach (Atkins, 1954) is the best as this is less likely to damage collateral vessels. Amputation is rarely indicated. In Buerger's disease, however, sympathectomy may result in temporary improvement, but loss of one or more fingers is likely.

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