VASCULAR SURGERY

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Editors' Foreword

The scope of this series has increased since it was first established, and it now serves a wide range of medical, nursing and ancillary professions, in line with the present trend towards the belief that all who care for patients in a clinical context have an increasing amount in common.

The texts are carefully prepared and organized so that they may be readily kept up to date as the rapid developments of medical science demand. The series already includes many popular books on various aspects of medical and nursing care, and reflects the increased emphasis on community care.

The increasing specialization in the medical profession is fully appreciated and the books are often written by Physicians or Surgeons in conjunction with specialist nurses. For this reason, they will not only cover the syllabus of training of the General Nursing Council, but will be designed to meet the needs of those undertaking training controlled by the Joint Board of Clinical Studies set up in 1970.

Preface

In the twenty-five years that I have been concerned with vascular surgery it has developed from a somewhat experimental and dangerous branch of surgery to a recognized specialty which is routinely practised in District Hospitals throughout the world with safety and great benefit to the patients.

Vascular surgery is sometimes presented in textbooks of cardio-vascular surgery where it tends to take second place to cardiac surgery. In this work I have attempted to describe and illustrate vascular surgery in simple terms. The illustrations are confined to line drawings which are easy to interpret. The book is primarily intended for nurses but it may also be useful for medical students and for those reading for examinations in surgery.

I wish to acknowledge my thanks to Margaret Sutton for her advice and help, and to Judy Coppin who typed and re-typed the script and assisted me with the text.

The original diagram illustrating the sympathetic nervous system was drawn by Mr. E. J. Turnbull.

Bristol, 1980 R.E.H.

Contents

Part 1

Surgery of the Peripheral Arteries

1
Acute Ischaemia

Ischaemia means reduction of blood supply to a part of the body, and when this is sudden, dramatic and complete it is referred to as acute ischaemia. Acute ischaemia of a limb is one of the great surgical emergencies.

Causes of Acute Ischaemia

Acute ischaemia is due to the sudden occlusion of a major artery so suddenly preventing the flow of blood to that part.

Embolism. In this condition the acute ischaemia is caused by a clot of blood (a thrombus) which has previously been formed in a cavity of the heart or on a patch of atheroma in an artery—see below—and which suddenly becomes detached and is swept along in the blood stream. It is arrested when it reaches a vessel too small for it to pass any further, and the circulation is arrested at this point.

Trauma. An accident may involve a major artery and so cause acute ischaemia beyond the point of injury.

Atherosclerosis. In atherosclerosis there is a gradual narrowing of the artery because of the deposition of plaques of yellow tissue (called atheroma) in the wall of the artery. As the process of narrowing is a gradual one other blood vessels called collaterals (Fig. 1.1) usually develop, so that when the main artery finally closes there are no signs of acute ischaemia. However, sometimes the collateral circulation does not develop adequately and acute ischaemia develops when thrombosis occurs in the artery.

Signs of Acute Ischaemia

It is particularly important for doctors and nurses to be able to recognize acute ischaemia as the treatment is urgent. Sometimes a community or home nurse caring for an elderly person with a bad heart may be the first person to whom the patient complains.

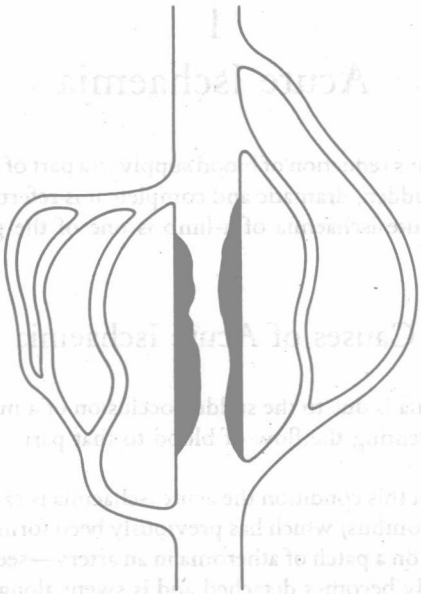

Fig. 1.1 Development of collateral circulation. The main artery is shown narrowed by atherosclerosis. New blood vessels formed to bypass the stenosis are called collaterals.

The first effects of acute ischaemia are upon the peripheral nerves. The part affected becomes anaesthetic as a result of failure of function of the sensory nerves. The nerves are unable to pass impulses from the skin to the brain where sensations are interpreted. Also, because of the interference with function of the motor nerves, the muscles cease to function and the patient is unable to move the ischaemic part. These effects are present within 15 minutes of the arrest of the circulation. When the circulation is restored function returns to the peripheral nerves.

The sudden arrest of inflow of blood causes the part to be emptied of blood so that it appears pale in colour. The skin temperature of a limb is dependent on the flow of blood through the skin. When the flow ceases the temperature begins to fall, but this is a slow process and is to some extent dependent on the temperature of the environment. In a very hot climate cooling may not be noticeable. Later, when there is no inflow of blood and little outflow, the remaining blood stagnating in the skin and losing its oxygen to the tissues becomes blue. So the limb, which is initially pale and warm, gradually becomes blue and cold.

Muscle can remain alive without blood flow for 6–8 hours and after this it undergoes necrosis (death). It is essential to restore the circulation before the muscles die as after this amputation is inevitable.

Treatment of the Acutely Ischaemic Limb

Surgical Treatment

In most cases an operation is urgently indicated to restore the circulation, and the type of operation depends on the cause of the arterial obstruction. For example, an arterial embolus is treated by the operation of removal of the embolus (embolectomy); an injured artery is repaired or replaced with a graft; and an atherosclerotic occlusion is treated with a bypass vein graft.

Medical Treatment

Although the only effective treatment of acute ischaemia is a surgical operation the surgeon may consider such an operation too risky. He may also wish to delay it for some hours to improve the patient's general condition or to see if some recovery of the circulation takes place. During this period certain non-surgical measures are taken.

1. Exposure

There is no strong evidence that this measure is of value but it is customary to expose an ischaemic limb to room temperature while keeping the rest of the body covered. The idea is that the cooled limb will need less oxygen for its survival. The use of fans and other techniques for cooling is now obsolete.

2. Posture

There is no doubt that the blood to an ischaemic limb is affected by posture. It should never be raised as this will still further reduce blood flow. The limb should be lowered below heart level when gravity will assist the flow of blood into the limb. Sometimes it is convenient to put blocks under the head of the bed, but if the patient is in shock this cannot be done and the individual limb must be lowered along the side of the bed where it can be supported on a chair.

3. Anticoagulants

When an artery is occluded the blood below the point of occlusion ceases to flow and this stagnant column of blood tends to thrombose after 5 or 6 hours. If the patient is to be treated conservatively it is wise to use anticoagulants to prevent this thrombosis which is called a propagated thrombus (Fig. 1.2). Intravenous heparin is the most convenient drug and is most commonly used. An intravenous infusion is set up, and after giving 10 000 units i.v. as a loading dose the heparin drip is given at the rate of 20 000 units in 12 hours. A convenient carrier is dextrose and saline.

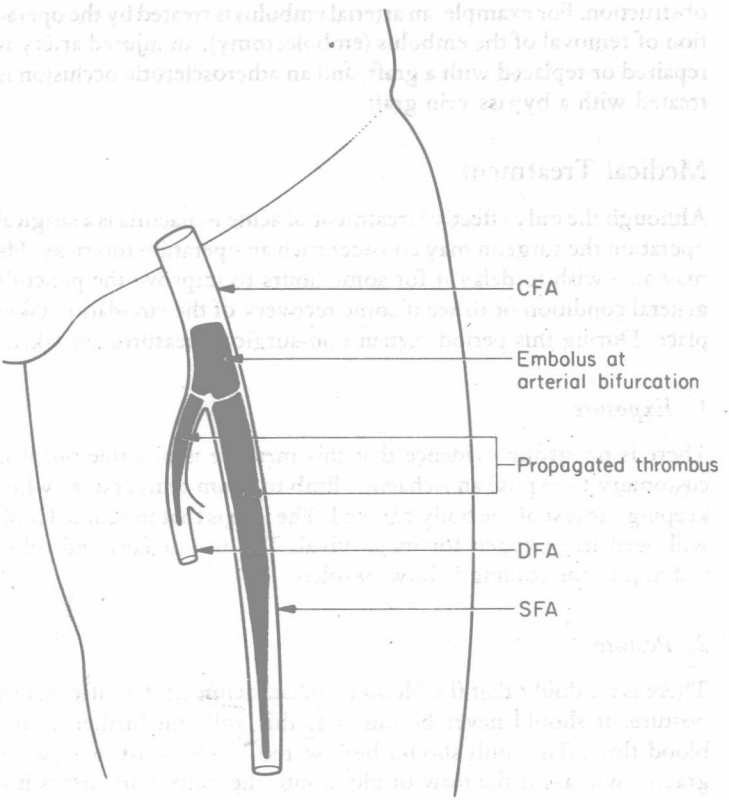

Fig. 1.2 Femoral embolus. The embolus is shown at the femoral bifurcation. Propagated thrombus has formed in the superficial and deep femoral arteries. CFA, common femoral artery; SFA, superficial femoral artery; DFA, deep femoral artery.

4. Low Molecular Weight Dextran

When this substance was first introduced it was thought that the circulatory improvement which resulted was due to reduction of viscosity of the blood enabling it to pass more easily through the capillaries. It is now thought that the effect is simply due to dilution of the blood which is similar to that resulting from the use of intravenous saline but much longer acting.

The usual dose is 500 ml of Dextran in saline given every 12 hours. It is convenient to add 20 000 units of heparin to each bottle of Dextran.

2
Chronic Ischaemia

In this condition there is a reduction of the flow of blood to a part of the body—most commonly a leg—insufficient to give rise to an acute emergency but enough to cause marked symptoms and signs and interference with normal function. The condition of chronic ischaemia may remain stationary for a long time, but over a period of months the blood flow may improve as a result of development of collateral arteries or deteriorate as a result of the gradual advance of the disease process.

Cause of Chronic Ischaemia

Chronic ischaemia is nearly always caused by atherosclerosis which causes gradual narrowing of the arteries. It is a progressive disease, and without treatment the condition is inclined to deteriorate gradually.

Effects of Chronic Ischaemia

1. Intermittent Claudication

The word claudication is derived from a Greek word meaning 'to limp'. Some surgeons prefer to speak of this condition as intermittent limping. The condition arises when there is an obstruction to the main blood supply to the leg. There are no symptoms at rest. When the patient walks and uses his muscles there is a need to increase the flow of blood to the leg. When the main artery is obstructed and the increased flow cannot take place the muscles are unable to function properly. The patient begins to limp because of pain and lack of proper function in his leg muscle, and finally has to stop. The need for an increased blood flow is now over and the pain soon passes enabling the patient to start walking again. The site of pain of intermittent claudication varies according to the site of the arterial obstruction. The calf of the leg is most commonly affected but buttock, thigh, and foot claudication also occur.

Sometimes an occlusion in the main artery to the arm causes similar effects in the forearm which is sufficient to stop a man from using the arm for work.

2. Rest Pain

When the degree of ischaemia is more severe the patient may complain of severe pain in the foot at rest. This may be due to lack of sufficient blood supply to the nerve endings. Rest pain is severe and relentless and impossible to relieve even with the most powerful drugs. Patients with rest pain get no sleep, deteriorate quickly, and ask for an amputation to relieve them. They sometimes discover that the pain is better if the leg is suspended over the bedside at night.

3. Gangrene

In the most severe form of chronic ischaemia the blood supply is so reduced that it is insufficient to maintain life, and there is local tissue death which is called gangrene. This usually begins at the most peripheral part of a toe but may also occur where pressure contributes to the ischaemia at the back of the heel. Death of tissue is called necrosis. When necrosis occurs in some external part of the body it becomes infected with putrefying organisms and this is called gangrene. Most gangrene seen today is dry gangrene in which the part is black, shrivelled, dry and with a faint odour of putrefaction. Wet gangrene is rarely seen except in cases of diabetes. In these cases the infection is a much more prominent and dangerous feature. The part is freely suppurating and the smell is very offensive. Severe rest pain accompanies gangrene.

Treatment of Chronic Ischaemia

Medical Treatment

Patients with arterial disease are often very worried about their condition. Elderly men fear the onset of gangrene and loss of a leg. Doctors and nurses have a duty to try and overcome these fears and to explain the possibilities of modern treatment.

1. Anaemia. If the patient's ability to carry oxygen in the blood is reduced by anaemia this should be corrected. Restoration of the

haemoglobin level to normal may lengthen the distance a patient can walk before getting intermittent claudication.

2. Exercise. The patient suffering from intermittent claudication should be encouraged to walk as far as his disability allows. Walking may cause some development of the collateral circulation and eventually increase the walking distance. It is possible for a patient to modify his way of life so that he can live with his disability. For example, he may find that walking at a slower pace he does not have to stop, and re-routing his walk to avoid a slope may also prevent claudication.

3. Smoking. All forms of vascular disease are made worse by smoking, and smoking must be absolutely forbidden.

4. Posture. In patients just beginning to get rest pain some benefit may come from lowering the limb in bed at night. One easy way to do this is to put blocks under the head of the bed so that gravity helps the circulation into the leg.

5. Vasodilator Drugs. Most patients with chronic ischaemia are given vasodilator drugs. There are a great number of these drugs available and all are effective in dilating normal arteries. When given by mouth vasodilator drugs have a generalized effect, but in patients with rigid atherosclerotic arteries the effect in no way matches the vasodilator effect in a normal subject. Experiments show that although the blood flow to a normal limb is increased when vasodilators are used they do not have a comparable effect in cases when the artery is occluded. There is in fact considerable doubt about the wisdom of giving vasodilator drugs in any circumstances.

Surgical Treatment

A variety of operations are used in chronic ischaemia.

Sympathectomy

This operation which removes the sympathetic nerve supply to a part causes a selective vasodilatation of the part of the body selected for the operation. In this way it differs from vasodilator drugs which have a generalized effect.

The sympathetic nervous system does not have any control over