APPOINTMENTS OF SPEAKERS

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(2) Dr. F. H. Doyle, Reader, Department of Diagnostic Radiology, Royal Postgraduate Medical School, and Consultant Radiologist, Hammersmith Hospital.

(3) Dr. Kristin Henry, Lecturer in Department of Morbid Anatomy, Royal Postgraduate Medical School, and Consultant Pathologist, Hammersmith Hospital.

(4) Dr. W. F. Doe, Assistant Lecturer in Medicine, Royal Postgraduate Medical School, and Senior Registrar, Hammersmith Hospital.

(5) Dr. D. J. Evans, Lecturer in Department of Morbid Anatomy, Royal Postgraduate Medical School, and Consultant Pathologist, Hammersmith Hospital.

(6) Dr. G. Neale, Lecturer in Medicine, Royal Postgraduate Medical School, and Consultant Physician, Hammersmith Hospital.

(7) Professor A. P. Waterson, Professor of Virology, Royal Postgraduate Medical School.

(8) Dr. June Almeida, Senior Lecturer, Department of Virology, Royal Postgraduate Medical School.

(9) Dr. G. Poste, Research Fellow, Department of Virology, Royal Postgraduate Medical School.

(10) Dr. G. F. Joplin, Lecturer in Medicine, Royal Postgraduate Medical School, and Consultant Physician, Hammersmith Hospital.

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Hospital Topics

Late Embolectomy

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Summary

Embolectomy with a balloon catheter even up to two months after embolism may be successful. Late embolectomy, meaning operation more than 48 hours after embolism, should be undertaken in a hospital where all facilities for arterial reconstruction are available.

Introduction

The earlier arterial emboli are removed the better the prognosis for the ischaemic tissue. Martin, King, and Stephenson¹ found that when embolectomy was performed within 48 hours of embolism the ischaemic symptoms were relieved in 92% of the patients, but in only 70% after 48 hours. There have been many records of successful late embolectomy. Spencer and Eisman² performed eight successful embolectomies by

instrumentation and flushing eight hours to 21 days after embolism. Cranley, Krause, Strasser, Haffner, and Fogarty³ claimed that 10 out of 11 embolectomies by balloon catheter done between four days and one month after embolism were successful. Hepp and Klaus⁴ recorded that seven out of 17 patients who had had late embolectomies "were discharged with healed extremities." Tarnay⁵ gave an account of 21 embolectomies performed later than 24 hours after embolism. Of the 21 patients nine were improved and in five the peripheral pulses were restored. Similarly Milliken⁶ recorded four successful embolectomies performed five days to three months after embolism.

It does not seem to be generally accepted, however, that late embolectomy with a balloon catheter can succeed. We think it should always be attempted when the limb is viable and the state of the patient allows it. Tsapogas, Kakkar, and Gleave⁷ stated that embolectomy is the treatment of choice up to 48 hours after embolism but that conservative measures should be used after this time. Some widely read textbooks still suggest that to be successful embolectomy must be performed early. Bailey and Love's *Short Practice of Surgery*⁸ advises embolectomy if a main artery is affected, if the patient is fit for operation, and, generally speaking, within 10 hours of the emergency, thus implying that it is not

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generally advised more than 10 hours after the onset. Cecil and Loeb's *Textbook of Medicine*⁹ states that embolectomy should be done within eight to 10 hours after the embolus has lodged. Such teaching could result in many patients being deprived of the possible benefits of late embolectomy.

This paper is presented to emphasize that late embolectomy with a balloon catheter can be very rewarding. The seven case histories reported are those of patients who were severely disabled by emboli for at least two weeks and who were dramatically improved by embolectomy. With one exception the operation was performed by balloon catheter alone. They were all treated since 1967 at Hammersmith Hospital.

Martin *et al.*¹ suggested that embolectomy is late when done more than 48 hours after the incident. Not only are the results of limb salvage better before this period but the mortality from the causative cardiac lesion is greater than after this period (36% compared with 11%). These patients have survived the initial catastrophe of an embolism as well as their underlying disease and are therefore self-selected. The affected limb is ischaemic, sometimes very ischaemic, but the collateral blood supply is still enough to support its life.

The management of longstanding embolism differs in many ways from that of an acute occlusion, and the cases described illustrate some of the differences.

Case Reports

Case 1.—A 35-year-old man had an aortic coarctation excised in 1962 with the insertion of a Teflon graft. In 1970 he presented with an eight-month history of intermittent claudication at 200 yd (183 m) in his left leg. A translumbar aortogram showed occlusion of the left common femoral and the origins of the superficial and profunda femoris arteries. Embolectomy was performed but the clot had to be loosened with a blunt stripper before it could be removed. After this all his distal pulses returned and he was able to walk normally.

Case 2.—A 67-year-old woman had mitral valve disease and atrial fibrillation. A saddle embolism two months previously resulted in claudication in the calves, thighs, and buttocks at 300 yd (274 m). Embolectomy with a Fogarty catheter through bilateral common femoral arteriotomies was successful and resulted in the return of her posterior tibial pulses and with the disappearance of her claudication. Her preoperative and postoperative aortograms are shown in the Photographs.

Case 3.—An 81-year-old man presented with a four week history of a cold, pulseless, cyanosed right arm. He had an atrial tachycardia with a 2 to 1 heart block. Axillary artery embolism was diagnosed and embolectomy done with a Fogarty catheter. The radial and ulnar pulses returned, but two days later the artery reoccluded and was successfully cleared again with a balloon catheter. Both pulses returned and recovery was uneventful.

Case 4.—A 53-year-old man went for his first walk six weeks after a myocardial infarct and had claudication in the right calf at 100 yd (91 m). Two weeks later he developed rest pain and came to the casualty department. A femoral arteriogram showed occlusion of the superficial femoral artery, and a diagnosis of embolism of at least two weeks' duration was made. Embolectomy was performed with a Fogarty catheter through an arteriotomy in the popliteal artery, restoring a warm foot but no pedal pulses. Three days later reocclusion occurred and a second thrombectomy was performed after arteriography showed the superficial femoral artery to be blocked. Still pulses did not return although the foot was warm. An arteriogram two days postoperatively showed the leg arteries to be clear to just above the ankle with a good collateral supply to the foot. He made an uneventful recovery and was relieved of his symptoms.

Case 5.—A 72-year-old man with ischaemic heart disease and atrial fibrillation presented with a two-week history of claudication at 20 yd (18 m) of sudden onset. There was associated rest pain in the forefoot. The right leg was very ischaemic with diminished sensation in its lower third, and an arteriogram showed a popliteal occlusion. The popliteal artery was explored at the bifurcation and the posterior tibial artery at the ankle. All the clot was cleared with a Fogarty catheter and after oper-

Case 2. Top: Preoperative aortogram showing saddle embolus. Bottom: Postoperative aortogram performed at end of operation showing embolus to have been removed.

ation the dorsalis pedis pulse returned and his symptoms were relieved.

Case 6.—A 58-year-old man had a 15-day history of pain and pallor in his left foot and calf of sudden onset. A femoral arteriogram showed a blockage of the lower superficial femoral artery with no run-off. After embolectomy of the popliteal artery with a Fogarty catheter his recovery was uneventful and he left hospital with good foot pulses. The source of his embolus could not be found.

Case 7.—A 70-year-old woman had a three-week history of severe claudication in the calf of sudden onset. She was fibrillating, and arteriography showed a popliteal embolus, which was removed with a Fogarty catheter. Although her pedal pulses did not return she was subsequently able to walk normally without claudication.

Discussion

These case reports emphasize that embolectomy with a balloon catheter can be successful many weeks after embolism, although occasionally it may be necessary to loosen the clot from the intima first. Embolectomy, however, whether early or late is only one aspect of the management of the patient. Most patients present with ischaemia of sudden onset together with an overt source of emboli, usually a diseased heart. Often, however, as in Case 4, the symptoms of ischaemia appear only when the patient returns to normal activity after

an episode such as myocardial infarction, cardiac surgery, or treatment of heart failure. In these cases the diagnosis of embolism must be presumed until disproved. Sometimes, as in Case 6, no source for an embolus can be found but the abruptness of onset must raise the possibility. Arteriography may help the diagnosis but not always. If occlusion of an otherwise normal vessel is shown, then embolism is the most likely cause in the presence of heart disease. Many patients, however, have generalized atherosclerosis, and in these it is impossible to be sure whether an arterial occlusion is due to embolism or atheroma. Nonetheless, radiography is very useful in showing the extent of the occlusion and where practicable should always be done before late embolectomy.

Management of the source of the embolus is important. There is no time for extensive investigations before operation, particularly in the acute case, but they should not be neglected after. Within a few weeks of a myocardial infarct embolism may originate from cardiac mural thrombus. If it occurs long after an infarct, however, this raises the possibility of a ventricular aneurysm, which can be shown by contrast radiography. Embolism frequently occurs from atrial thrombus in patients with atrial fibrillation but can occur when the heart rhythm is normal in congestive cardiomyopathy. Occasionally atrial myxomata may give rise to emboli.

Treatment of embolism must be directed towards relief of ischaemia, improvement of the condition of the heart, and prevention of further embolism. The treatment of acute embolism is well established. Anticoagulation with heparin at the rate of 2,500 IU/hr intravenously is started as soon as the diagnosis is made to try to prevent extension thrombosis in the sluggish blood stream distal to the embolus. Distal thrombosis is more important than proximal thrombosis, for the clot is more difficult to remove at operation. Embolectomy should be performed as soon as possible, for delay may lead to loss of the limb. This can be done under local anaesthesia, and with the balloon catheter is an easy procedure which should not unduly disturb a seriously ill patient.

In the late case there is no point in treating the patient with anticoagulants, as the propagation thrombus will have already formed. Because the collateral circulation is obviously good enough to enable the limb to survive for the time being at least, there is no need for immediate operation. Good arteriograms should be obtained and some time spent in improving the general state of the patient before attempting embolectomy. The groin should be explored first. Proximal thrombus can usually be removed by this route and the distal vessels often cleared also. Clot can often be removed from all three calf arteries by passing a No. 4 Fogarty catheter as far as it will go, passing a second one, then flexing the knee and passing a third one. The first two will tend to enter the posterior tibial and peroneal arteries respectively and the third the anterior tibial.

If the popliteal artery has to be explored direct the possi-

bility of future amputation should be kept in mind while making the skin incision.

The operation is best performed under general anaesthesia, for it may be difficult and extensive arterial reconstruction may be required. It may be impossible to remove a very adherent embolus with a balloon catheter although sometimes, as in Case 1, the clot can be gently dissected from the intima. If there is well established atherosclerosis then a formal endarterectomy can be performed, but otherwise an attempt to rebore the vessel will be unsuccessful and will severely damage it. In these cases some sort of graft procedure will be needed. Sometimes at operation it will be found that the occlusion is due to atherosclerosis or thrombosis. In these cases also reconstructive surgery will have to be performed. Special facilities and experience will be needed to deal with many of these situations, and as there is no need for immediate operation the patient should be treated in a unit where they are available.

After embolectomy operative arteriograms should always be done. Brisk retrograde bleeding can occur even when there is still severe obstruction in the distal arterial tree, and if all the clot is not removed there is a serious risk of recurrent thrombosis. After operation a careful watch should be kept for reocclusion. Foot pulses may not return although the result is otherwise satisfactory, but if they return and then disappear again further operation is often successful, as in Cases 3 and 4.

Once the ischaemia is relieved attention must be given to the cause of the embolism. Correction of the cardiac lesion must be considered in order to prevent further incidents and recurrent embolism is an indication for cardiac surgery. Anticoagulants are used to try to prevent further thrombosis in the heart chambers and thus reduce the chance of further emboli. Twenty-four hours after operation anticoagulation is started with heparin and warfarin, and the latter is continued indefinitely.

In the late case nothing is lost by attempting catheter embolectomy and much can be gained, and it can often be performed with minimal upset to the patient. In a few cases major arterial reconstruction is required.

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