accommodation. It is always difficult to convince the accountant of the cost-effectiveness of an activity that does not in itself produce a tangible end-product but claims to help other people to do their job more effectively. Traditionally, managers have not been convinced by cost data for supplying information, but it will soon be possible to produce standard costings for many information activities and reliable techniques for calculating the cost-benefit from information services.^{16 17}

We do not claim that this information service would automatically reduce financial outlay on equipment and instruments. In an inflationary economy, and with a growing population, *actual* savings are perhaps too much to expect, but experience suggests that savings in real costs, and a reduction in the rate at which costs rise, may be predicted with some confidence. Given access to full information on products available, those responsible for selecting and purchasing equipment and instruments will be able to make more reliable and more consistent decisions.

Increasingly, private consumers consult *Which?* before buying, so it seems strange to deny a similar opportunity to highly educated specialists responsible for the proper expenditure of large sums of money and for the health care of large numbers of people.

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Today's Treatment

Diseases of the central nervous system

Treatment of stroke

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Introduction

Stroke is the major neurological disease of our times, causing more death and severe disability than any other. The pathological basis may be either vascular occlusion, causing cerebral ischaemic infarction, or intracerebral haemorrhage with destruction of brain tissue. With generally available methods it is not always possible to distinguish these two types during life. This is unfortunate, because, although the general aims of treatment are the same in both cases, they are likely to be achieved by different methods. The failure to differentiate reliably between infarction and haemorrhage is just one factor which has hindered the development of effective treatments.

Three aspects of treatment will be considered: treatment in the acute phase of completed stroke; the prevention of further strokes; and rehabilitation. They are described separately merely for convenience. In practice, all three must be considered together as soon as the patient presents. The purpose of treatment in the acute phase is to limit the brain damage as far as possible. Clearly this includes trying to prevent the early occurrence of another stroke. Similarly, early mobilisation and the prevention of secondary complications must be carried on to allow the patient to derive maximum benefit from formal rehabilitation procedures introduced as soon as he can tolerate them.

Treatment in the acute phase

The age of the patient, the nature and extent of any extra-cerebral disease, his functional ability before the stroke, and the likely prognosis are just some factors to be considered when deciding how far to pursue active treatment in the acute phase. If vigorous treatment is contemplated hospital admission is necessary. Whether that is possible depends on what facilities are available in a given area. Since 1971 the Oxford neurology department has provided an emergency service for admitting patients with acute stroke. The service has been given in the hope that active treatment in a specialist unit may improve the prognosis. Even so, the limited facilities mean that only a relatively small proportion of the total stroke admissions to Oxford hospitals can be taken, and, inevitably, preference has been given to younger patients, especially those having their first stroke symptoms, however severe or mild.

GENERAL TREATMENT

General treatments are indicated regardless of whether the stroke is due to haemorrhage or vascular occlusion.

Airways obstruction must be prevented, particularly in patients who are obtunded or have dysphagia due to bulbar paralysis. They should be fed through a nasogastric tube, nursed in the bulbar palsy position, and given frequent physiotherapy to the chest during the initial stages. The cough reflex is usually well preserved despite bulbar paralysis. So endotracheal intubation or tracheostomy is rarely necessary if simpler nursing measures are applied properly. Similarly, endotracheal intubation and assisted respiration is rarely justified in patients with central respiratory depression due to the stroke because the prognosis from the brain damage is so bad.

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Hypertension is common and many patients are on treatment at the time of the stroke. A transient increase to diastolic pressures of 110-120 mm Hg settling to 90-100 mm Hg within 48 hours is not unusual. It also occurs in those who have not been on medication. When the hypertension persists beyond the first 48 hours I usually start treatment with alphas-methyl-dopa and diuretics. If the diastolic pressure is above 130 mm Hg on several consecutive readings then more urgent reduction is necessary, particularly in patients with cerebral haemorrhage. Our practice is to use intramuscular hydralazine. Great caution is necessary because cerebral vascular autoregulation is impaired in the acute phase of stroke. Excessive reduction of the diastolic pressure below 80-90 mm Hg may so impair the cerebral perfusion that further infarction occurs.

Cardiac failure and arrhythmias may need treatment and in this context one should remember that cardiac infarction may sometimes present with a stroke due to impaired cerebral perfusion at the onset.

SPECIFIC TREATMENT

If specific treatments are to be applied then haemorrhage and vascular occlusion must be distinguished at the outset. Unfortunately, they often cannot be separated on the history and physical signs. Even lumbar puncture does not show blood-stained cerebrospinal fluid in many cases because the bleeding is intracerebral rather than from an aneurysm and the haematoma does not rupture into the subarachnoid space but remains contained within the brain substance. Carotid angiography may be hazardous in the acute stage of occlusive stroke. Furthermore, it distinguishes reliably only between haemorrhage and infarction if a definite vascular occlusion is seen. Ischaemic infarction and haematoma, however, can be much more easily defined on EMI computer assisted tomographic brain scans. More widespread availability of this method should improve the treatment of stroke.

Ischaemic infarction

Cerebral tissue deprived of its blood supply is irreversibly damaged within a few minutes. Treatment cannot be directed at this process, which is too quick, but is based on the assumption that the infarct is surrounded by other areas not irrevocably damaged by the initial vascular occlusion, whose blood supply will be jeopardised for several days. The purpose is to save these areas, but unfortunately it is not entirely clear what specific aspects of the pathophysiology should be treated. Indeed, what is most important probably varies with several factors, including the interval since the initial infarction and the part of the brain affected.

Treatments are usually directed towards altering cerebral perfusion, reducing cerebral oedema, or preventing the formation of more thrombus. The rational development of really effective treatment, however, requires a better understanding of the dynamics of the condition. It has been difficult to achieve because of the lack of a safe and accurate method for monitoring the processes during life and for directly observing the effects of treatment. Consequently, ideas about the benefit of various treatments have been based mainly on empirical observations in more or less controlled clinical trials. This is a cumbersome method at the development stage. Furthermore, most trials have followed the patients for only three weeks, a period too short to assess the final outcome.

Glycerol is recommended for the acute phase after ischaemic infarction. It may be administered by mouth (1.5 g/kg body weight⁻¹ 24 hours⁻¹ in six divided doses), or intravenously (10% glycerol in 5% dextrose, 500 ml/24 hours administered over three to four hours). The treatment may be continued for up to 10 days. Intravascular haemolysis, a recognised complication of glycerol, is said not to occur on this regimen but a careful watch must be kept. The beneficial action is attributed to

increased cerebral blood flow and oxygen metabolism and decreased cerebral oedema. The latter is the main cause of death in the acute phase after ischaemic infarction. Frusemide, which experimentally withdraws water and sodium from damaged brain, may be administered (40-80 mg/day) along with the glycerol. The electrolyte levels should be monitored daily. The precise indications for treatment with glycerol and frusemide have not been established but my policy is to treat all patients under 70 who have evidence of a severe hemisphere infarct liable to develop cerebral oedema—that is, those who are drowsy with a dense hemiplegia and failure of conjugate gaze towards the side of the limb weakness.

Dexamethasone, in doses of around 4 mg every 6 hours for one week followed by reducing doses over the next week, has many advocates. Controlled trials, however, do not provide evidence that it is beneficial even when administered to those patients most liable to develop cerebral oedema. Dexamethasone's failure to control brain swelling due to infarction is in contrast to its dramatic effect on oedema associated with cerebral metastases and some gliomas. Methods directed at altering cerebral perfusion by constricting or dilating cerebral blood vessels, such as papaverine and changing arterial CO₂ tension, have not been generally accepted.

There has been recent interest, however, in the possibility that aminophylline might improve the outcome from cerebral infarction, especially if administered as a continuous infusion. This is a complex specialist procedure, as yet only in the developmental phase.

Anticoagulants should be given to patients with an undoubted source of embolus, such as mitral stenosis. The purpose is to prevent further emboli rather than to improve the prognosis from an already completed stroke. Treatment with heparin (10 000 units/6 hours in saline by continuous intravenous infusion) and warfarin may be started as soon as the diagnosis is made; the heparin is discontinued after 48 hours, when the prothrombin time should be approaching the therapeutic range. Careful laboratory control is mandatory. Subcutaneous injections of heparin 5000 units every 6-8 hours may be equally effective. If so this more convenient method, which is free from the hazards of excess sodium administration, will almost certainly replace continuous intravenous infusion. The evidence is less clear, but anticoagulation is probably advisable in patients without rheumatic heart disease whose stroke seems to be still progressing after six hours. The problem here is being certain that the diagnosis of ischaemic infarction is correct. It will be greatly eased by the availability of EMI brain scans. My current practice is to anticoagulate patients with progressing strokes provided the cerebrospinal fluid is free from blood and the isotope brain scan is normal, but there is a clear risk that some patients will have a contained intracerebral haemorrhage.

Haemorrhage

Haemorrhage producing focal neurological signs may arise from spontaneous rupture of a blood vessel within the brain substance, an aneurysm, or, less commonly, an angioma. Spontaneous intracerebral haemorrhage is unusual in patients without hypertension, and the younger the patient the greater the likelihood that the source is an aneurysm or angioma. Otherwise the conditions can be distinguished only by angiography. The investigation should be performed in all patients whose clinical condition is sufficiently good to justify surgery if a vascular anomaly is found. Both the carotid and the vertebral circulations should be examined. When no source of bleeding is found, the management is as for ischaemic infarction except that mobilisation should be more gradual. On the whole, surgical drainage of a haematoma arising from spontaneous intracerebral haemorrhage is not indicated unless it is situated superficially in a temporal lobe or in the cerebellum. Then the response to surgery may be dramatic. Distinguishing these from the more common deeply seated haematomas requires the facilities of a specialised neurology or neurosurgery unit.

Prevention of further strokes

The mildest stroke is the transient ischaemic attack with symptoms lasting only a few minutes. Such attacks are important because they may herald a severe completed stroke. It is surprising how often these warning signs are ignored by the patient or his doctors. They should be urgently investigated in the hope that a treatable cause might be found and a completed stroke avoided. Patients presenting with minor ischaemic strokes whose effects last longer than 24 hours but ultimately leave little disability should be similarly investigated.

The heart should be carefully examined for sources of emboli, such as rheumatic heart disease, ventricular aneurysm after cardiac infarction, and myxoma. If there is any doubt a cardiological opinion should be sought with a view to possible ultrasonic investigations. Prolonged electrocardiographic monitoring may be necessary to exclude episodes of transient dysrhythmia.

Younger patients with a normal heart and ischaemia in the distribution of the carotid artery should be investigated angiographically, looking for treatable sources of emboli regardless of whether or not a carotid bruit is detected. Our practice is to start with carotid angiography by direct puncture of the common carotid on the relevant side. This allows careful examination of the bifurcation, using biplanar views to detect atheromatous ulcers, and the carotid syphon. The intracranial circulation should be examined in detail to exclude other conditions such as tumour masquerading as transient ischaemic attacks. If the initial angiography reveals atheromatous plaques amenable to carotid endarterectomy, then the contralateral carotid and the vertebrals are examined by femoral catheterisation and archaortography.

The decision to operate is taken only after full examination of the vessels. Endarterectomy is the treatment of choice if a localised lesion amenable to surgery is found in a patient with a normal heart. This is especially so if the patient is hypertensive, thus contraindicating anticoagulants. The latter treatment is reserved for normotensive patients in whom definitive ulcerative lesions have been found but in whom surgery is contraindicated. Those without a detectable lesion are treated with 1 tablet of soluble aspirin taken each morning and evening.

These procedures are justified only in a minority of patients who have suffered a stroke. For the majority the most effective way of preventing, or at least delaying, the next cerebral vascular episode is to control hypertension rigorously. The importance of this aspect of treatment, especially for those under 70, cannot be overemphasised. The blood pressure should be reduced to diastolic levels of 85-95 mm Hg and kept there. A few patients have a stroke as a manifestation of cerebral arteritis, particularly

temporal arteritis and syphilitic arteritis. Erythrocyte sedimentation rate and Wassermann reaction should always be obtained during routine investigations and if they suggest any possibility of these conditions then the appropriate further investigation should be undertaken and treatment instituted. Lastly, mention must be made of the contraceptive pill. Taking the contraceptive pill produces a three-fold rise in vascular occlusive stroke in young women. I advise that the pill should never be taken again by any woman who has had a cerebral episode attributable to ischaemia or hemiplegic migraine.

Rehabilitation

Six months after a stroke about 60% of survivors from an unselected sample admitted to a general district hospital during the acute phase will be independent. About half of the others will still be in hospital, occupying long-stay beds, because of severe disability. The remaining 20% will be living at home but dependent on the support of others. The first aim of rehabilitation must be to achieve independence in activities of daily living such as feeding, toilet, dressing, and walking. Much can be achieved by physiotherapists and occupational therapists working on the ward. They should start as soon as the patient is well enough to get out of bed. By then the likely prognosis for recovery of motor function is usually clear. Both the relatives who will be responsible for home care and the domiciliary services should be involved at an early stage. The relatives must understand how to help the patient in activities such as moving and dressing; the domiciliary services should assess the home environment and make arrangements for any necessary modifications. Failure to involve the relatives and domiciliary services early enough may delay return home.

It is difficult to assess the value of formal rehabilitation once independence in daily living has been achieved, and few patients who were employed when they suffered the stroke succeed in returning to the same job. On the whole, rehabilitation procedures have concentrated on motor disabilities and little attention has been paid to the cognitive deficits resulting from the brain damage. Yet dysphasia, disturbances of visual and spatial perception, and memory impairment may be the main causes of failure to progress. There is a clear need for a better understanding of how these cognitive factors affect rehabilitation and what can be done to overcome them. Such an understanding may be achieved only by close co-operation between neurologists and rehabilitation specialists, on the one hand, and neuropsychologists and remedial teachers on the other.

Two years ago a married man in his thirties had a successful radical perineal excision of the rectum for carcinoma. He became impotent post-operatively and this is recovering very slowly. Will improvement continue and what therapy might help him?

Surgical procedures which damage the muscles of the perineum or interfere with their nerve supply may cause difficulty with both erection and ejaculation. The psychological trauma associated with major cancer surgery may also contribute to such a man's problems. A slow but usually complete recovery is the rule provided there is good general health. Reassurance will be most helpful and to avoid discouragement there should be no other treatment.

How often do immunising injections in children produce permanent induration, and is treatment advised?

The triple antigen (diphtheria, tetanus, pertussis) contains alum-precipitated diphtheria toxoid, which is an effective adjuvant in animals. When an antigen is injected in adjuvant a granuloma may form at the injection site, which may certainly cause chronic irritation. Such reactions occur occasionally after administration of triple antigen, and usually subside spontaneously. If the lesions continue to cause irritation, however, it would be quite justifiable to excise them.

Recently four infants each received in error the equivalent of 12 doses of smallpox vaccine given intramuscularly. So far none of the infants have suffered any harm, or even developed a vaccinal eruption. Is the vaccine inactivated by intramuscular injection, or is there another explanation for the lack of any response?

The vaccinia virus infects and multiplies in the cells of the deeper layers of the epidermis. An intramuscular injection will, therefore, "take" only if sufficient vaccine leaks back along the needle track to infect the skin. These infants had a lucky escape, but should not be regarded as protected against smallpox.

Sometimes a pack of morphine sulphate BNF injections has a tag "Use before such and such a date," whereas another batch will have no such warning. What is the stability of this injection?

Morphine sulphate BNF injections are relatively stable (five years or more) under normal conditions of storage. Changes in pH affect stability, and exposure to light may cause darkening. It would be prudent to replace or return to the manufacturer any batch which does not quote an expiry date. Indeed, such a batch would not satisfy the present recommendations for labelling requirement.