

with gunshot wounds of the spinal cord or cauda equina. The spinal cord lesions are usually complete and permanent. Lesions of the cauda equina, however, tend to be incomplete, with some of the nerves escaping injury altogether.

Most patients with spinal injury have an operation to remove necrotic tissue and to prevent a cerebrospinal fluid fistula. In the cervical region decompression of a cervical nerve root may help recovery of function in muscles controlling the hand.

However, there is no convincing evidence that operation helps recovery of function in the spinal cord itself. In the lumbar region removal of bone fragments compressing the dural sac or individual nerve roots probably contributes to recovery of function in some patients. Incomplete cauda equina injuries caused by missiles are often followed by considerable referred pain lasting for years. This is relatively uncommon in patients with closed fractures received in road traffic accidents.

Hospital Topics

Indications for Angiography and Surgery in Carotid Artery Disease

M. J. G. HARRISON, J. MARSHALL

British Medical Journal, 1975, 1, 616-617

Summary

The results of angiographic investigation of 211 patients suffering from transient cerebral ischaemic attacks in the carotid territory have been reviewed. The greatest proportion of patients with carotid stenosis and who were referred for endarterectomy were those with a neck bruit ipsilateral to the affected hemisphere. Ocular involvement (amaurosis fugax) was associated with a still higher prevalence of angiographic abnormality, and carotid occlusion was commonest in this group. The implications for the management of patients with transient ischaemic attacks are discussed.

Introduction

There is good evidence that most transient cerebral ischaemic attacks (T.I.A.) are due to cerebral thromboembolism, the emboli originating in the heart or major neck vessels.¹⁻³ When stenosis or atheromatous ulceration of the internal carotid artery is associated with T.I.A. in the ipsilateral retina or cerebral hemisphere endarterectomy reduces the proportion of patients continuing to experience attacks.⁴⁻⁵ That this is due to the removal of a source of emboli and not to a change in flow rate is suggested by the finding of friable thrombus at operation,¹ the effectiveness of anticoagulation,⁶ and the cessation of attacks after carotid occlusion or ligation.⁷ Furthermore, endarterectomy may be successful in preventing further T.I.A. even when the cerebral blood flow is normal before operation.⁸

On the basis of these findings we have evolved a policy by which patients with T.I.A. in the carotid territory who have no cardiac or other systemic cause for their symptoms and whose blood pressure is not unusually high are referred for angio-

graphy. Those with stenosis or ulceration of the internal carotid artery are then considered for endarterectomy if the lesion is surgically accessible.

We review here the yield of this policy in terms of angiographic abnormalities and operable lesions. We also considered whether on clinical grounds it is possible to locate groups of patients in whom the yield of angiographic abnormalities and operable lesions is particularly high.

Patients and Methods

A total of 294 patients who were referred to one of us (J.M.) for investigation of one or more episodes of transient ischaemia of the retina or cerebral hemisphere were initially considered. All patients were asymptomatic within 24 hours. If there was any possible systemic or cardiac cause for the T.I.A.—for example, severe anaemia or atrial fibrillation—the patient was excluded. A diastolic pressure consistently of 110 mm Hg or above was the criterion for exclusion because of high blood pressure though this was not absolute. For example, a patient with a diastolic pressure of 115 mm Hg who had a well localized bruit over the carotid bifurcation in the neck would have been included. For these reasons 83 patients were not studied angiographically.

The remaining 211 patients were studied angiographically between 1956 and 1972. There were 167 men and 44 women aged from 35 to 75 years (table I). The interval between the first T.I.A. and the time of admission for angiography varied from less than one month to more than five years (table II).

TABLE I—Age and Sex Distribution of Patients

Age Group:	30-39	40-49	50-59	60-69	70-79	Total
No. of men ..	3	28	74	57	5	167
No. of women ..	1	9	23	8	3	44
Total	4	37	97	65	8	211

TABLE II—Interval Between First Transient Ischaemic Attack and Time of Study

Interval (months)	<1	1-3	4-6	7-12	>12	Total
No. of patients ..	71	51	29	26	34	211

The clinical data were reviewed: 19 (9%) patients had amaurosis fugax only, 162 (77%) had hemisphere symptoms only, and 30 (14%) had both retinal and hemisphere symptoms. The presence of bruits

University Department of Clinical Neurology, National Hospital, Queen Square, London WC1N 3BG

M. J. G. HARRISON, B.M., M.R.C.P., Senior Registrar
J. MARSHALL, M.D., F.R.C.P., Professor of Clinical Neurology

in the neck was particularly noted, 42 (20%) patients having carotid bruits on the same side as the involved retina or hemisphere and 6 (3%) having bruits in other neck vessels.

The radiologist's report at the time of carotid or arch angiography was noted with respect to changes in the internal carotid artery on the side of the affected retina or cerebral hemisphere, and his diagnosis of stenosis, occlusion, or "atheroma" was accepted.

During the earlier part of the study we thought it important to visualize the origin of all four major neck vessels so most studies were carried out by arch angiography. Later attention was focused on the detailed anatomy of the carotid sinus so more patients had carotid angiography by common carotid puncture or selective catheterization. Also the value of biplanar views of the internal carotid artery at its origin came to be appreciated so that the angiographic technique evolved during the period covered by the study. Had recent techniques been applied in some of the earlier cases a greater yield of minor abnormalities would almost certainly have been obtained.

Results

The overall yield of abnormalities in the carotid artery territory on the side of the neurological symptoms is shown in table III. In 43% the carotid bifurcation, cervical carotid artery, and siphon appeared normal and there was no evidence of branch occlusion in the intracranial vessels. Possibly some small ulcerative lesions in the wall of the internal carotid artery at its origin may have been missed in early cases. Another possible reason for the failure to find abnormalities in all the patients relates to the interval in some cases between the first clinical episode and the time of study, allowing time for some ulcerative lesions perhaps to become endothelialized. Finally, despite careful endeavours to exclude them there may have been unsuspected emboli from the heart² or aortic arch in some patients.

TABLE III—Angiographic Findings in 211 Patients According to Clinical Findings

	Retinal Ischaemia		Retinal and Hemisphere Ischaemia		Hemisphere Ischaemia Only				Total	
	No.	%	No.	%	With Ipsilat. Bruit		Without Bruit		No.	%
					No.	%	No.	%		
Normal...	6	32	8	27	6	21	71	53	91	43
Stenosis...	4	21	10	33	17	61	17	13	48	23
Atheroma...	6	32	4	13	4	14	34	25	48	23
Occlusion...	3	16	8	27	1	4	6	5	18	9
Branch occlusion							6	5	6	3
Total	19	100	30	100	28	100	134	100	211	100

In 49 patients transient retinal ischaemia had occurred with or without hemisphere ischaemia. The prevalence of carotid occlusion proved higher in this group than in those without retinal symptoms particularly among those who had hemisphere symptoms also (table III).

The yield of angiographic abnormalities among the 42 patients who had a carotid bruit on the side of the involved retina or hemisphere was higher than in patients without a bruit. In the patients with hemisphere T.I.A. only stenosis was almost five times as common among those with as among those without bruits.

By contrast, if the patients had neither retinal involvement nor a bruit the proportion with a severe abnormality was lower.

Twenty-five of the patients studied had a diastolic blood pressure on admission of 110 mm Hg or more. None of this group had carotid occlusion but stenosis was reported in half. Bruits were no more common in the hypertensive group, but ocular symptoms were (32% as against 22% in non-hypertensive patients), which influenced the decision to subject these hypertensive patients to angiography.

Carotid endarterectomy was carried out in 32 of the 211 cases (15%). Again retinal involvement or the presence of an

ipsilateral bruit had an influence on the proportion offered surgery (table IV).

TABLE IV—Proportion of Patients referred for Endarterectomy According to Clinical Groupings*

	Retinal Ischaemia		Retinal and Hemisphere Ischaemia		Hemisphere Ischaemia		Total
	With Bruit	Without Bruit	With Bruit	Without Bruit	With Bruit	Without Bruit	
No. of patients	9	10	5	25	28	134	211
No. (%) operated on	3(33)	3(30)	1(20)	5(20)	10(36)	10(8)	32(15)

*Groups classed as without bruit include patients without ipsilateral bruits.

Discussion

This study covered 15 years, during which our understanding of the pathogenesis of T.I.A. progressed and the techniques of angiographic investigation evolved. These retrospective data do not therefore cover a homogeneous group of cases, nor can the results be used to predict exactly what the yield of investigation by modern refined angiographic techniques will prove to be.⁹ The figures do, however, show the very considerable yield of useful information from angiography and indicate the proportion of patients who may have operable disease of the internal carotid artery. The rationale for surgery has shifted ground also. Initially concern was with stenosis as an impediment to flow, but growing awareness that unless the stenosis is very severe, obliterating as much as 90% of the lumen, there is no reduction of flow displaced this as the most common reason for endarterectomy. Stenosis came to be regarded as a source of emboli, the emboli arising from a thrombus on the surface of the stenosing lesion. This remains an important indication for endarterectomy, but emboli may arise without there being any stenosis; "irregularities" of the vessel wall, particularly ulcers, are frequent sources of emboli and should be removed by endarterectomy. Current policy will probably lead to rather more than the 15% of cases recorded here being referred for endarterectomy.

Analysis of the clinical data shows that the presence of a neck bruit on the side of the neurological symptoms significantly increased the chance of finding carotid stenosis and the proportion receiving surgery. This finding agrees with those of previous studies¹⁰ and confirms the importance of auscultation over major neck vessels.

The other factor associated with a high prevalence of abnormality in the carotid artery was the occurrence of retinal ischaemia on the same side as the affected hemisphere. Carotid occlusion was more often found under these circumstances. Again inquiry should always be made for a history of minor visual symptoms.

By contrast, the group of patients in whom symptoms of hemisphere ischaemia had occurred without eye involvement and without a bruit proved to have a low prevalence of stenosis, and few had carotid surgery. This difference may well reflect the fact that despite careful endeavour to exclude patients with cardiac lesions some cases of T.I.A. in this group were due to embolism from the heart rather than from neck vessels. The examples of branch occlusion without carotid abnormality in this group seem to support this suggestion (table III). It seems wise in such patients to investigate further the possibility of cardiac disease. An intermittent cardiac dysrhythmia should be particularly considered and, if necessary, the heart should be monitored.

We thank Dr. L. Sedal for help with data handling.

References

- Gunning, A. J., *et al.*, *Quarterly Journal of Medicine*, 1964, **33**, 155.

² Blackwood, W., *et al.*, *Brain*, 1969, 92, 897.³ Harrison, M. J. G., in *Tenth Symposium on Advanced Medicine*, p. 215, ed. J. G. G. Ledingham, p. 215. London, Pitman Medical, 1974.⁴ Fields, W. S., *et al.*, *Journal of the American Medical Association*, 1970, 211, 1993.⁵ Thompson, J. E., *Annals of Surgery*, 1973, 178, 263.⁶ Millikan, C. H., *Stroke*, 1971, 2, 201.⁷ Fisher, C. M., *Archives of Ophthalmology*, 1952, 47, 167.⁸ Skinhøj, E., Høedt-Rasmussen, K., and Paulson, O. B., *Neurology*, (Minneapolis), 1970, 20, 485.⁹ Du Boulay, G. H., *British Journal of Hospital Medicine*, 1973, 10, 258.¹⁰ Marshall, J., *Lancet*, 1971, 1, 719.¹¹ Walter, P. F., Reid, S. D., and Kass Wenger, N., *Annals of Internal Medicine*, 1970, 72, 471.

Contemporary Themes

Emigration of Doctors: A Problem for the Developing and the Developed Countries. Part I

B. SENEWIRATNE

British Medical Journal, 1975, 1, 618-620

Many developed countries such as the United Kingdom, North America, Australia, and New Zealand rely heavily on a supply of foreign trained doctors, especially from developing countries such as India, Pakistan, and Sri Lanka, to man their health services. The latter countries, alarmed by the drain of trained personnel, are now taking steps to prevent their doctors from leaving. The withholding of travel documents, the imposition of compulsory periods of service after qualification, crippling financial and service bonds, and even threats of prosecution¹ are now being used by some developing countries to stop the exit of doctors.

It seems likely that the effects of these steps even if successful will only be temporary, since restrictive measures rarely succeed beyond a certain period of time. As they fail, even more restrictive measures will undoubtedly be introduced, which in turn would temporarily stem the outflow and then cease to be effective. These stop-gap measures offer no long-term solution to the major problem. Even for the (short) time during which they are effective they will—as has happened in Sri Lanka—only create a group of disgruntled and dissatisfied doctors who are of little use in the running of an efficient Health Service in these developing countries.

In the developed countries, if restrictive measures taken by the developing countries were to succeed even temporarily, the sudden cessation of the steady inflow of foreign-qualified doctors is likely to create problems in the staffing of some of the hospitals which rely heavily on them.

Recently, a team of international experts made a detailed study of the problem of the "brain drain" and collected a mass of data on the problems facing the Colombo Plan countries.² Despite this they failed to formulate a plan that would satisfy the needs of both the developed and the developing countries, which is the only permanent solution to this world-wide problem.

This paper is based on 14 years' experience of undergraduate and postgraduate medical education and medical practice in England with a knowledge of the requirements of the Health Services in the West and six years of medical teaching and consultant practice in Sri Lanka. It is hoped that this analysis will throw some light on the problem so that a long-term solution can be found which could benefit both the developed as well as the developing countries.

Magnitude of the Problem

Though the immensity of the problem is widely appreciated, a few figures are worth quoting in order to emphasize the dependence of some developed countries on the developing ones and the losses incurred by the latter.

RECIPIENT COUNTRIES

Though some countries such as Britain, Canada, and New Zealand are "donor" countries to the United States, from the point of view of the developing countries they act as "recipients."

United States.—In 1971 alone, 22 000 Asian professional and technical people, most of whom were engineers, teachers, nurses, doctors, and dentists, migrated from their developing countries to the United States.³ The number of foreign medical graduates entering the United States annually increased from 308 in 1950 to 2307 in 1969.

Canada.—Not only are a third of the doctors in Canada foreign-trained but, while the output of the Canadian medical schools has only slightly increased, the total number of immigrant doctors in Canada has rapidly increased and now outnumbers those trained in Canada. In 1967 only 1016 doctors were trained locally while 1277 migrated into Canada, by far the largest source being Asia.⁴

United Kingdom.—In 1969, of a total stock of 66 000 active doctors, 15 000 (23.5%) were estimated to have qualified overseas, of whom two-thirds came from the developing countries.⁵ There is an even greater dependence on foreign graduates by the hospital services in England and Wales, where in 1969 33.4% of all hospital staff, and over 50% of the registrars and about 66% of the senior house officers, were overseas doctors.⁶ In 1971, 577 doctors migrated to the United Kingdom mainly from the developing countries. In that year only 2800 medical students were taken into all of the many medical schools in Britain. The immigrant doctors were therefore equivalent to the output of several British medical schools. During the five-year period 1962-7 there was an average annual net loss of some 320 British or Irish born doctors.⁶ The current figure is about 400. Most of them are being replaced by overseas doctors. Of an annual inflow of about 3000 overseas doctors who find employment in the National Health Service only 2300 leave, a net gain of 700 overseas doctors a year. These figures emphasize the enormous turnover and the dependence of the National Health Service on these doctors, and the chaos that might result if the supply of foreign doctors were to cease suddenly (see below).