EXCISION OF OCCLUSIVE LESIONS OF THE MIDDLE CEREBRAL ARTERY*

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When the middle cerebral artery becomes obstructed, the large and important area of cortex to which that vessel is assigned is placed in great peril. Fortunately, there are paths available for readjustment of the circulation so that ischemia is lessened by inflow of blood from branches of the other cerebral arteries. This new circulation is sometimes adequate for recovery, but in other cases it is not sufficient and recovery is incomplete or does not occur. Even should function be regained, the danger is not lifted, for the collateral circulation may fail later and the stroke recur. For these reasons, in 2 patients with middle cerebral artery occlusion, an attempt has been made to remove the obstruction and to allow blood flow to be reestablished through its usual path.

CASE REPORTS

Case 1.† The patient was a 47-year-old man who had had a traumatic amputation of the left leg at the midthigh in 1928 and had also been treated in the past for syphilis.

On Sept. 14, 1954, he wakened after 2 hours of sleep feeling lightheaded, and found himself paralyzed on the left side. His tongue felt thick and there was slurring of his speech. Subsequently, there was some recovery in his leg. He was admitted to the hospital 2 days later.

Examination. There was left facial weakness with protrusion of the tongue toward the left. The left arm was flaccid and motionless, with diminished reflexes. There was weakness of flexion of the stump of the left leg. Two-point discrimination and position sense were impaired on the left.

Course. Some improvement occurred, and he gradually regained strength in the stump of his leg and some movement in the arm, but selective weakness of pyramidal distribution with extreme impairment of finger dexterity and blunting of two-point discrimination and position sense persisted.

1st Angiography. On October 8, 1954, arteriograms were made. The films are reproduced elsewhere.12 There was obstruction of the right middle cerebral artery just beyond the posterior temporal branch and impaired filling in the distribution of the ascending branches. An hour after the arteriogram, his arm became paralyzed again, but some recovery was observed during the next 3 days.

Operation. On Oct. 12, 1954, the right middle cerebral artery was exposed, with

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† This case was reported previously in a different connection and the preoperative arteriograms were reproduced.13 The present case is Case 2 of that report.
**Fig. 1.** Case 1. Operative findings and steps in operative procedure are outlined.

**Fig. 2.** Case 1. Organizing thrombus removed from the middle cerebral artery. Hematoxylin eosin stain, \( \times 225 \).
hypothermia (28°C.) as an adjunct. There was a segmental thrombus which extended from just beyond the origin of the posterior temporal branch to well beyond the next branching (Fig. 1). The vessel was incised and the thrombus was expressed by external pressure. After the vessel was sewn and the proximal control was released, the occluded segment ballooned up with blood and the wound was closed. The thrombus was an organizing one (Fig. 2), its age by history compatible with the histological appearance.

2nd Angiography. Sixteen days after operation, right carotid angiography was repeated. This time one exposure was made after the injection of only 3 cc. of 35 per cent Diodrast, because of his response after the first arteriogram. The films demonstrated patency of the ascending branches of the middle cerebral artery, though the posterior temporal branch did not fill (Fig. 3).

![Fig. 3. Case 1. Postoperative right carotid angiogram. The ascending branches of the middle cerebral artery are filled but the posterior temporal branch is not.](image)

Course. Clinical recovery has been excellent. He walks as well as ever with his prosthesis. The upper extremity shows very good strength throughout, but there is still slight awkwardness in movements requiring finger dexterity.

Summary. In a 47-year-old man, who had previously had an amputation of the left leg and had also been treated for syphilis, left hemiplegia developed during sleep. Spontaneous improvement began early, but after 3 weeks the neurological deficit was still severe. The lesion was demonstrated by angiography to be an obstruction of the common origin of the ascending branches of the right middle cerebral artery. A thrombus was removed from the vessel, and later arteriography revealed patency of the ascending branches of the right middle cerebral vessel, though the posterior temporal branch, previously open, did not fill. Clinical recovery has been good.
Fig. 4. Case 2. Preoperative left carotid angiogram. There is obstruction of the left middle cerebral artery.

Fig. 5. Case 2. Operative findings and procedure are shown.
Case 2. The patient was a 51-year-old obese woman who lived alone. On the morning of Nov. 26, 1954, she was discovered in her room with a right-sided paralysis and inability to speak. She was admitted to the hospital at once.

Examination. Her blood pressure was 150/80, her pulse was irregular, and a systolic murmur was heard over the apex of the heart and in the aortic area. There was total paralysis of the right arm and leg, and the right side of the face was weak. She was unable to speak, but was conscious.

Angiography. A left carotid arteriogram was made on the morning of admission. Five cc. of 35 per cent Diodrast were injected, and a single exposure was made. The film revealed good filling of the carotid and anterior cerebral arteries, but the middle cerebral artery was filled only in its most proximal part (Fig. 4). The column of dye ended abruptly, and there was no filling in the peripheral territory of the middle cerebral artery.

Operation. That afternoon, operation was carried out, again with hypothermia ($29^\circ$C.). The internal carotid artery and the most proximal part of the middle cerebral artery had a normal blue-gray color; beyond this, the middle cerebral artery was pale and distended and was firm to palpation. The embolus reached to a distance of approximately 2 cm. beyond the bifurcation of the middle cerebral artery (Fig. 5).

A small opening was made just proximal to the bifurcation of the artery, and it was possible to extract quantities of friable red-yellow material from within the vessel. It was thought that all the embolus distal to the arteriotomy had been removed when good backflow was obtained. An excellent forward flow of blood followed expression of the clot from the proximal part of the artery. The opening in the

![Fig. 6. Case 2. Embolus removed from the left middle cerebral artery. A small fleck of calcium is present. Hematoxylin eosin stain, ×100.](image-url)
vessel was then sewn with a single figure-of-eight stitch, and the wound was closed. The histological appearance of the embolus is illustrated in Fig. 6.

Course. Postoperatively, the patient remained hemiplegic and aphasic. Repeat arteriograms showed the middle cerebral artery obstructed as before.

Summary. A 51-year-old woman had complete right hemiplegia and aphasia caused by an embolus of the left middle cerebral artery from a fibrillating heart. The obstruction was demonstrated by arteriography and removed surgically, but the patient’s condition did not improve and repeat angiography showed that the vessel was occluded as before.

DISCUSSION

Following obstruction of the middle cerebral artery or a branch of that vessel there are important and interesting readjustments of the circulation of the brain, and the efficiency with which these are brought about will limit, in a measure, the devastation that results. That extensive softening is not the inevitable result of such an occlusion was recognized many years ago and has been illustrated more recently, both from autopsy data and by the remarkable, even complete, recovery of function achieved by several patients after surgical closure of the middle cerebral artery. The question of survival of infarction in the territory assigned that vessel appears not to be absolutely settled from the moment of occlusion, but to depend upon factors that come into play afterward. Among these are propagation of clot proximally into the region of origin of the penetrating branches and the efficiency or inefficiency of the collateral circulation. The surface connections between the terminal branches of the cerebral arteries have been known for three-quarters of a century, but their function as alternative pathways for circulation was subject for debate. More recently, Vander Eecken and Adams have made a precise study of these vessels in normal brains and in brains in which a major vessel was occluded. They have demonstrated that these terminal connections, which they named meningeal arterial anastomoses, do indeed serve to protect the cortex from infarction in the territory of distribution of an occluded vessel. They were also able to correlate the protection afforded with the total cross-sectional area of the anastomotic bed, and they suggested that when the meningeal arterial anastomoses are narrowed by disease the protective function might be impaired. The importance of adequately maintained blood pressure in the face of the increased peripheral resistance imposed by the collateral vessels was also discussed by these authors.

The rapidity with which the collateral circulation is brought into play must be very important, but has not been studied. The balance between the state of the general circulation and the efficiency of the surface anastomoses between the cerebral arteries is a precarious one, not only during the period immediately following the stroke but also afterward. It would appear, therefore, that definite advantages might be expected were it possible to
relieve the obstruction and reestablish blood flow through the middle cerebral artery.

Attempts to relieve cerebral ischemia by reopening an occluded vessel have previously been confined to the carotid artery in the neck. The release of deliberate surgical closure made for the treatment of aneurysm has sometimes been followed by great improvement in lost function, so that now it is more or less standard practice to make these occlusions so that they can be released if necessary. In 1951, Spence removed a spontaneously occurring occlusive clot from the internal carotid artery with relief of symptoms, but there was recurrence after 3 years. This approach to carotid thrombosis in the neck was suggested by Fisher in 1952, and several unsuccessful attempts have been recorded since. Eastcott et al. have recorded successful reconstruction of the internal carotid artery in a patient with intermittent hemiplegia, with relief of symptoms and arteriographic demonstration of patency.

Meanwhile, interest in the treatment of cerebral aneurysms has resulted in improved methods for exposure and for dealing with cerebral arteries. Particularly pertinent was the demonstration by Campbell and Burklund that the middle cerebral artery can be sewn. Also of great importance was the development of hypothermia as an adjunct to surgery and its application to surgery of the blood vessels of the brain.

Perhaps because recognition of cerebral softenings antedated recognition of arterial obstruction as their cause, emphasis and interest have centered much more upon cerebral infarction than upon arterial obstruction. As a result, precise information regarding sites of election of occlusive lesions and the natural history of the various occlusions is badly needed. Until the natural history of middle cerebral closure is better known, it will not be possible to be precise in the evaluation of treatment, and certainly before direct surgical approach to intracranial arterial obstruction can be appraised, a considerable experience with this method must be available for analysis.

SUMMARY

Occlusive lesions have been removed from the middle cerebral artery in 2 patients. The first was a 47-year-old man who had shown some recovery from hemiplegia after a right middle cerebral artery thrombosis. Four weeks after onset, the right middle cerebral artery was incised, the thrombus was removed, and the vessel was sewn. Subsequently, the ascending branches of the middle cerebral artery were demonstrated by arteriography to be open. There has been recovery of function except for finger dexterity. The second patient was a 51-year-old woman who had auricular fibrillation. She was studied and operated upon 12 hours after being found with right hemiplegia and aphasia. An embolus was excised from the left middle cerebral artery. Her neurological status has not improved, and subsequent arteriography revealed, as before, obstruction of the middle cerebral vessel.
REFERENCES