PERIPHERAL COLLATERAL CIRCULATION BETWEEN CEREBRAL ARTERIES
A DEMONSTRATION BY ANGIOGRAPHY OF THE MENINGEAL ARTERIAL ANASTOMOSES*

MAJOR HAROLD ROSEGAY, M.C., U.S.A., AND KEASLEY WELCH, M.D.†
Neurosurgical Service, Letterman Army Hospital, San Francisco, California
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AN OPPORTUNITY does not often arise to observe the functioning of the peripheral anastomoses between intracerebral arteries. For one thing, the type of case required is one in which there is an occlusion of the proximal part of a major cerebral artery, and this is not often encountered in routine angiography. For another, the angiogram will not be revealing unless the exposure happens to be made at the precise instant of passage of contrast substance through the collateral vessels.

Occlusive thrombosis of the proximal segment of a cerebral artery is not common, and the diagnosis is made clinically more often than justified by either angiographic or autopsy data. As more studies, both from angiography and autopsy, have become available the impression is gained that cerebral infarction caused by thrombosis is much more often the result of carotid occlusion than of cerebral artery occlusion.9,14 In the literature on angiography there is a striking preponderance of cases of carotid thrombosis10,18,21,22,32,34 Proximal thrombosis of a cerebral vessel is infrequently illustrated by angiograms.2,20 Krayenbühl19 has reported 2 cases of thrombosis of the middle cerebral artery and 4 of the anterior cerebral, all verified by angiography, but there were in the same series 18 cases of carotid thrombosis.

Other cases suitable for the study of the collateral circulation are those in which the patients have survived imperative and unavoidable ligation of a major cerebral artery. Postoperative angiograms may then reveal the extent of the collateral circulation in the territory of the occluded vessel.

The first case described here is one of segmental thrombosis of the proximal part of the right middle cerebral artery. It represents an ideal, though unfortunate, natural experiment for the demonstration of the functional validity of the meningeal arterial anastomoses inasmuch as retrograde filling of the proximally occluded middle cerebral artery is shown to occur from branches of the anterior cerebral. The second case also demonstrates this retrograde filling. It is one in which the right middle cerebral artery had been permanently occluded in the Sylvian fissure during isolation of an

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† Present address: Department of Surgery, University of Colorado, Denver 7, Colorado.
aneurysm, and in which complete recovery from a total hemiplegia subsequently took place. The angiograms of the third case demonstrate flow in the reverse direction, from the middle to the anterior cerebral artery. For this to occur, the proximal connections of the anterior cerebral artery with the circle of Willis must be completely interrupted. This condition was met in this case because the left anterior cerebral had been clipped in the course of isolating an aneurysm of the anterior communicating artery, and the right anterior cerebral had undergone postoperative thrombosis.

CASE REPORTS

Case 1. On Nov. 11, 1953, a 5½-year-old girl, previously well, suddenly had numbness of the left foot, followed by numbness and then paralysis of the left leg and arm. The child's mother noted drooping of the left side of the face, with drooling from the corner of the mouth. There were no convulsive movements, nor was there loss of consciousness. The paralysis cleared within an hour. Two days later this episode was repeated, lasting 30 minutes, and on November 15 there was paralysis of the left foot for 10 minutes. She was seen as an outpatient on November 17, and admitted for study.

Examination. At this time no neurological changes could be detected. The visual fields were normal. Blood count, urinalysis and x-rays of the skull were normal.

On the evening of November 18, generalized headache developed. The temperature was 100.2°F., and she appeared ill. When seen the next morning she had a flaccid left hemiplegia. Deep tendon reflexes were markedly depressed on the left. The left plantar response was extensor. The tongue protruded to the left and elevation of the left shoulder was weak. There was no impairment of consciousness, no speech difficulty or field defect. The neck was not stiff.

Angiography. A vascular malformation was suspected and right common carotid angiography was done. Ten cc. of 35 per cent diodrast were injected and three exposures were made in the lateral position, at intervals of approximately 1 sec., the cassettes being pulled by hand. This was repeated to obtain stereoscopic lateral films, and then a third injection was made for a single AP film. In the first film in the series filling of the anterior cerebral artery to the posterior limits of the pericallosal and callosomarginal branches was seen (Fig. 1). There was no evident filling of the middle cerebral artery. A fine vessel running obliquely across the territory of the middle cerebral was considered to be the superficial temporal artery. On the second film, made 1 sec. later, retrograde filling of the middle cerebral from the internal frontal branches of the callosomarginal artery was seen (Fig. 2). A diagnosis of thrombosis of the most proximal segment of the middle cerebral artery was made. Rheumatic fever and subacute bacterial endocarditis were excluded as etiologic possibilities.

Course. For treatment following the arteriography CO₂ inhalations were given to produce vasodilatation of the collateral vessels, but this did not noticeably influence the paralysis. A single stellate block was also without effect. Within the first week there was return of reflexes and tone to the left lower extremity and lessening of the left facial weakness. On a supervised program of physical rehabilitation gradual improvement was noted, so that on December 3 it was recorded that there was some return of power in the left hip flexors and commencing contraction of the left quadriceps.