Angiographic Appearance of Carotid Occlusion in Acute Stroke

Michael S. Pessin, M.D., Gary W. Duncan, M.D., Kenneth R. Davis, M.D., Richard C. Hinton, M.D., Glenn H. Roberson, M.D., and J. P. Mohr, M.D.

SUMMARY The angiographic appearance of the proximal end of internal carotid artery occlusion is reported in 41 patients with acute stroke in the areas of the brain supplied by the carotid artery. All patients had angiography within 6 days of stroke onset, the majority within 24-48 hours.

Three angiographic configurations of internal carotid occlusion were found, in descending order of frequency: a sharp, pointed stump; virtual absence of the artery; and a rounded, blunt stump.

The results suggest that the angiographic appearance of the proximal occlusion alone may not accurately predict the age of the occlusion within the first 6 days from stroke onset.

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IN THE EVALUATION of patients with occlusion of the extracranial internal carotid artery, little emphasis has been placed on the angiographic appearance of the proximal end of the occlusion. Recent reports of emergency operations upon acute carotid occlusions1, 2 and the potential role of the stump of the occluded artery in the pathogenesis of cerebral ischemia3, 4 make more important our familiarity with the angiographic configuration of the occluded internal carotid artery.

It has been a commonly held assumption that a pointed stump configuration is characteristic of acute occlusion and that the rounded, blunt stump or non-visualization of the stump configuration suggests an older occlusion.

The purpose of this report is to illustrate the angiographic appearance of internal carotid artery occlusion in a series of patients with acute carotid territory stroke.

Method

Over a 3-year period (1973-1976) and as part of a larger study5 on acute carotid territory stroke, 41 patients were encountered with angiographic documentation of extracranial internal carotid artery occlusion. The 41 patients all had brain infarction in the territory of the occluded carotid artery and had cerebral angiography within the first 6 days following the stroke, the majority within 24-48 hours.

Acute carotid stroke was diagnosed if clinically there was a persistent, focal neurologic deficit lasting for greater than 24 hours and indicating ischemic infarction in the brain supplied by the internal carotid artery. Only patients with presumed atherosclerotic occlusive disease were selected. Patients were excluded when they had other conditions such as fibromuscular hyperplasia, carotid dissection, Moyamoya syndrome, etc.

All angiograms were interpreted by neuroradiologists (KRD, GHR). The majority of angiograms were carried out by the transfemoral route with magnification technique. The remainder were done by either the right retrograde brachial or direct percutaneous carotid techniques. The carotid bifurcation was visualized in 2 projections, anterior-posterior and lateral. There was consistency in the occlusion configuration in both views, but only the clearest projection was selected for configuration analysis. Films of the carotid bifurcation were carried out over a period of 4 sec. If any suggestion of antegrade flow above a presumed carotid occlusion was present, then a prolonged series of films over 14 sec were made, including neck and base of skull, to exclude the possibility of a persistent, thread-like residual lumen.

Results

Forty-one patients had total occlusion of the extracranial internal carotid artery. In 21 patients the symptomatic occlusion was on the left, and in 20 it was on the right. Three relative types of angiographic configurations of the proximal end of the occluded artery were identified, in decreasing order of frequency: sharp, pointed stump; virtual absence of the artery at its origin; and a rounded, blunt stump. Hand-traced drawings of the bifurcations are presented in figures 1, 2, and 3.

A sharp, pointed stump (fig. 1) was found in 24 patients (59%). The stump lengths varied from a few millimeters to several centimeters. The stump length was greater than 5 mm in 17 instances. Of the 24, 18 angiograms were performed within 24 hours following onset of stroke, and the remaining 6 were performed between one and 6 days after the stroke.

The proximal end of the internal carotid artery was not visualized (fig. 2) in 12 patients (29%). In this group angiograms were performed within 24 hours following the stroke in 9 and the remaining 3 between one and 3 days after the stroke.

A rounded, blunt stump (fig. 3) was observed 5 times (12%). The stump lengths varied from 3 mm to 1 cm. On two of the patients, angiograms were per-
formed within 24 hours following onset of the stroke, 2 within 3 days, and the fifth at 6 days following the stroke.

**Discussion**

We have reported the appearance of the proximal end of 41 occluded internal carotid arteries as demonstrated by angiography performed within 6 days of acute stroke. It was assumed that the stroke was secondary to the diseased artery. The most frequently encountered configuration was a pointed stump, followed in frequency by virtual absence of the artery, and then a rounded stump.

Previously it has been commonly accepted that the pointed stump configuration is characteristic of acute occlusion and that the rounded stump and non-visualized stump configurations suggest an older occlusion. In this study all types of configurations were seen acutely, suggesting that the angiographic appearance of the occlusion is not necessarily related to the age of the occlusion, at least during the acute
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It may be that a pointed stump configuration does not persist after several weeks, but the present study did not examine chronic occlusion configuration.

While we have assumed that the artery became occluded simultaneously with the recent stroke, several reports have indicated that symptoms of cerebral ischemia, including stroke, can continue to occur subsequent to occlusion of the artery. It should be emphasized that prolongation of the angiographic arterial phase to at least 4 sec is important to determine if there is delayed antegrade flow through an apparent, rather than a real, complete carotid occlusion.

Clinicians often find themselves evaluating the angiographic demonstration of an occluded artery in a recently symptomatic patient and having to decide if the occlusion is recent or remote. Our results suggest that the angiographic appearance of the proximal end of the occlusion may not accurately predict the age of the occlusion in the first 6 days from stroke onset, although a pointed appearance was most often seen.

Regardless of the configuration of the proximal carotid occlusion, another important parameter in suggesting a recent occlusion is the occurrence of retrograde flow of contrast material from the ophthalmic artery down to the cervical internal carotid. Selected patients with stroke having this condition have benefited from acute surgical restoration of cerebral blood flow.

REFERENCES


Correlation Between rCBF and Histological Changes Following Temporary Middle Cerebral Artery Occlusion

AKIRA TAMURA, M.D., TAKAO ASANO, M.D., AND KEIJI SANO, M.D.

SUMMARY Correlations between changes in regional, cortical, cerebral blood flow (rCBF) and histological changes in the corresponding brain regions were examined following middle cerebral arterial occlusion in 24 cats. In all animals, the duration of arterial occlusion was 2 hours followed by 2 hours of recirculation. The animals were divided into 2 groups according to the severity of the observed histological damage. Severe cortical damage was observed in 8 cats (Group A), and, in the remaining 16 cats, little or no cortical damage was seen (Group B). There was a statistically significant difference between these 2 groups in the average rCBF values during ischemia. During recirculation, there was a prompt and uniform recovery of rCBF in animals in group B but a marked diversity of rCBF ranging from hyperemia to oligemia in animals in group A. This diversity of rCBF reflects inhomogeneous blood flow. This study indicates potential hazards for surgical revascularization in the acute stage of stroke when brain damage has progressed beyond a certain level.

SINCE THE DEVELOPMENT of microsurgical techniques, reperfusion of brain distal to an occluded artery and the possibility of its clinical application following an occlusion of a major cerebral artery have been widely investigated. In most instances techniques such as superficial temporal-middle cerebral artery (STA-MCA) anastomosis have been carried out in the chronic stage of stroke with favorable results reported. However, in acute stroke early surgical revascularization with STA-MCA anastomosis or embolectomy of occluded cerebral arteries has seldom been done for fear of causing either an intracerebral hemorrhage or an aggravation of cerebral edema. Occurrence of intracerebral hemorrhage following revascularization of an occluded proximal artery in man and the detrimental effects of post-ischemic hyperemia in animals after stroke have both been reported.

In the present study the influence of early revascularization was investigated hemodynamically and histologically using an animal with regional cerebral ischemia to simulate the efforts of surgical revascularization following proximal arterial occlusion. The inherent technical difficulties of a hemodynamic study in a stroke model are related to the fact that regional cerebral blood flow (rCBF) is
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M S Pessin, G W Duncan, K R Davis, R C Hinton, G H Roberson and J P Mohr

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