TABLE 4. Relationship between Mental Status Measures and Outcome Criteria

<table>
<thead>
<tr>
<th>Mental status measures</th>
<th>Average functional status at discharge</th>
<th>Discharge destination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tau</td>
<td>p</td>
</tr>
<tr>
<td>Orientation</td>
<td>.35**</td>
<td>.001</td>
</tr>
<tr>
<td>Other cognitive measures</td>
<td>.48**</td>
<td>.001</td>
</tr>
<tr>
<td>Aphasia</td>
<td>-.25**</td>
<td>.006</td>
</tr>
</tbody>
</table>

**Significant at the .01 level.

The etiology of the thrombi may partly be related to underlying cerebral pathology, others were composed of individuals without other evidence of neurological abnormality. The present investigation demonstrates that such reflexes are common in those stroke patients who are selected for inpatient rehabilitation. The presence of developmental reflexes was found to be negatively related to favorable treatment outcome. The strength of the relationship was too small to be useful in the selection of patients or the prediction of outcome. A research design which does more than examine the presence of reflexes at one time might better establish their predictive nature in relation to directed motor activity.

References

Disappearing Carotid Defects

PHILIP YARNELL, M.D., MICHAEL EARNEST, M.D., GLENN KELLY, M.D., AND BOB SANDERS, M.D.

SUMMARY Large intraluminal cervical carotid artery filling defects consistent with mural thrombi were angiographically demonstrated during acute hemispheric neurologic episodes. These thrombi disappeared benignly as shown by serial angiography in 2 patients treated with intravenous heparin and spontaneously in 1 patient treated surgically. Thus, partially obstructing cervical carotid artery thrombi may lyse either with the use of anticoagulant therapy or else spontaneously.

The etiology of the thrombi may partly be related to underlying atheromatous disease.

CAROTID ARTERY DISEASE is a common cause of cerebral dysfunction. Pathophysiologically, carotid stenosis, occlusion, ulceration, dissection, inflammation, mural thrombus and trauma have all been implicated.1-4

A large intraluminal carotid artery filling defect shown by arteriography suggests a thrombus.5 The imminent danger of such a clot is either distal embolization or progression to occlusion. The neurologic symptoms and signs may be related to either regional flow insufficiency or embolization or both. Discovery of an intraluminal lesion requires immediate decisions about treatment.

We have recently treated 3 patients with large intraluminal carotid defects and probable distal embolization. Two were treated with anticoagulation and the third had surgical exploration. In all 3 cases the presumed carotid clot...
disappeared. The findings and course in these patients help
to define the natural history of some of the carotid intra-
luminal lesions.

Reports

Patient No. 1

A 46-year-old Caucasian, right-handed man with chronic
obstructive pulmonary disease, bronchiectasis, mild hyper-
tension, angina, and gout developed an acute right temporal
headache, speech difficulty and visual blurring. After an
hour, he noted left body weakness. He specifically denied
neck trauma.

Examination revealed a moderate left hemiparesis, hemi-
sensory loss and homonymous hemianopsia. Over the first 2
hospital days his deficits worsened.

Laboratory examination showed normal spinal fluid; non-
contributory cardiovascular evaluation included electro- and
echocardiography and there was negative collagen vascular
disease evaluation. Clotting studies revealed a decreased ac-
tivated partial thromboplastin time with normal pro-
thrombin times and platelet counts. Without obvious cause
he developed anemia with his hematocrit falling from 35 to
28 but this responded to folic acid.

Beginning on his fifth hospital day, he was treated with
oral sulfinpyrazone and intravenous heparin until day 18. He
also received steroids (dexamethasone).

Serial radionuclide studies revealed persistent decreased
right-sided perfusion with an evolving right parieto-occipital
static uptake.

Retrograde right brachial angiography on day 1 showed a
right middle cerebral artery posterior trunk occlusion by an
intraluminal filling defect. The extracranial vasculature was
not studied. On day 4 a transfemoral right carotid angi-
ogram showed a large smooth sausage-shaped intraluminal
mass in the proximal internal carotid artery (fig. 1). The
right middle cerebral artery was occluded more proximally
than on day 1 and there was suprasylvian mass effect.
Repeat transfemoral right carotid angiogram on day 19 no
longer showed an intraluminal filling defect. There was only
a small smooth plaque in the proximal internal carotid
artery (fig. 2).

Seventeen months after his initial infarction, he had
evidence of further right hemisphere injury. He developed a
severe right temporal headache followed by left visual field
hallucinations. Radionuclide images show a new area of
right posterior parietal infarction. He complained of in-
creased spasticity. Laboratory evaluation again failed to
demonstrate a cardiac, hematologic or collagen vascular
etiology. A computerized tomographic (CT) scan showed
extensive right parietal infarction. Angiography showed
slight increase in the size of the right internal carotid plaque
plus persistence of the paucity of the right posterior parietal
circulation.

He has continued to have intermittent seizures despite
anticonvulsants. He has a dense, spastic, left hemiplegia,
sensory loss and homonymous hemianopsia.

![Figure 1. Patient 1, day 4: Common carotid angiogram with arrow demonstrating the large intraluminal filling defect in the cervical internal carotid artery.](image1)

![Figure 2. Patient 1, day 19: Slight atheromata at base of formerly present thrombus.](image2)
Patient No. 2

A 49-year-old right-handed Caucasian housewife developed nausea, vomiting and mild headache. She awoke early the next morning with a left arm paresis, rightward gaze preference and headache. For the preceding months, she had had episodes of transient blurring of vision. She specifically denied neck trauma.

She had been taking birth control pills 3 years because of menometrorrhagia. She also had been taking 1 grain of thyroid extract daily, chronically.

Her initially flaccid, paretic left arm evolved within a day to a spastic paresis. Her gaze preference resolved after admission, but she still maintained left-sided inattention to visual and tactile stimuli.

Pertinent laboratory findings included: a hypochronic, microcytic, anemia with a hematocrit of 30, a 608,000 platelet count and a low antithrombin III level. Initial, normal or noncontributory findings included: chest x-ray, echocardiograms, blood chemistry panels, spinal fluid, prothrombin and activated partial thromboplastin times.

Radionuclide images showed initial symmetrical perfusion later evolving into a right-sided decrease, and an evolving right fronto-parietal static uptake. CT scans evolved from normal on day 1 to a right posterio-frontal infarction picture. Transfemoral right carotid angiography on day 2 showed a large, irregular, intraluminal mass attached to the bifurcation of the common carotid, (fig. 3). There was also occlusion of some middle and anterior cerebral artery branches with retrograde flow into the angular branch of the middle cerebral artery. Repeat angiography at 5 weeks showed only small, smooth indentations of the right internal and external carotids at the bifurcation (fig. 4). The intracranial vasculature was normal.

Birth control medication was discontinued on admission and she was treated initially with sulfinpyrazone. On day 3, sulfinpyrazone was stopped and she was started on intravenous heparin. Over the subsequent 2 weeks, she was gradually switched to oral anticoagulation with warfarin.

At 5 weeks, anticoagulation was discontinued and her antithrombin III level had become normal. She continued with severe left hand weakness and inattention to stimuli on her left side. There was continued improvement over the next 9 months with only mild residual left hand clumsiness.

Patient No. 3

A 66-year-old Caucasian woman had recurrent bouts of left hand weakness and numbness. Her symptoms had begun 2 years previously with a severe episode lasting 10 days. Subsequent brief episodes occurred 1 year, 3 weeks and immediately before admission.

Examination revealed a slightly weak left hand with diminished sensation to pin and touch. There was a harsh right carotid bruit. Preliminary laboratory tests were normal and included: CBC, biochemical survey, coagulation panel, ECG, EEG and CT scan.

A transfemoral right carotid arteriogram showed an estimated 95% stenosis of the proximal internal carotid artery.
with a large, poststenotic, intraluminal filling defect (fig. 5). The intracranial vessels were normal.

Within 5 hours she underwent right carotid artery exploration. There was no palpable thrill. Great care was exercised to avoid possible embolization of loose clot or atheroma. After systemic heparinization, the mean internal carotid artery stump pressure was measured (110 mm Hg) and an arteriotomy performed without the use of a temporary shunt. There was a thick atheromatous plaque involving the carotid bifurcation. The proximal one cm of internal carotid artery contained a 95% stenosis and a 1 mm ulcer on its posterior wall. No evidence of intraluminal thrombus was found at or above the atheroma. Neither back flushing nor Fogarty catheter exploration of the cervical portion of the internal carotid artery produced any thrombus. A standard endarterectomy was performed.

Postoperatively the patient made an uneventful recovery. Her left hand became stronger; and she and her family reported that her cognitive function improved.

Discussion

An intraluminal filling defect seen on angiography fulfills the definition of a thrombus if it is at least partly surrounded by contrast material.5 This was the finding in patients #2 and #3. In patient #1, the defect was demonstrated as bulging into the lumen. The differential diagnosis of that defect was a mural lesion or an intraluminal clot. The absence of a history of trauma, the angiographic finding of probable distal embolization and the eventual course, and subsequent disappearance of the filling defect led to a diagnosis of intraluminal thrombus in this case also.

The natural history of large, intraluminal, carotid clots is still unclear. Possibilities include progressive thrombosis, distal embolization of fragments or the entire clot, stabilization or disappearance. In each of our patients the clot disappeared, 2 with anticoagulation therapy and the third spontaneously. Distal embolization remains a remote possibility but this was not shown in the follow up angiography in patients #1 and #2 so studied; nor was there any clinical suggestion of embolization after the carotid clot was discovered and treated in any of the patients.

Although in patients #1 and #2 the carotid clot was no longer demonstrated on follow up angiography, there were small, smooth plaques at the base of the former filling defects. In patient #1 this plaque had further increased in thickness when he had arteriography at 17 months following another right cerebral infarction. This suggests that a banal appearing atheroma may, in combination with as yet undefined other factors, serve as a nidus for the formation of a large superimposed thrombus. Patient #2 had the known thrombogenic stimulus associated with birth control medication4, 6 and thrombocytosis. Both patients #1 and #2 had evidence on their earliest angiograms of intracranial embolization with branch filling defects as described by Ring.7 These defects presumably originate from or are simultaneous with their carotid lesions. Patient #3 had her carotid clot in association with an atheromatous carotid stenosis. All these findings suggest some relationship between atheroma and the thrombus, a previously suggested association.8

Intravenous heparin infusion was the major therapy in patients #1 and #2. The anticoagulation was started on day 5 in patient #1 and on day 3, in patient #2 following the method described by Genton,9 and using the activated partial thromboplastin time (PTT) to monitor the therapy. We aimed for a PTT of once and one-half to twice control.

Patient #3 underwent carotid endarterectomy just 5 hours after demonstration of her carotid filling defect near the site of her ulcerated and highly stenotic atheromatous plaque. Despite a careful and vigorous search at surgery no intraluminal clot was detected. It was feared that intraoperative distal embolization had occurred. However, the patient had no change in her neurologic status. The failure to find an angiographically well seen carotid thrombus at subsequent carotid surgery was noted in 1 of 8 operated patients described by Roberson, Scott and Rosenbaum,6 but not explained. Siebert and Swanson10 have also described such an occurrence and pointed out the similarity to radiologically defined disappearing pulmonary artery thrombi.

Internal carotid artery occlusion with early spontaneous restoration of flow has been angiographically documented.10, 11 Thromboembolus migration, fragmentation or complete lysis have been offered as possible explanations. Many of these cases have shown sanguinous spinal fluid as indication of hemorrhagic infarction.11-13 Hemorrhagic infarction has also been a complication of the early surgical embolectomy on patients with infarction.9 Fortunately, our patients did not have this complication.

FIGURE 5. Patient 3: Carotid angiogram demonstrating intraluminal thrombus (arrow) just distal to internal carotid artery origin high grade stenosis.
Leptomeningeal Artery Atherosclerosis Visualized by Angiography: Clinical Correlates

DAVID S. KNOPMAN, M.D., DAVID C. ANDERSON, M.D., ANGELINE MASTRI, M.D., AND DAVID LARSON, M.D.

SUMMARY Circumscribed atherosclerotic involvement of secondary and tertiary branches of major cerebral arteries is a common angiographic finding whose nature is rarely in question. However, widespread and severe changes are unusual, and radiologic interpretation may be more difficult. We recently cared for a patient whose angiogram demonstrated extensive involvement of leptomeningeal vessels and were prompted to review the clinical courses and autopsy findings of a number of other patients with similar angiographic findings. Our observations suggest that the radiological appearance of leptomeningeal artery atherosclerosis can be confused with that of an arteritis. Atherosclerosis of leptomeningeal arteries is strongly associated with a history of arterial hypertension and seems to parallel arterial lesions thought responsible for lacunar infarction and intraparenchymal hemorrhage.

ATHEROSCLEROTIC INVOLVEMENT of the secondary and tertiary branches of the major cerebral arteries is common.1, 2 That more extensive involvement may cause small vessel angiographic arteriopathy similar to that produced by various inflammatory diseases is, however, poorly documented in the literature.2, 3 In contrast to atherosclerosis of the cervical vessels or circle of Willis, and in contrast to the intraparenchymal arteriolar sclerosis not seen angiographically, leptomeningeal artery atherosclerosis visualized at angiography has incited few efforts to describe clinical correlates.4, 5 We recently cared for a middle-aged patient whose clinical course and angiographic findings were, we thought, compatible with inflammatory arteriopathy. Postmortem studies, however, disclosed the presence of marked atherosclerotic involvement of the smaller surface arteries, while the larger vessels were spared. The case emphasizes the necessity, we believe, for histologic confirmation prior to initiating anti-inflammatory therapy for cerebral "vasculitis" suspected on angiographic and clinical grounds. The case, furthermore, stimulated an examination of the literature and of our previous clinical experience with angiographically demonstrable small-vessel atherosclerosis with the purpose of defining characteristic clinical and pathological correlates of the radiologic entity. Our findings suggest that such leptomeningeal artery disease occurs most commonly in hypertensive patients and perhaps in those with diabetes mellitus. It appears that the pathogenetic mechanisms responsible for the production of leptomeningeal artery atherosclerosis may be more akin to...
Disappearing carotid defects.
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