Limitations of Radionuclide Flow Studies in Bilateral Carotid Thrombosis

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Abstract: Radionuclide angiography as a noninvasive procedure has become an important tool in the evaluation of cerebrovascular diseases. Determinations of arm-to-brain circulation times complemented by the transit times of the radionuclide bolus through the brain afford insight into the functional status of the vascular system of the brain. Delays in perfusion, asymmetries in appearance, and washout of the radionuclide material can be correlated with disease entities. However, as with many procedures elevated to the status of a screening test, the possibility of false-positive and false-negative results exists. Two cases of bilateral carotid occlusion are presented, showing normal or only delayed, fairly symmetrical brain perfusion. The appearance of the radionuclide flow in the neck in AP and lateral views gave no suggestion of the involved deficits. Even multiple-projection imaging might fail to demonstrate major vascular obstructions. However, attentive study of these projections might yield interesting evidence of unexpected collateral flow systems.

Introduction

The diagnostic approach to the patient with cerebrovascular disease has undergone great change in the last decade. The recognition that occlusive processes in the relatively accessible great vessels in the neck could underlie many of the classic “stroke syndromes” generated a major interest in visualization of the major arterial supply to the brain. Angiography, utilizing radiopaque contrast materials, is an extremely effective technique but the attendant complications, especially in the elderly, make this a major diagnostic procedure and not a routine screening test. Radionuclide angiography, however, is a relatively benign procedure that has enjoyed wide acceptance as a reliable and safe technique for the diagnosis of cerebrovascular disease. Unfortunately, as with many diagnostic tests that are elevated to the status of a screening procedure, the possibility of a false-negative result is often not considered and a report of a “normal flow study” is taken to mean the absence of significant cerebrovascular disease. We wish to draw attention to the possibility of false-negative radionuclide angiography by reporting two cases of bilateral occlusion of the internal carotid vessels in patients with normal-appearing radionuclide flow studies.

Case Reports

CASE 1

A 48-year-old white man was admitted to the Madison Veterans Administration Hospital for evaluation of cerebrovascular disease. Three years prior to admission he had sudden onset of left hemiparesis which was diagnosed as a "stroke." One year prior to admission he had experienced abrupt loss of consciousness following which he had become dysarthric, dysphonic and emotionally labile. There was no personal or family history of heart disease, hypertension or diabetes.

Neurological examination revealed marked emotional lability with paroxysmal, inappropriate, tearless crying, aphony, drooling and increased jaw jerk. All deep reflexes were hyperactive and fairly equal but no Babinski signs were elicited. The patient was fully ambulatory but the gait was somewhat awkward and hesitant. CBC, BUN, electrolytes, cholesterol and EKG were normal. Fasting blood sugar (FBS) was 124 mg %. EEG was "minimally abnormal." The technetium pertechnetate flow study was normal (fig. 1) with brain transit times in the hemispheres of 16 seconds on the right and 12 seconds on the left.

A femorocerebral angiogram (fig. 2) revealed occlusion of the left common carotid artery 1 cm distal to its origin from the aorta and occlusion of the right internal carotid artery at its origin with an arteriosclerotic plaque in the distal right common carotid artery, and stenosis (30%) of the right external carotid artery. The right vertebral artery was markedly dilated and had stenosis (50%) at its origin. The ascending cervical branch of the left thyrocervical trunk was markedly dilated and supplied the vertebralbasilar distribution through collaterals to the left vertebral artery.

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This work was done at the Veterans Administration Hospital, 2500 Overlook Terrace, Madison, Wisconsin 53705.
CASE 2
A 52-year-old man was admitted to the Madison Veterans Administration Hospital with a history of sudden onset of left hemiparesis in 1972 and right hemiparesis with aphasia in 1973. Following this second event he had a seizure disorder treated with diphenylhydantoin, 300 mg daily.

Neurological examination revealed a nonfluent aphasia, generalized weakness, symmetrical hyperreflexia and bilateral extensor plantar responses. CBC, FBS, BUN, electrolytes, cholesterol and triglycerides were normal. An EKG showed an old inferior wall myocardial infarction; EEG revealed slowing in the left hemisphere anteriorly. A technetium pertechnetate flow study revealed a delayed but relatively symmetrical perfusion of the right and left cerebral hemispheres (fig. 3).

A femorocerebral angiogram (fig. 4) revealed occlusion of both internal carotid arteries at their origins. The vertebral arteries were dilated bilaterally.
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Discussion

In both cases, the anteroposterior radionuclide flow study showed normal amounts of activity in the neck and symmetrical arrival and distribution of the radionuclide at the hemispheres. A slight delay in arrival time of radionuclide in Case 1 and a greater delay in Case 2 were clues to the presence of some abnormality but not to occlusion of the carotid systems bilaterally. The apparent normal radioactivity in the neck was due to enlarged vertebral and ascending cervical arteries in Case 1, and bilaterally enlarged vertebral arteries in Case 2. Pathways of extracranial collateral flow are well known, and include the ophthalmic artery, the artery of the pterygoid canal, the caroticotympanic artery as well as other carotico-carotid, subclavian-carotid and subclavian-vertebral collaterals.4

The study of these patients allows one to emphasize certain points about radionuclide angiography.

1. A normally appearing sequential radionuclide flow pattern does not preclude the existence of significant, severe cerebrovascular disease.
2. Calculation of arrival time of radionuclide at the hemispheres and transit time evaluation are a mandatory part of the procedure.
3. The resolution of the radionuclide images in

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Flow study in the anterior position showing radionuclide to be symmetric in time and distribution in the carotid regions, however, with prolonged transit time.

Right lateral flow study showing normal distribution of radioactivity in the internal carotid and middle cerebral artery distributions, and a normal venous return pattern.

the single AP view and even the combined AP and lateral views of the sequential radionuclide flow pattern is inadequate to differentiate between carotid system and basivertebral flow in the neck. Additional
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10 sec 14 sec 18 sec 22 sec
26 sec 30 sec 34 sec 30 sec

Vertex view flow study showing intracranial arterial distribution to be symmetric and outlining the middle and anterior fossa vessels. (In this projection the injection bolus in the left axillary vein is seen at ten seconds.)

posterior and vertex views may be necessary to detect the existence of complex collateral flow patterns.

4. Thorough analysis of radionuclide flow studies could result in better understanding of the many vital collateral systems becoming operative in vascular diseases of the brain.

5. It is almost axiomatic that a patient surviving bilateral carotid thrombosis in a fairly functional manner must have unusually effective collateral systems.

References
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