jnm/CASE REPORT

THE "LUXURY-PERFUSION SYNDROME" FOLLOWING A CEREBROVASCULAR ACCIDENT DEMONSTRATED BY RADIONUCLIDE ANGIOGRAPHY

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A radionuclide angiogram done with ^{99m}Tc immediately after the onset of symptoms of a cerebrovascular accident revealed the expected findings of decreased flow on the affected side. However, a repeat study 11 days later showed markedly increased flow in the same area with pronounced uptake also seen on the early static images. By 23 days, the flow pattern and early static images had reverted to normal. This sequence appears to represent a radionuclide demonstration of the "luxury-perfusion syndrome" and supports the hypothesis that the occurrence of this syndrome in ischemic cerebrovascular disease is a transient, time-dependent phenomenon. Clinicians should be aware that this pattern of increased flow can be compatible with the diagnosis of stroke.

The standard 1-hr delayed brain scan done with ^{99m}Tc generally becomes positive within 2–3 weeks following an acute cerebrovascular accident, then reverts to negative within 3–4 months (*1,2*). Rapid-sequence radionuclide angiography often demonstrates decreased flow through the affected cerebral artery immediately following the onset of the stroke. Several weeks later, the radionuclide angiogram may revert to a normal, symmetric flow pattern. One may also note a delayed increase in flow through the affected hemisphere (the so-called flip-flop phenomenon), implying the development of collateral flow (*3,4*). However, both Rosenthall (*4*) and Handa (*5*) have noted early increased flow on the side of the lesion in rare cases. The following case report details a transient period of hyperperfusion of an area of infarcted brain using radionuclide angiography, brain scanning, and computer analysis of flow patterns.

CASE REPORT

A 66-year-old woman was admitted to the Strong Memorial Hospital following the abrupt onset of a left hemiplegia and a left homonymous hemianopsia. A radionuclide angiogram done with 15 mCi of ^{99m}Tc on the following day revealed markedly diminished flow through the right middle cerebral artery (Fig. 1). A static brain scan done 1 hr after injection was normal. The findings were felt to be consistent with a recent occlusion of the right middle cerebral artery.

The patient did not improve and was restudied 11 days later. The radionuclide angiogram now showed an immediate, marked increase in flow through the right middle cerebral artery. Both the immediate and the 1-hr delayed brain scans showed increased uptake in the right midparietal region in a pattern corresponding to the distribution of the right middle cerebral artery (Fig. 2). The flow rates through the middle cerebral arteries were analyzed by computer (Fig. 3). The curves indicate simultaneous arrival of radionuclide at both middle cerebral arteries with identical peak count times; however, the right middle cerebral artery curve showed a higher peak and a higher plateau than the left, demonstrating abnormal concentration of radionuclide. The studies were thought to show hyperperfusion of the previously compromised right middle cerebral artery associated with cerebral infarction.

After some return of neurologic function was observed, a final radionuclide angiogram and brain scan were done 23 days after the initial onset of symptoms. This study showed a normal, symmetric

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flow pattern and computer analysis of the flow curves revealed no significant differences. The immediate scan was now negative whereas the 1-hr delayed scan remained positive.

DISCUSSION

Bright red cerebral veins have been identified at surgery in many pathologic entities including vascular malformations, tumors, and infarctions (*6*). Lassen (*7*) noted that in the absence of direct arteriovenous communications this phenomenon could result from cerebral anoxia leading to metabolic acidosis in the affected area. The acidosis, causing vascular endothelial damage, abolishes the normal cerebral autoregulation of blood flow. With clot lysis, resumption of perfusion through the damaged circulation which is dilated results in increased blood flow which exceeds the metabolic requirements of the tissues. An abnormally small extraction of oxygen occurs as the blood passes through the infarcted area of brain and the bright red cerebral veins result. Lassen termed this condition the "luxury-perfusion syndrome." Taveras (*8*) has described the findings in conventional contrast angiography following cerebrovascular occlusion and has noted that persistent vasodilatation distal to the lesion may occur following occlusion. This phenomenon results in the appearance of early-draining veins on arteriogram and was always demonstrated less than 2 weeks after the onset of symptoms.

In the case presented here, the initial radionuclide angiogram demonstrated the expected decrease of flow through the right middle cerebral artery, followed 11 days later by the unusual occurrence of markedly increased flow through the same vessel and positive immediate and delayed scans. Finally, there was a return to normal, symmetric flow in both middle cerebral arteries 23 days after the onset of symptoms. On the final study, the immediate brain scan was normal whereas the delayed scan was still positive. The computer curves, demonstrating simultaneous peaks on the right and left sides, indicated that the increased flow through the right middle cerebral artery was definitely due to immediate hyperperfusion and was not the result of collateralization. The positive immediate scan on the second study also supports the supposition that the abnormality is due to increased blood flow through this region. With the return to a normal, symmetric flow pattern on the last study, the immediate scan became negative. These findings suggest that the "luxury-perfusion syndrome" can be demonstrated by radionuclide angiography and that it is a time-dependent, transient phenomenon occurring during the early weeks following the onset of a cerebrovascular accident. This state of hyperemia following the resumption of flow through a damaged cerebral vessel may explain Rosenthall's (*5*) findings of increased perfusion on the side of the lesion in several cases. Clinicians should be aware that reactive hyperemia can follow stroke and produce this variant in the appearance of a cerebrovascular accident by brain scan.

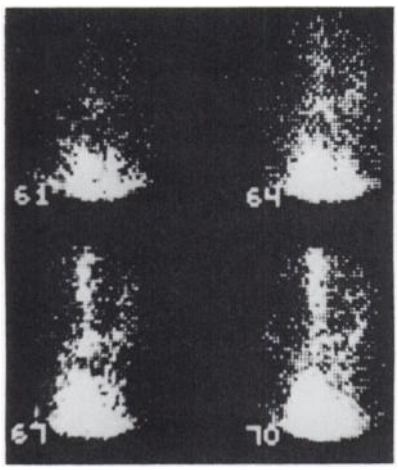

FIG. 1. Selected frames from initial radionuclide angiogram demonstrating decreased flow through right middle cerebral artery.

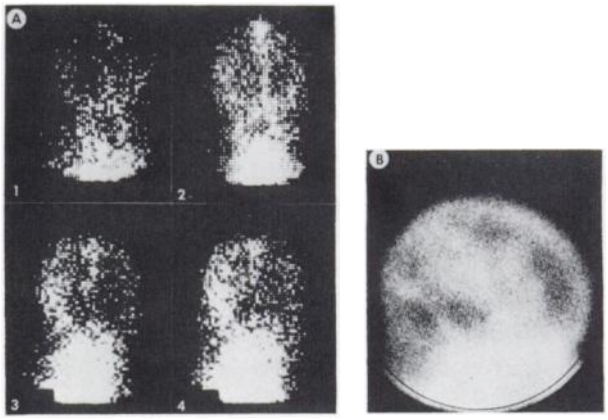

FIG. 2. (A) Selected frames from radionuclide angiogram done 11 days after onset of symptoms. (B) Immediate right lateral brain scan showing increased uptake in right midparietal region.

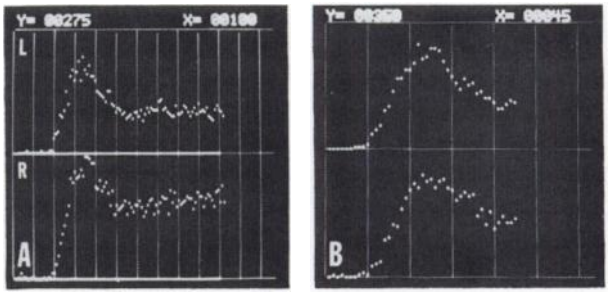

FIG. 3. Computer flow curves showing (A) increase in perfusion of right middle cerebral artery on second study 11 days after onset of symptoms, (B) return to normal, symmetric flow 23 days after admission.

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