An Unusual Cause of Apparent Regional Hyperperfusion on Radionuclide Cerebral Angiography Study: Case Report

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An unusual pattern of radioactivity in the venous phase was noted in the ^{99m}Tc-DTPA cerebral angiogram of a patient with persistent headaches. Initially the possibility of a small arteriovenous malformation with large draining veins was considered. However, contrast angiography revealed dilated cerebral veins with significant arteriovenous shunting. The differential diagnosis of regional hyperperfusion on the radioactivity study is discussed.

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For the differentiation of intracranial lesions seen on the static brain scan, the value of a radionuclide cerebral perfusion study has now been established (*1,2*). Such lesions as meningioma, glioblastoma multiforme, arteriovenous malformation, and aneurysm can usually be detected by a localized increase in radioactivity in the early arterial phase of the cerebral perfusion study. Recently, acute cerebrovascular accidents associated with "luxury perfusion" and status epilepticus have been added to the list of conditions associated with regional hyperperfusion (*3,4*). In this case report, the apparent increased regional activity was related to congenital dilatation of cerebral veins.

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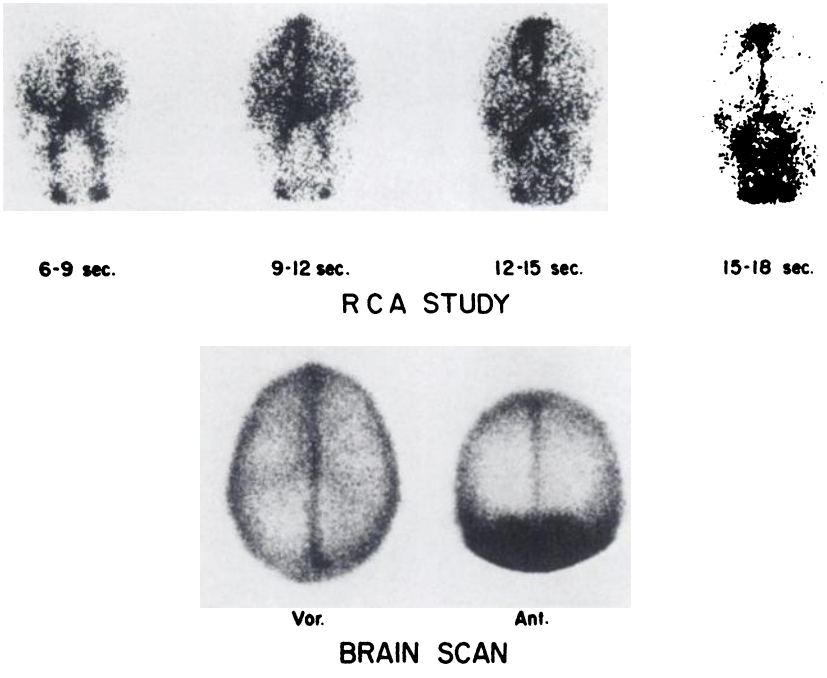

FIG. 1. Radionuclide cerebral angiography using 25 mCi of ^{99m}Tc-DTPA. Arterial phase (6–9 sec) is normal. Abnormal blood pool activity is seen in venous phase (9–12 and 12–15-sec frames); 15–18-sec frame shows disappearance of activity. Subsequent static images (bottom) are normal.

CASE REPORT

For evaluation of chronic persistent headaches, a 40-year-old white woman was referred for a cerebral perfusion study and brain images. Her headaches, which generally involved the right side of the head, had been occurring for 20 years, but recently their frequency had increased. There were no associated symptoms, and physical examination was essentially unremarkable except for the presence of a left carotid bruit. A cerebral perfusion study and brain scan were performed using 25 mCi of ^{99m}Tc-DTPA (diethylenetriaminepentaacetic acid). Rapid-sequence images obtained in the anterior view at 3-sec intervals revealed symmetric distribution of the radioactivity in both carotids and in the distribution of the anterior and middle cerebral arteries. Early appearance of the superior sagittal sinus was observed, along with an unusual area of increased activity projecting to the right of the midline in an inverted "Y" configuration. This blush of activity diminished rapidly due to venous drainage (Fig. 1). The static images were normal. The unusual pattern suggested an arteriovenous malformation (AVM). However, contrast carotid angiography revealed a prominent dilated superficial cerebral vein on the right, draining into the sagittal sinus. There was no evidence of an AVM (Fig. 2).

DISCUSSION

Focal increase in radioactivity, seen on radionuclide cerebral angiography, is generally a significant finding and requires suitable explanation. Review of the literature indicates that several conditions may be associated with this phenomenon. Among these are the congenital lesions, such as AVM and intracranial aneurysm. These present most often with focally increased activity in the arterial phase. In aneurysm, the capillary and venous phases are generally normal. Arteriovenous malformation, however, shows additional evidence of early venous drainage (*5,6*). In such tumors as meningioma or other vascularized primary intracranial neoplasms (e.g., glioblastoma multiforme or hemangiopericytoma), markedly increased activity seen in the early arterial phase persists through the entire capillary and venous phases (*1,2*).

Recently, in some cases of acute cerebrovascular accident, regional hyperperfusion was noted in the involved area of the brain. This phenomenon was transient, however, and subsided with the recovery

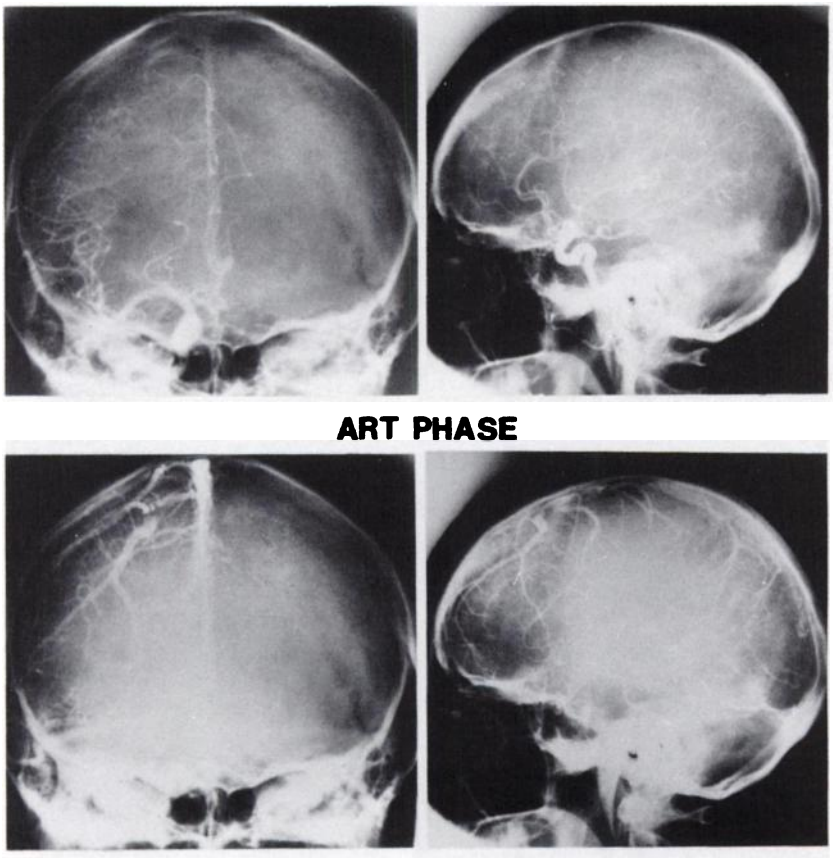

FIG. 2. Contrast angiography confirms presence of large dilated cerebral veins.

TABLE 1. CONDITIONS ASSOCIATED WITH REGIONAL HYPERPERFUSION ON RADIONUCLIDE CEREBRAL ANGIOGRAPHY

Clinical conditions	Radionuclide cerebral angiography			Followup studies
	Arterial phase	Capillary phase	Venous phase	
Congenital				
Arteriovenous malformation	Early focal increase	Quick capillary transit	Early appearance of superior sagittal sinus	No change
Aneurysm	Early focal increase	Normal	Normal	No change
Dilated cerebral veins	Normal	Normal	Abnormal pooling in venous structures	No change
Neoplastic				
Glioblastoma multiforme	Early focal increase	Persistent increase	± Early venous drainage	Unchanged; no surgery
Meningioma	Early focal increase	Persistent increase	± Early venous drainage	
Vascular				
Acute stroke ("luxury perfusion")	Early focal increase	Quick capillary transit	Early venous drainage	Transient; not present on followup
Metabolic				
Seizure disorder	Early focal increase	Normal	Normal	Transient; subsided after seizure disorder

phase (*3*). This finding, termed "luxury perfusion," was explained by Lassen through radioxenon washout studies in patients with acute stroke (*4*). Transient arterial hyperperfusion thus depicts capillary dilation in response to acute stroke and the resultant local metabolic acidosis in the brain tissue (*4,5*). A similar type of transient regional increase in perfusion on radionuclide cerebral angiography has been described in patients with recent seizures, apparently due to the increased regional metabolic activity of the brain (*4*). The case presented here is unusual in that increased radioactivity was seen only in the venous phase. The possibility of a small AVM with large draining veins was considered at first, but contrast angiography revealed only dilated superficial cerebral veins. Dilated veins are a benign cause of apparent regional hypervascularity seen in the venous phase only. A summary of the conditions presenting with regional hyperperfusion is presented in Table 1.

As the clinical applications of brain scanning increase, more variations are being brought to light. It is important that normal variations be considered in the interpretation of the study.

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