EVALUATION OF THE POSTERIOR FLOW STUDY IN BRAIN SCINTIGRAPHY

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To evaluate the usefulness of the posterior cerebral flow study, a prospective study was instituted. Of 32 adult patients examined for presumed posterior disease, 17 were found to have a positive posterior flow study that yielded information not available from the anterior study. Indications for posterior flow studies include posterior parietal, occipital, and posterior fossa tumors, posteriorly located arteriovenous malformations, Paget's disease involving occipital bone, posterior cerebral infarcts, and sagittal sinus occlusions. Our experience indicates that the posterior flow study is a valuable adjunct in those patients carefully screened for suspected posterior cerebral disease.

Dynamic cerebral bloodflow studies, as a component of brain imaging, have become widely accepted as a valuable precursor to static brain imaging (*1–4*). The additional information relating to the vascular nature of a lesion obtained from the dynamic flow study is often helpful for the proper interpretation of the static images. In many institutions the anterior flow study, prior to static imaging, has become routine. The use of the lateral, vertex, and posterior views to assess cerebral vascular dynamics has also been reported (*5–7*).

Our experience suggested that the posterior flow study may be a worthwhile examination in selected patients. This thought prompted us to initiate a study to evaluate the posterior flow study in brain imaging. A careful review of the history and physical examination of patients sent to the Nuclear Medicine Service for brain scans was conducted in an attempt to select those patients suspected of disease in the posterior half of the head. The posterior flow study was presumed to be useful in posterior parietal, occipital, and posterior fossa tumors, posteriorly located arteriovenous malformations, Paget's disease involving the occipital bone, posterior cerebral infarcts, and sagittal sinus occlusion. Thirty-two adult male patients were selected and form the basis for this report.

The studies were all performed using 20 mCi of ^{99m}Tc-pertechnetate and an Anger Pho/Gamma HP camera with a high-sensitivity collimator. A Radx

Received July 1, 1975; revision accepted Aug. 12, 1975.

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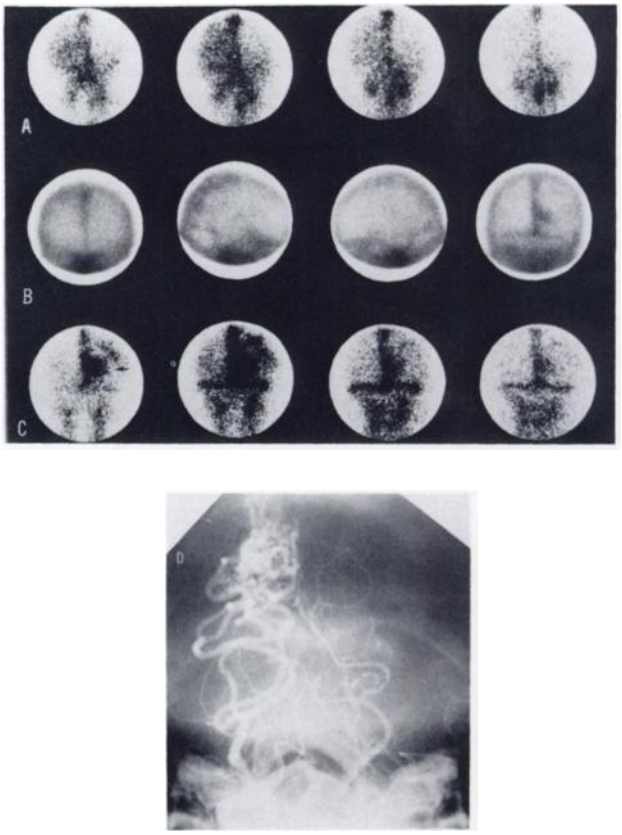

FIG. 1. Arteriovenous malformation of right posterior cerebral artery shown on posterior flow study. (A) Anterior flow study; (B) static brain images; (C) posterior flow study; and (D) posterior fossa arteriogram.

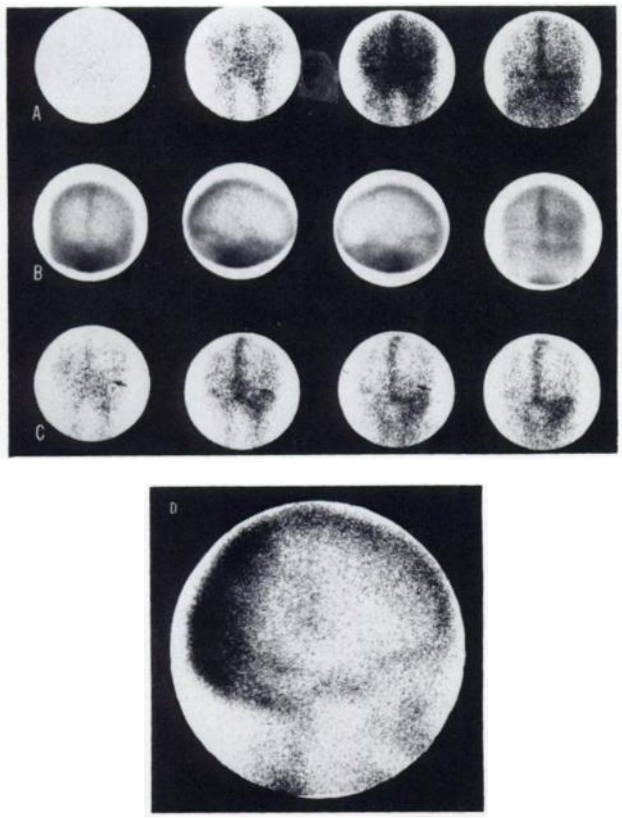

FIG. 2. Paget's disease of occiput shown as region of increased vascularity on posterior flow study. (A, C) Posterior flow studies; (B) static brain images with increased activity in right occiput; and (D) ^{99m}Tc-pyrophosphate scintiphoto of right lateral skull showing increased activity in occipital bone.

Scinti-Cam 750 permitted sequential pictures at 3-sec intervals during the dynamic studies.

CASE REPORTS

Case 1. A 26-year-old man presented with a 2-year history of generalized headaches and tinnitus. Neurologic examination, including auscultation of the head, was normal. The anterior flow study shows increased activity in the right hemicerebrum, while images reveal localized increased activity in the right occipital region (Fig. 1). The posterior flow study shows a highly vascular localized lesion with early venous filling in the posterior occipital area. At angiography an arteriovenous malformation was found.

Case 2. A 65-year-old man had a 3-month history of dizziness and occipital headaches. A brain scan indicated normal anterior flow and static images showed increased peripheral activity in the right occipital region. Skull x-rays were interpreted as normal. The posterior flow study shows the skull lesion to be hypervascular (Fig. 2). These findings, plus an elevated alkaline phosphatase, led to the diagnosis of early Paget's disease of bone.

Case 3. A 42-year-old man presented with severe headaches and a left supraclavicular mass. Neurologic examination revealed papilledema consistent with increased intracranial pressure. The brain scan shows poor visualization of intracerebral vessels on the anterior flow study, with increased activity in the occipital bone noted on static images (Fig. 3). Posterior flow again gave poor definition of intracerebral vascular structures (a manifestation of increased intracranial pressure) and apparent obstruction of the sagittal sinus with collateral drainage of veins. Biopsy of the occipital skull lesion and left supraclavicular mass revealed undifferentiated squamous cell carcinoma. Autopsy findings verified sagittal sinus thrombosis.

Case 4. A 50-year-old man presented with a 4-week history of declining mentation. The brain scan indicates normal anterior flow but the static images reveal a dumbbell-shaped lesion of increased activity extending on both sides of the midline in the parietal region (Fig. 4). The posterior flow study reveals the lesion to have a vascular pattern consistent with tumor. Tumor vessels were present at angiography, and needle biopsy revealed a Grade-3 astrocytoma.

Case 5. A 69-year-old man presented with confusion and a left homonymous hemianopia. The pos-

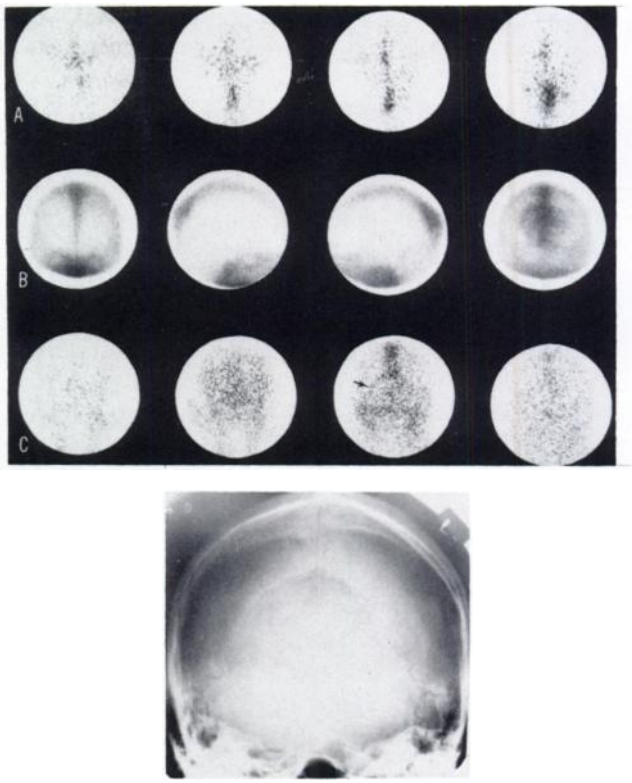

FIG. 3. Sagittal sinus occlusion is shown on posterior flow study. Arrow indicates venous collateral from point of obstruction. (A) Anterior flow study; (B) static images; (C) posterior flow study; and (D) Towne's view of skull showing lytic destructive lesion of occiput.

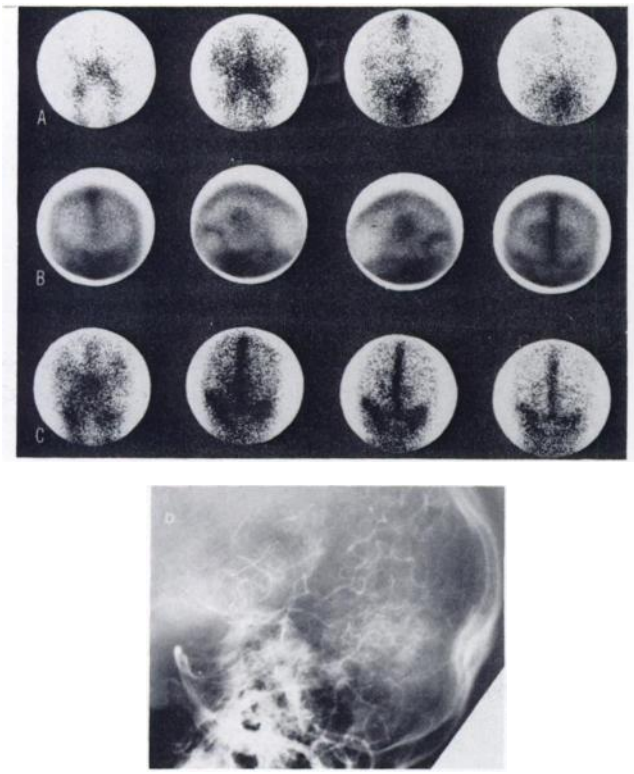

FIG. 4. Dumbbell-shaped midline brain tumor. (A) Anterior flow study; (B) static brain images; (C) posterior flow study showing increased activity (vascularity) in region of tumor; and (D) posterior fossa angiogram with vessels in region of splenium of corpus callosum.

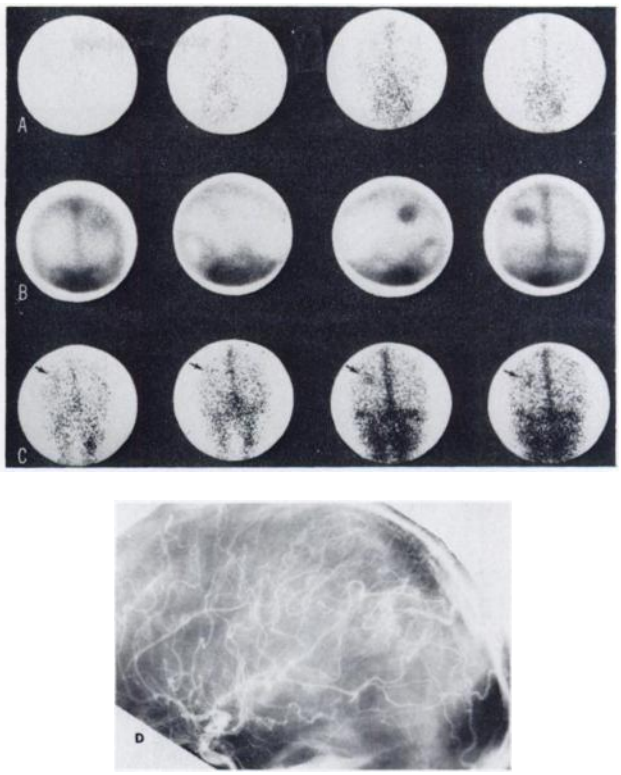

FIG. 6. Left parietal lobe glioma. (A) Anterior flow study; (B) static brain images with localized lesion in left parietal lobe; (C) posterior flow study with arrows indicating vascular activity characteristic of tumor; and (D) tumor vessels evident in parietal lobe on carotid arteriogram.

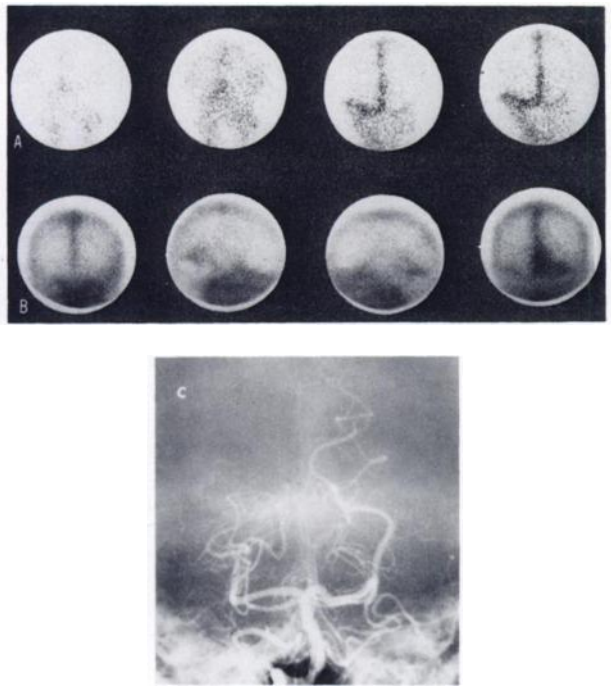

FIG. 5. Right posterior cerebral infarction. (A) Posterior flow study with minimal decreased activity in arterial phase in distribution of right posterior cerebral artery; (B) static brain images with triangular region of increased activity characteristic for right posterior cerebral infarction; and (C) posterior fossa angiogram showing occlusion of distal branches of right posterior cerebral artery.

terior flow study shows minimal decreased vascularity in the arterial phase in the distribution of the right posterior cerebral artery (Fig. 5). This same area has increased activity on static images. Posterior fossa angiography confirmed an occlusion of the right posterior cerebral artery.

Case 6. A 49-year-old man presented with recurrent memory loss and difficulty in differentiating right from left. The brain scan shows localized increased activity in the left parietal lobe (Fig. 6). The posterior flow study shows this to be a vascular lesion which gradually becomes more prominent in the venous phase of the study. An undifferentiated glioma was found at surgery.

The normal anatomic distribution of the cerebral blood flow, viewed from the rear, is diagrammed in Fig. 7. An accompanying arterial phase from a normal posterior flow scintiphoto is presented for comparison. A major portion of the image is contributed by the distribution of the posterior cerebral and vertebral artery branches.

Table 1 summarizes the indications for posterior flow studies.

DISCUSSION

While the use of lateral, vertex, or posterior views to assess cerebral vascular dynamics has been pre-

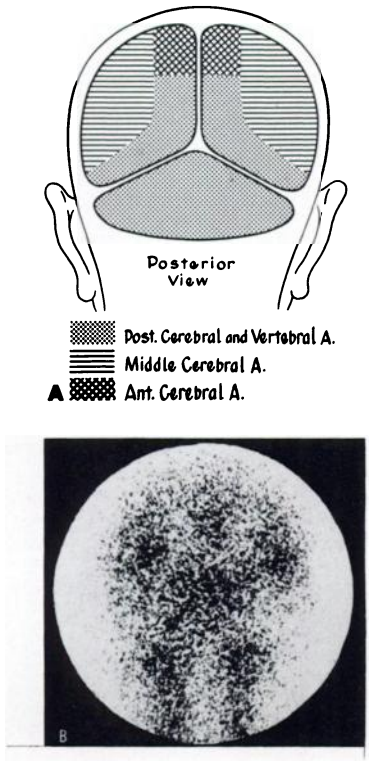

FIG. 7. Drawing and accompanying scintiphoto of normal arterial blood supply to brain, posterior view.

TABLE 1. INDICATIONS FOR POSTERIOR FLOW STUDY

1. Posterior arteriovenous malformation
2. Posterior tumors (primary or metastatic)
3. Paget's disease of occiput
4. Posterior cerebral infarcts
5. Sagittal sinus occlusion
6. Pediatric brain imaging

viously reported, we know of no attempt to document the relative usefulness of these studies in the clinical setting. In 32 patients examined prospectively for presumed posterior disease, we found 17 with positive posterior flow studies that yielded information not readily apparent on the anterior flow studies.

When pertechnetate is used in brain imaging, its 140-keV photons have a half-value layer of approximately 4.5 cm in soft tissue. It follows that abnormalities located posteriorly have a much greater likelihood of being visualized on flow studies obtained with the back of the patient's head placed against the scintillation camera. Angulation of the head in a chin-down position (camera crystal vertical) allows better visualization of the posterior fossa.

In pediatric brain imaging, when dynamic studies are desired, the posterior flow is usually obtained due to the ease of positioning of the patient and also because two-thirds of all brain tumors in the pediatric age group occur in the posterior fossa.

The flow study, when positive, is helpful in evaluating the vascular nature of a lesion. The rate of vascular appearance helps to differentiate most vascular tumors from arteriovenous malformations, and relative avascular areas indicate hypovascular tumors or cerebral infarcts when these regions show increased activity on static images. At our institution, several patients had a brain scan followed by a bone scan at a later date. In this situation, one has the opportunity to inject the bone-scanning agent as an intravenous bolus for a posterior cerebral flow study if this was not obtained along with the original brain scan.

CONCLUSION

From this investigation we conclude that the nuclear medicine physician should carefully review each patient's clinical history prior to brain scintigraphy. If abnormality is suspected in the posterior portion of the brain or skull, a posterior flow study should be planned to complement or replace the routine anterior flow study.

ACKNOWLEDGMENT

This paper was presented at 22nd Annual Meeting of the Society of Nuclear Medicine, June 17–20, 1975, Philadelphia, Pennsylvania.

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