

# ABNORMAL BRAIN SCAN IN PAGET'S DISEASE OF BONE—CONFUSION WITH SUBDURAL HEMATOMA

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*Static brain images utilizing  $^{99m}\text{Tc}$ -pertechnetate were performed on two patients with the clinical impression of subdural hematoma. In each the brain scan was compatible with that diagnosis. Skull radiographs and soft-tissue x-rays were normal. Cerebral arteriograms were also normal. Bone images with  $^{99m}\text{Tc}$ -pyrophosphate in conjunction with a clinical re-evaluation and persistent elevation of the serum alkaline phosphatase permitted the correct diagnosis of Paget's disease of bone.*

The clinical signs and symptoms of an individual with fluid accumulation in the subdural space are often vague and nonspecific. The physician is dependent upon the brain scan for specific diagnosis and for assistance in localization of the lesion. In the absence of a positive brain scan, subdural hematomas are frequently missed. Similarly, the use of the brain scan to screen for the clinical indications of carotid angiography limits the undue use of these angiographic procedures in a high percentage of normal individuals. The incidence of false-negative brain scans in patients with subdural hematomas has been estimated at 20% (1). The accuracy of the images has been shown to improve when the study is performed several hours after injection of the  $^{99m}\text{Tc}$ -pertechnetate. The activity ratio between the subdural accumulation and the intravascular space increases with time and therefore the lesion becomes much more apparent on delayed views (2). We have found, as have others, in several instances that images obtained at 30 min were normal but became definitely positive in the presence of large subdural accumulations at 3 hr. Brain scans with delayed views utilizing  $^{99m}\text{Tc}$ -pertechnetate are now routinely done at 3 hr in all patients with suspected subdural hematoma. At present, our incidence of false-

negative brain scans for suspected subdural hematomas is less than 10%.

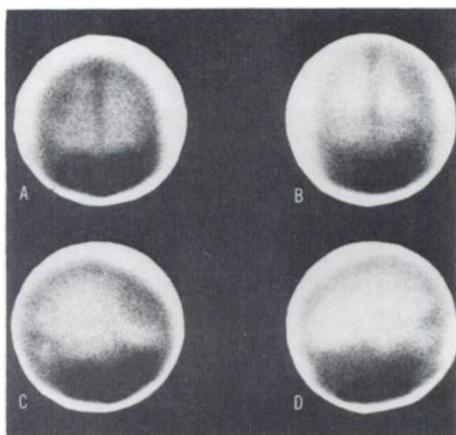
False-positive studies for subdural accumulations are more commonly seen during the acute stage and are usually secondary to scalp hematoma, skull fracture, cerebral hematoma, or contusion. Other causes include postsurgical traumatic defects, bone metastases, scalp infection, osteomyelitis, and Paget's disease. Pachymeningitis and peripheral metastatic tumor as well as peripheral vascular infarcts are also included. In general, with appropriate review of the history and physical examination as well as review of the skull radiographs, the incidence of false-positive studies should be minimal. The classic subdural hematoma presents as a crescentic pattern of increased radioactivity over the hemiconvexity in the anterior or posterior view of the brain scan (3). However, this pattern of increased activity is a non-specific finding and produced by other lesions as well as subdural accumulations (4).

We have always assumed that Paget's disease of the skull could be excluded if skull radiographs were normal. However, we have recently seen two patients with clinical and scintiphoto evidence suggestive of subdural hematoma in whom skull x-rays were normal. Paget's disease of the skull, which was totally unsuspected both clinically and by x-ray examination, was diagnosed after a  $^{99m}\text{Tc}$ -pyrophosphate bone scan was performed.

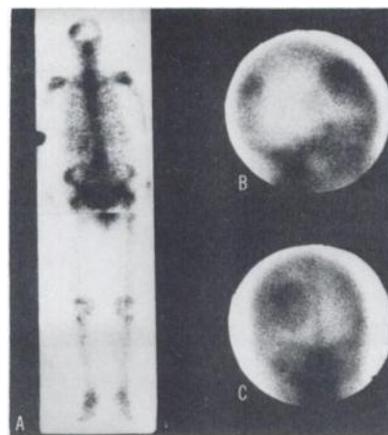
## CASE REPORTS

**Patient No. 1.** LR, a 63-year-old woman was referred to the University of Minnesota Hospitals for evaluation of right frontal headaches. The headaches

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**FIG. 1.**  $^{99m}\text{Tc}$ -pertechnetate brain scintigraphs showing area of increased activity over right frontal convexity. (A) Anterior view; (B) posterior; (C) right lateral; (D) left lateral.

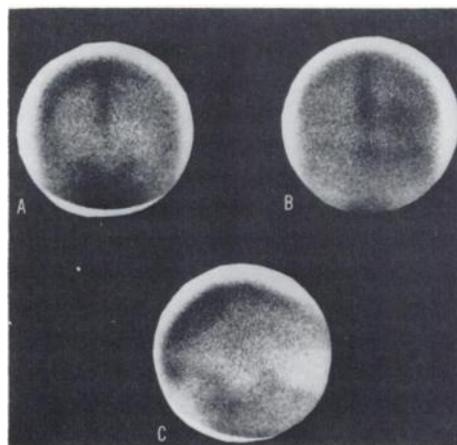


**FIG. 2.**  $^{99m}\text{Tc}$ -pyrophosphate bone scintigraphs showing areas of increased activity in calvarium and right pelvis. (A) Scanning-camera anterior view; (B) right lateral skull; (C) anterior skull.

began 1 year prior to admission when the patient sustained head trauma in an auto accident. The diagnosis of chronic subdural hematoma or other mass lesion was considered. Skull radiographs and electroencephalogram were normal. Brain imaging using  $^{99m}\text{Tc}$ -pertechnetate showed an area of increased activity located peripherally over the right frontal convexity (Fig. 1). A carotid angiogram was performed, which was normal. A second brain scan showed the same area of increased activity. The patient was discharged and returned 2 weeks later with persistent headaches. Brain imaging for a third time showed the area of hyperactivity over the right convexity. A repeat right carotid angiogram, taking appropriate oblique views to exclude the possibility of a small subdural collection of fluid, was again normal. A pneumoencephalogram was also normal. A review of laboratory studies showed elevated serum alkaline phosphatase levels of 203, 171, and 175 I.U. (normal 24–96). A bone scan (Fig. 2), using  $^{99m}\text{Tc}$ -pyrophosphate and the Nuclear Data Radi-Camera 60 scanner-camera showed an area of increased activity over the right convexity which corresponded to that seen with the brain scintigram. Areas of hyperactivity were also noted in the right occipital skull and right pelvis. A repeat radiographic study of the skull was again considered normal. X-rays of the pelvis showed thickening of the bony trabeculation which was compatible with early Paget's disease. The patient was discharged with that diagnosis and has since done well.

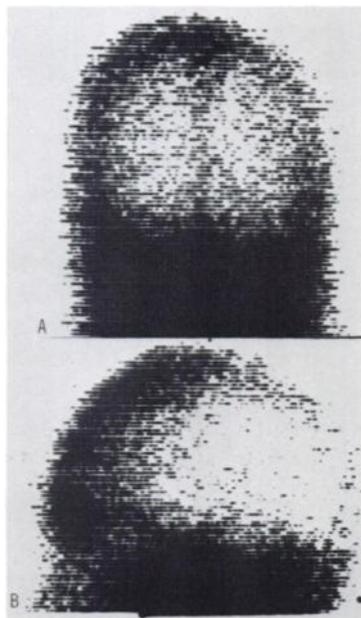
**Patient No. 2.** LS is a 65-year-old white man referred to the Neurology Service of the Minneapolis V.A. Hospital for evaluation of occipital headaches and dizziness of 6-months duration. Clinical history was unremarkable except for mild head trauma sustained in a fall 6 months prior to admission. The

patient also noted occasional episodes of blurred vision. The impression after neurological evaluation was probable cerebral vascular disease. A brain scan was ordered to assess cerebral blood flow as well as to exclude the possibility of a mass lesion. In light of the history of trauma, a subdural hematoma was considered a possibility and for this reason delayed views were included in the brain scan. Brain imaging using the Pho/Gamma HP Anger camera and  $^{99m}\text{Tc}$ -pertechnetate showed a poorly defined area of increased activity over the right hemiconvexity on both anterior and posterior views (Fig. 3). For confirmation, a repeat brain scan was performed utilizing the Picker Magnascanner and the previously identified lesion was much more clearly defined on the rectilinear scan (Fig. 4). Reasons for this include the ability to choose a tomographic cut as well as modifications of contrast enhancement, which are

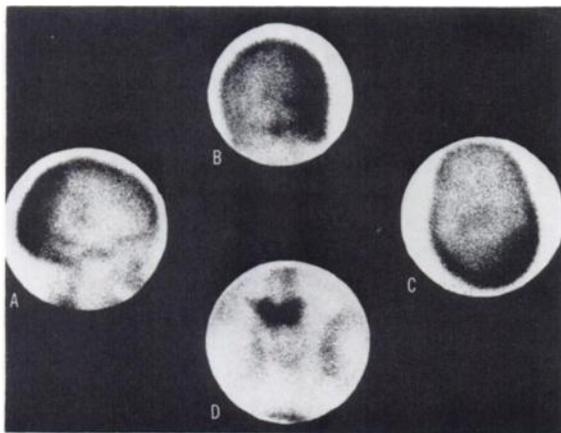


**FIG. 3.**  $^{99m}\text{Tc}$ -pertechnetate brain scintigraph showing area of increased activity over right convexity and right posterior parietal-occipital area. (A) Anterior view; (B) posterior view; (C) right lateral view.

possible with the rectilinear scanner. In light of this abnormal scan, skull films were reviewed and found to be normal. Because of an increased alkaline phosphatase level of 120 I.U. (normal 24–96) and experience gained from Case No. 1, a bone scan (Fig. 5) was done which showed areas of increased activity in the skull corresponding to the areas seen on the brain scan as well as in the lower lumbar spine. Radiographs of the lumbar spine and pelvis showed the classic changes of Paget's disease. Skull x-rays were again reviewed and considered normal. The



**FIG. 4.**  $^{99m}\text{Tc}$ -pertechnetate rectilinear scan, performed immediately after camera scintigraph in Fig. 3, better delineates the peripheral increased activity. (A) Anterior view; (B) right lateral view.



**FIG. 5.**  $^{99m}\text{Tc}$ -pyrophosphate bone scintigraphs showing areas of increased activity in skull which correspond to those seen on brain scan. Lumbar spine view shows increased activity of L<sub>5</sub>. (A) Right lateral view of skull; (B) posterior; (C) vertex; (D) lumbar spine.

patient's cerebral symptoms were not thought to be sufficiently severe to warrant angiography and upon demonstration of the abnormal bone scan and the diagnosis of Paget's disease, this invasive maneuver was avoided.

#### DISCUSSION

Paget's disease of bone is reported to occur in 3% of the population over 40 years of age, making it among the most common of skeletal diseases (5). Paget's disease during its early stage may present with a totally normal-appearing roentgenogram. Bone scans done during this period, however, will be positive (6). The skull follows the pelvis and femur in incidence of involvement. The lesions are generally highly vascular and this may account for the concentration of radioactivity on brain scans with  $^{99m}\text{Tc}$ -pertechnetate. Patients with calvarial involvement may present with headache, especially early in the disease (7). A reliable clue to the diagnosis of Paget's disease is the elevated serum alkaline phosphatase which is inevitably present (8).

The clinical information obtained from both patients was compatible with the diagnosis of subdural hematoma. Brain scans were definitely abnormal and since soft-tissue and skull x-ray examinations were normal, the presumptive diagnosis of a subdural lesion was made. Persistence in our diagnosis of the first patient led to two unnecessary invasive angiographic procedures as well as a pneumoencephalogram. The bone scan was done only when all other neuroradiologic procedures had been exhausted. From this initial patient we learned to review the skull x-rays as well as the serum alkaline phosphatase before recommending carotid angiography. The elevated level of serum alkaline phosphatase in the second patient resulted in a recommendation of a  $^{99m}\text{Tc}$ -pyrophosphate bone scan and based upon the resulting findings, the diagnosis of Paget's disease was made and carotid angiography was avoided.

Multiple points for emphasis are presented by the two patients. First, Paget's disease of the skull may exist when skull roentgenograms are normal. Second, patients with Paget's disease of the skull may be quite symptomatic, especially during the initial stages when radiographs are normal. Third, although the elevation may be slight, serum alkaline phosphatase levels are invariably elevated and may be a significant indicator for active disease. Finally, an abnormal brain scan with a crescentic pattern of increased activity over the hemiconvexity seen on anterior and posterior views of the brain scan together with an increased circulating serum alkaline phosphatase may be an indication for a bone scan.

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