we believe this is due largely to limitations in high-frequency response caused by our data-collection frequency of 2.5 frames/sec (multipeak boluses contain a greater proportion of high frequencies than prolonged boluses). Faster sampling rates may improve our ability to deconvolute a fragmented bolus.

In our clinical trials of deconvolution analysis we have been purposely injecting a slow, smooth bolus. This minimizes the chances for a fragmented, multipeak injection and maximizes the ability of our current deconvolution algorithm to provide accurate shunt quantitation. Our initial clinical experience with the algorithm in both adult and pediatric patients has been excellent, and we hope to report it in the near future.

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Regarding Venography and Lung Scanning

After I read this superb article (*1*), I remained frustrated with regard to several points:

1. Of 19 patients with abnormal venograms and normal perfusion lung scans, eight were said to have had pulmonary embolism. In my experience no patients with pulmonary embolism have had a normal perfusion lung scan when performed within 24 hr of the occurence of embolism. Nor am I aware of any reports in the literature describing such a case. The time of study after onset of suspected pulmonary embolism was not stated in the article.

2. The article states that "47 of 102 patients were serially studied on two to four occasions," but there was no discussion of those repeat studies. When the perfusion lung scan is delayed 24 to 48 hr after occurence, if the lesion is small, all evidence of pulmonary embolism may be gone. (I have seen only one such case; however, I rarely have the opportunity to repeat lung scans after one day.) The authors report normal venograms with abnormal perfusion lung scans in five patients with pulmonary embolism. Although it certainly is possible that embolism originated at a site not amenable to diagnosis by lower-extremity venography, evidence of thrombosis and/or phlebitis may have disappeared if the study were delayed too long following onset of the pulmonary lesion. Here again it is important to know the timing of the study in relation to the clinical situation, and both results and timing of any follow-up studies that may have been obtained. I have had the opportunity to do follow-up venograms on only two patients with definite evidence for thrombosis-phlebitis at initial examination. Both had perfusion lung scans that showed high probability for pulmonary embolism. Follow-up radionuclide venography and perfusion lung scanning was carried out on one patient after 6 days and on the other after 7 days. Both showed partial regression of abnormality in lung scan but entirely normal venogram. I am sure the authors can shed further light on this problem, which deserves systematic evaluation. I am confident that the eight false-normal lung scans will be found to have been done at least 24 hr following onset of the clinical problem, and I believe delay in performing venography probably accounts for many of the false normal results described in this paper (*1*) and in previous reports.

3. "Emission venograms were interpreted as abnormal if one of the following criteria were met: (a) venous occlusion with or without collaterals; (b) intraluminal defects in ileofemoral segment with stasis distal to the partially occluded segment." How many abnormal venograms met criteria (a) only, (b) only, or both? Venous occlusion may represent permanent residual of old thrombophlebitis. Since the criteria for final diagnosis of pulmonary embolism were primarily clinical, I wonder if any of the "false-normal" lung scans were actually correct with diagnosis inferred from venogram abnormality representing sequalae of previous disease.

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REFERENCE

1. MUNIR A, FLETCHER JW, PUR-SHAHRIARI AA, et al: Radionuclide venography and lung scanning: Concise communication. *J Nucl Med* 20: 291-293, 1979

Reply

In Table 1 of our article (*1*), perfusion studies with high probability of pulmonary embolus were considered positive, whereas normal nondiagnostic, or low probability perfusion lung scans were handled as negative. The note at the bottom of this table ("+ lung interpreted as low probability for pulmonary embolus") applies to negative lung scans in that column.

We agree with Dr. Wolfstein that pulmonary embolus is highly unlikely if the perfusion study is normal. None of the patients considered to have pulmonary embolus in this study had normal perfusion.

We emphasize the importance of follow-up studies in patients who have evidence of thromboembolism (*2*), and of a simultaneous repeat emission venogram. The latter increases the diagnostic accuracy of acute venous thrombosis, since it is invariably associated with evolutionary changes, whereas chronic venous disease without superimposed acute thrombi remains unchanged.

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REFERENCES

1. AHMAD M, FLETCHER JW, PUR-SHAHRIARI AA, et al: Radionuclide venography and lung scanning: Concise communication. *J Nucl Med* 20: 291-293, 1979
2. SASAHARA AA, BELKO JS, MCINTYRE KM: Problems in the diagnosis and management of pulmonary embolism. *Semin Nucl Med* 1: 122-131, 1971

Scintigraphic Findings in Angioimmunoblastic Lymphadenopathy

Angioimmunoblastic lymphadenopathy (AIL) is a lymphoproliferative syndrome first described by Lukes and Tindle in 1973 as immunoblastic lymphadenopathy (*1*). The syndrome is characterized by fevers, sweats, weight loss, rash, pruritus, lymphadenopathy, hepatosplenomegaly, and hypergammaglobulinemia. The clinical course is usually rapid and fatal (*2*). The lymph-node architecture is distorted by infiltration with immunoblasts and a peculiar proliferation of aborizing postcapillary venules (*4*). The disorder usually appears between the third and fifth decades and is slightly more common in males. Its initial clinical presentation often suggests malignant lymphoma, and histologically it resembles Hodgkin's disease (*1*). Radiographic findings in AIL had been reported (*2,5*), but its scintigraphic characteristics have not been described in detail. We discuss here the scintigraphic findings in two patients with AIL. The first case had a malignant course; the

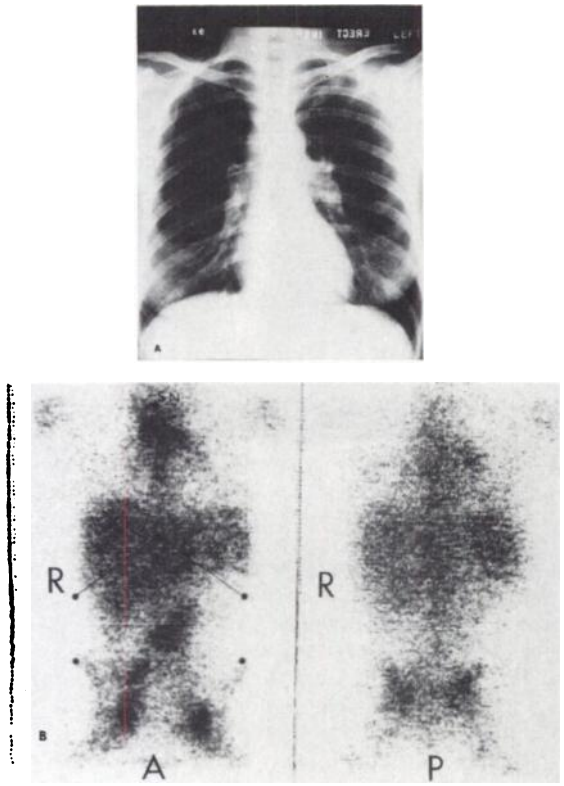

FIG. 1. (A) PA view of chest shows right paratracheal and bilateral hilar adenopathy. (B) Gallium scan reveals increased uptake in mediastinum, para-aortic, right iliac, and both inguinal lymph nodes.

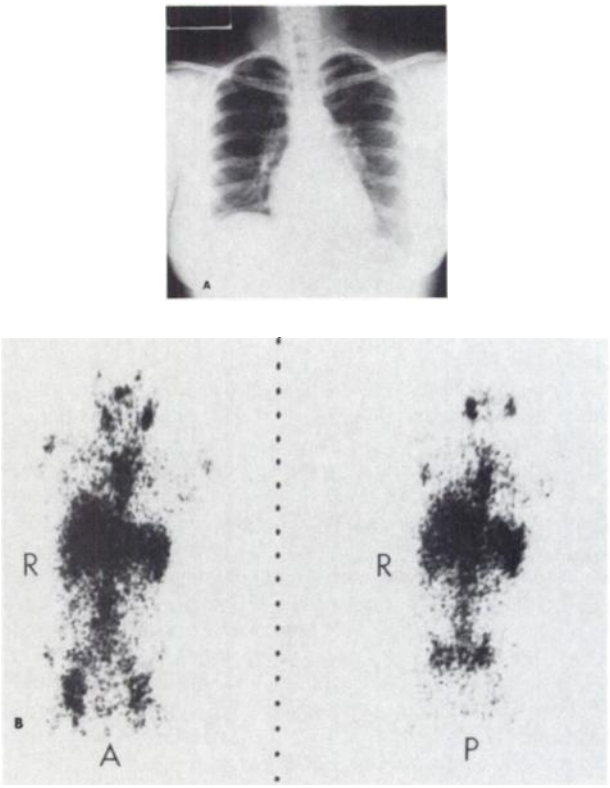

FIG. 2. (A) PA view of chest shows bilateral hilar adenopathy. (B) Gallium scan reveals increased uptake in both cervical, hilar, axillary, para-aortic, iliac, and inguinal lymph nodes.

second has been rather benign.

Case 1. A 49-year-old white housewife was first seen in December, 1974, with a recent history of weakness and rapid onset of peripheral lymphadenopathy. Initial chest radiograph revealed right paratracheal and bilateral hilar adenopathy (Fig. 1A). A Tc-99m sulfur colloid liver-spleen scan revealed hepatomegaly with irregular uptake. A gallium-67 scan revealed increased uptake in the mediastinal, para-aortic, right iliac, and both inguinal regions. The scan also revealed hepatomegaly with irregular uptake (Fig. 1B). Lymph-node, bone-marrow, and liver biopsies at this time revealed changes compatible with Hodgkin's disease. The patient was then treated with cyclophosphamide, vinblastine, carmustine, and prednisone. One year later a chest radiograph and biopsies of liver and bone-marrow were normal, and the patient was considered to be in remission. In October, 1976, she was readmitted because of weakness, chills, and fever. The Tc-99m sulfur colloid liver-spleen scan revealed further irregular uptake, and a gallium scan showed increased uptake over the para-aortic and iliac regions. A laparotomy demonstrated enlarged retroperitoneal and right paraspinal masses with typical histological features of AIL. Review of the initial lymph-node biopsy material established the diagnosis of AIL. Chemotherapy was reinstituted but no major improvement was obtained.

In October, 1978, 4 yr after the initial symptoms, the patient developed severe hepatic failure and died after several episodes of gastrointestinal bleeding and bronchopneumonia. At autopsy there was diffuse immunoblastic sarcoma involving the lungs, hili, liver, spleen, kidneys, right adrenal gland, vertebrae, and paraspinal and pelvic masses.

Case 2. A 32-year-old chemistry assistant was admitted on January 14, 1979, because of fatigue, fever, bilateral cervical lymph-node enlargement and pruritic macular rash over her entire body. Symptoms had appeared suddenly 3 wk earlier and progressed to the extent of seriously interferring with her daily work. Past medical history was unremarkable, with no history of allergies. Physical examination revealed a well-nourished female with a temperature of 102°F and markedly enlarged nontender cervical nodes along both anterior chains and in the occipital region. There was no organomegaly. Biopsy of a right cervical node revealed the AIL, and this was confirmed by a second biopsy on a left cervical lymph node. Chest radiographs taken in November, 1978 were normal. Three weeks later, chest radiograph revealed marked bilateral hilar adenopathy and clear lung fields (Fig. 2A). Three days after admission, a gallium-67 scan revealed increased uptake in both hilar, para-aortic, axillary, cervical and inguinal regions (Fig. 2B). By this time, bilateral inguinal lymph-node enlargement became clinically apparent, although it was not noted at the time of her admission to the hospital. A liver-spleen scan revealed splenomegaly. Protein electrophoresis was normal. There was mild elevation of serum alkaline phosphatase and of lactic dehydrogenase. A lymphocyte count showed 40% B cells and 33% T cells. Therapy was instituted with prednisone, 100 mg/day, and the patient was discharged from the hospital. A follow-up chest radiograph 6 wk later revealed complete regression of the hilar adenopathy. Currently the patient is on maintenance doses of prednisone, and has no peripheral lymphadenopathy. She has returned to her usual activities.

The clinical presentation of AIL closely resembles that of malignant lymphoma, and the histological features of involved lymph nodes frequently suggest Hodgkin's disease. The cause is not certain. The immunoblastic features include abnormal proliferation of the lymphocytes with concommitant depletion of T lymphocytes (*4*). These features suggest that acute AIL is primarily

an immunologic reaction, although the identity of the presumed triggering antigen is not known. A hypersensitivity reaction to therapeutic agents such as penicillin, sulfonamide, and phenytoin has been postulated as a possible mechanism in the development of AIL. Anticonvulsive therapy with phenytoin has been found in association with histologic changes in lymph nodes similar to those in AIL, as well as development of Hodgkin's disease and malignant lymphoma (*3*). The rapid downhill course of most reported cases of angioimmunoblastic lymphadenopathy has been due to development of fulminating infection, renal disease, or cardiovascular disease. The radiographic findings in AIL are similar to those of lymphoma (*5*). However, the rapid development of hilar or mediastinal lymphadenopathy seen in our two cases are very useful clues in the diagnosis of AIL. The lack of anterior mediastinal involvement is another feature that helps to distinguish this condition from Hodgkin's disease (*5*). The importance of differentiating AIL from Hodgkin's disease and other lymphomas has been emphasized (*6*), since therapy with cytotoxic drugs is not only ineffective in AIL but is potentially harmful, increasing the patient's susceptibility to infection. Scintigraphic findings are nonspecific. However, both of our patients had rapid onset of lymphadenopathy and markedly abnormal gallium scans. We feel these scintigraphic findings, and the radiographic findings of the lung in patients who have had rapid onset of adenopathy are strongly suggestive of AIL. Lymphoma or sarcoidosis has much slower clinical manifestation. Moreover, radionuclide imaging is useful in assessing the course of AIL under different therapeutic regimens, and permits early detection of metastatic involvement when the malignant course of this disease ensues.

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REFERENCES

1. LUKES RJ, TINDLE BH: *Immunoblastic Lymphadenopathy: A New Hyperimmune Entity Resembling Hodgkin's Disease. Workshop on Classification of Non-Hodgkin's Lymphomas.* Chicago, University of Chicago, June 25-29, 1973
2. FRIZZERA G, MORAN EM, RAPPAPORT H: Angio-immunoblastic lymphadenopathy. Diagnosis and clinical course. *Am J Med* 59: 803-818, 1975
3. HYMAN GA, SOMMERS SC: The development of Hodgkin's Disease and lymphoma during anticonvulsant therapy. *Blood* 28: 416-427, 1966
4. NEIMAN RS, DERVAN P, HAUDENSCHILD C, et al: Angioimmunoblastic lymphadenopathy: An ultrastructural and immunoblastic study with review of the literature. *Cancer* 41: 507-518, 1978
5. LIBSHITZ HI, CLOUSER M, ZORNOZ AJ, et al: Radiographic findings of immunoblastic lymphadenopathy and related immunoblastic proliferations. *Am J Roentgenol* 129: 875-878, 1977
6. HUSSEY HH: Immunoblastic lymphadenopathy. *JAMA* 236: 2098, 1976

Unusual Spread of Juxtacortical Osteosarcoma

A 51-year-old housewife complained of a gradual onset of stiffness and discomfort in the right knee. This began 15 mo before presentation and occurred only when she flexed her right knee fully. Over the last 3 mo, she found the knee becoming stiffer and more uncomfortable when walking. She had no other complaints and her general health has always been good.

On examination, she was found to have a firm swelling in the posterior aspect of the thigh just above the knee. There was limitation of flexion of the knee to 90°. No other abnormal findings were noted on admission.

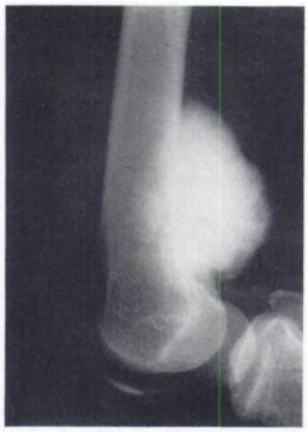

FIG. 1. Typical radiographic appearance of paraosteal sarcoma.

Except for an alkaline phosphatase of 185 IU, all biochemical investigations, were normal. Full blood count and ESR were normal. A radiograph of the femur showed a very typical appearance of a juxtacortical osteosarcoma with a well-defined cauliflower-shaped mass of bone on the posterior aspect of the distal femur (Fig. 1). Biopsy of the tumor showed that the bone was very dense, with no soft component of the tumor. Once again, the appearances were those of a juxtacortical osteosarcoma. In response to a surprisingly positive finding in a staging whole-body bone scan with Tc-99m methylene diphosphonate (Figs. 2 and 3), the left temple was carefully examined. A 2.3-mm nodule was excised from the scalp and sent for microscopy.

Two weeks later, the distal 160 mm of the right femur was excised and replaced with a Stanmore femoral replacement including

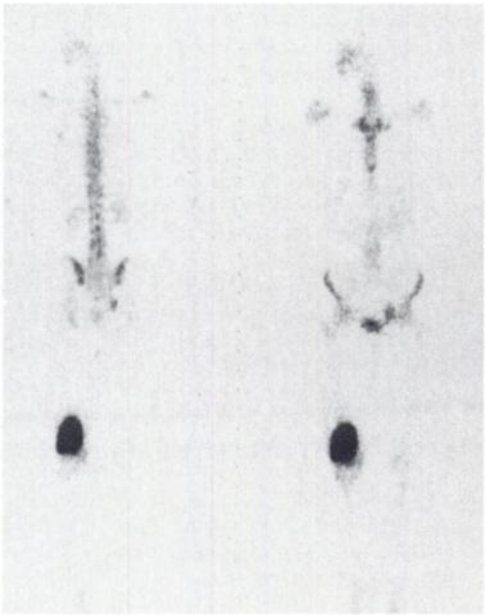

FIG. 2. Whole-body bone scan. Note intense uptake over primary tumor and questionable very small focal area of uptake in the skull.