

ABSTRACTS OF CURRENT LITERATURE

Prognostic Value of Pretreatment Bone Scans in Breast Carcinoma. R Komaki, W Donegan, R Manoli, et al; Milwaukee County Medical Complex, Milwaukee WI. *Am J Roentgenol* 132: 877-881, 1979.

One hundred consecutive, previously untreated breast cancer patients who had Tc-99m pyrophosphate bone scans before treatment (between 1972 and 1976) were retrospectively evaluated to determine the contribution of the bone scans to staging, treatment, and prognosis: The patients were staged by the AJC-UICC 1973 TNM system clinically according to the original descriptions of the physical examination without using information from the bone scans. The bone scans were performed using 15-20 mCi of Tc-99m pyrophosphate, and images were obtained after 3 hr with a gamma scintillation camera. The scans were reviewed and reinterpreted without knowledge of the original interpretation by two radiologists. The consistency between the original and review interpretations was 78%. Bone scans were initially categorized as normal (60) and abnormal (40). No correlation was found between abnormal bone scans and clinical status of the axillary nodes, but bone scans were significantly more often abnormal in patients with locally advanced tumor (T₃ and T₄) and in the presence of distant metastasis (M₁). The patients were followed for an average period of 22 mo. In clinical stages I and II, abnormal bone scans did predict a higher occurrence of distant metastasis (35%) than did normal scans (24%) and predicted more frequent bone metastases (19% against 9%). A poor 4-yr survival was found in patients with abnormal bone scans (48%) compared with normal ones (58%) among the patients with clinically undissected carcinoma (Stages I-III). Abnormal scans were significantly more frequent (35% among patients older than 50 yr). Seven of 91 patients showed lytic lesions on radiographs, all of which demonstrated abnormal uptake on scans. Seven of 10 patients with elevated alkaline phosphatase had abnormal bone scans as well as lytic lesions on radiographs. The occurrence of false-negative radiographs was 28%.

How Ominous Is an Abnormal Scan in Bronchogenic Carcinoma? S. Gravenstein, MA Peltz, W Pories; Case Western Reserve University School of Medicine, Cleveland, OH. *JAMA* 241: 2523, 1979.

This retrospective study evaluated prognosis in 162 patients who had histologically confirmed primary bronchogenic carcinoma and who had received one or more of the following scans: liver (Tc-99m-sulfur colloid), brain (Tc-99m-pertechnetate), and bone (Tc-99m-polyphosphate, -pyrophosphate, or -diphosphonate). Imaging was done by rectilinear scanner or gamma camera. Radiologic diagnoses were accepted as the basis for deciding whether scans were negative or positive for metastases. A positive bone scan in 46 patients was associated with death within 6 mo for 40 of the patients and within a year in four additional patients ($p < 0.001$). The two surviving patients were found later to have had false-positive bone scans. A similar predictive finding, but of lesser magnitude, occurred with brain and liver scans. Half of a group of 111 patients with more than one normal scan survived for more than 6 mo. That survival was also predicted by a normal bone scan alone. No combination of scans predicted survival for 6 or 12 mo

with greater accuracy than did a solitary normal bone scan. Similarly, a single abnormal scan predicted death at 1/2 to 1 yr later with accuracy equal to that from multiple abnormal scans. Clinically undetected metastases were disclosed by 78%, 39%, and 18% of bone, liver, and brain scans, respectively. In cases of confirmed lung cancer but which lacked clinical evidence of metastasis, a bone scan is felt to be of value in the initial diagnostic work-up. Then, only after a negative bone scan, should a liver scan be performed. A brain scan is warranted only when metastasis is strongly suspected (i.e., in patients with neurologic signs or symptoms). The authors conclude that routine scanning is not justified in patients with potentially resectable bronchogenic carcinoma. In suspected metastatic disease of the lung, however, scanning is useful for predicting 1-yr survival.

The Sensitivity Of Scintigraphic Myocardial Imaging By The Use Of ^{99m}Tc-Labelled Pyrophosphate In The Diagnosis Of Cardiomyopathy of Various Etiology. F Duska, J Vizda, J Kubicek, P Kafka, Z Nesvadba, P Zdansky, and J Bastecky; Kralove, Czechoslovakia. *Eur J Nucl Med* 4: 87-90, 1979.

Positive pyrophosphate (PPI) scans in nonischemic degenerative myocardial diseases have been described previously. The authors report results of Tc-99m PPI scintigraphy in 10 patients with cardiomyopathy. Five were children with progressive muscular dystrophy. CPK plasma levels were elevated. Diffuse ECG alterations were seen in four, and five men referred with primary non-obstructive cardiomyopathy were also studied. Exertional dyspnea and noncharacteristic chest pain were present in all. One hour after i.v. injection of 4-8 mCi Tc-99m PPI, gamma camera images, each containing 200,000-300,000 cts, were obtained in AP, LAO, and left lateral projections. The scintigraphic results were registered on a five-step scale. Focal and diffuse uptake were also differentiated. The authors found myocardial imaging to be positive in two children, negative in three, and CPK was elevated in all. The PPI uptake by skeletal muscle was normal in the five children. Three men with nonobstructive cardiomyopathy had obviously positive scans, two were negative. The authors conclude that positive PPI scans are not proof for presence of ischemic damage but suggest that positive PPI scans may indicate progress of disease.

Blood Kinetics of ^{99m}Tc-Pyrophosphate In Anuric Patients with Renal Osteodystrophy. G Fanfani, M Mele, A Fratello, VD Damato, F Dammacco, and A D'Addabbo; Bari, Italy. *J Nucl Med All Sci* 22: 159-161, 1978.

The blood kinetics of Tc-99m pyrophosphate (PPI) in chronic hemodialysis patients suffering with renal osteodystrophy were examined. Nineteen patients, with renal failure of 1-9 yr, and 11 controls were examined. Radiograms demonstrated presence of osteodystrophy in all patients. The study was done between hemodialysis treatments with 60 μ Ci Tc-99m PPI injected per kg body wt of 2 ml of heparinized blood. Probes were taken at 5-min intervals during the first 30 min, later at 1, 2, 3, and 4 hr. Tracer disappearance rate was plotted on semilogarithmic paper. T_{1/2} was derived, decay constants were calculated, and tracer clearance was determined. The authors found both rapid (k₁) and slow segments

(k_2) of the radionuclide disappearance curve elevated in anuric patients. The mean clearance rate, however, was similar in the anuric and control populations. The authors believe that the rapidly falling curve segment indicates increased skeletal uptake of the tracer. The tracer clearance visualized with the slow component of the disappearance curve cannot be related to renal excretion. The authors conclude that the second exponential component of the disappearance curve of Tc-99m PPI from the blood is not due to renal excretion but may be attributed to edema and the abnormal distribution of the tracer in the skeleton, which alters tracer kinetics.

The Use of Technetium-99m-Stannous Pyrophosphate Scintigraphy to Identify Muscle Damage in Acute Electric Burns. J Hunt, S Lewis, R Parkey, and C Baxter; University of Texas Health Science Center, Dallas, TX. *J Trauma* 19: 409-413, 1979.

High voltage electric burns are often associated with extensive deep local and regional muscle damage, the extent of which may not be apparent either grossly or because of overlying eschar. Fourteen patients with total body surface area burns ranging from 2½-45% were examined using Tc-99m stannous pyrophosphate (PYP) scintigrams performed between the first and sixth postinjury days. Fifteen mCi of Tc-99 PYP containing 5 mg of stannous PYP were injected into a peripheral vein and scans obtained after a 2-hr delay. When possible, the opposite, uninjured extremity was scanned for comparison. Several characteristic scintigraphic imaging patterns were noted: (a) areas with no uptake of Tc-99m PYP, therefore devoid of blood supply and obviously necrotic; (b) a "doughnut" pattern consisting of a central cold spot with surrounding increased uptake of Tc-99m PYP; (c) focal hot spots; (d) homogenous Tc-99m PYP uptake present both adjacent and proximal to areas of focal uptake. Five of the 14 patients required nine major extremity amputations. Each amputation was through an area of diffuse homogenous tracer uptake proximal to areas of dense homogenous uptake of Tc-99m PYP. The level of amputation was correctly identified (as determined by clinical and histologic examination and by wound healing) in the scintigrams from all patients in this series. The early identification of injured muscle with Tc-99m PYP aids in the formulation of the preoperative and operative approach to patient care. Serial scintigrams allow the surgeon to evaluate the completeness of surgical debridement and/or amputation.

The Importance of Scintimetry in the Differential Diagnosis of Roentgenological Areas of Increased "Translucence" in the Skeleton of Children. G Benz and P Georgi; Heidelberg, Germany. *Fortschr Röntgenstr* 130: 465-469, 1979.

The authors evaluated benign and malignant bone lesions in 33 children to compare radiotracer uptake with the radiographic findings. The study includes seven patients with benign bone tumors; eight suffered systemic malignant disease and concurrent skeletal lesions; ten had osteomyelitis; and eight had primary malignant bone tumors. Gamma camera scintigraphy followed 2 hr after i.v. injection of 0.1 mCi Tc-99m MDP per kg body weight. Images stored in a minicomputer were evaluated with ROI technique on a color display unit. For scintigraphic evaluation a bone-to-bone ratio was used. The authors found that benign bone tumors, not originating from osseous tissue, have a low or absent radionuclide uptake. Tracer uptake was not related to the radiographic findings. Two patients with marginal sclerosis failed to demonstrate increased tracer incorporation. An eosinophilic granuloma showed massive tracer uptake but no signs of marginal sclerosis or radiography. One eosinophilic granuloma appeared as an area of decreased uptake. Bone lesions that occurred due to

systemic malignant disease had radiotracer uptake patterns ranging from normal to highly pathologic. The authors conclude that radionuclide uptake cannot be used to differentiate benign and malignant tumors.

Radlpharmaceutical Bone Scanning in Pediatric Neurosurgery. RP Humphreys, DL Gilday, JM Ash, EB Hendrick, and HJ Hoffman; Hospital for Sick Children and University of Toronto, Toronto, Canada. *Child's Brain* 5: 249-262, 1979.

This report examines the positive bone scan results in 174 children investigated for craniosynostosis, skull tumor, undiagnosed back pain, craniospinal infection, and child abuse. Radionuclide examination of the skull was performed in 120 children with clinical features suggestive of premature craniosynostosis. In these patients, scanning was performed 4-6 hr after the injection of Tc-99m-labeled MDP, and anterior and posterior angled vertex exposures were obtained in addition to the four usual projections. Suture fusion was confirmed in 106 of the 120 children with suspected synostosis, and bone scans of the skull proved to be a valuable adjunct to plain skull radiography in the evaluation of these patients. Thirty-five children with suspected skull tumors were evaluated, 29 of whom had positive scans. The most common lesions seen were histiocytosis X (including eosinophilic granuloma), fibrous dysplasia, and metastatic tumors. Seventy-one children with back pain were examined, 24 of whom showed radionuclide accumulation somewhere in the spine or pelvis. The most common abnormality detected in this group was disk infection. Bone scanning is particularly useful in osteomyelitis that involves the skull or spinal column, and may be the earliest objective abnormality. In cases of child abuse, bone scans may reveal recent injuries not seen on scout radiographs and should be obtained in cases in which standard radiography is negative or equivocal.

Demonstration of Steroid-Producing Gonadal Tumors by External Scanning with the Use of NP-59. PC Carpenter, HW Wahner, RM Salassa, and DJ Duick; Mayo Clinic, Minnesota. *Mayo Clin Proc* 54: 332-334, 1979.

This study reports increased uptake of I-131-6β-iodomethyl-19-norcholesterol (NP-59) by gonadal tumors in two patients. In a 31-year-old man who had earlier undergone bilateral adrenalectomy, bilaterally testicular nonmalignant Leydig cell tumors were found to produce elevated levels of plasma and urinary steroids (hypercortisolism). A tomographic adrenal scan with NP-59 at 72 hr after dose showed no abdominal localization of the pharmaceutical but intense concentration in both testes (0.17 and 0.11% in left and right testicle, respectively). NP-59 uptake by normal testes in two other men was found to be 0.008 and 0.005%. In a 58-year-old woman with progressive virilization, tomographic NP-59 scan at 96 hr showed normal adrenal uptake and uptake (0.16% of dose) in a Leydig-cell tumor of the left ovary. In both patients, surgical removal of the tumor caused return toward normal of the circulating steroids. These authors' experience with NP-59 has indicated insignificant concentration of iodocholesterol in normal gonadal tissue of men and women, in women with polycystic ovarian disease, and in laboratory animals. Benign neoplastic processes of adrenals concentrate NP-59, while malignant tumors generally have insignificant uptake. These authors question whether that conclusion will also hold true for gonadal lesions. NP-59 scanning of the gonadal area may permit localization for surgical exploration of suspected gonadal neoplasia not otherwise detected.

Comparison of Radioactive Phosphorus (³²P) Uptake Test in

Comparable Sized Choroidal Melanomas and Hemangiomas. R Lanning and JA Shields; Wills Eye Hospital, Philadelphia, PA. *Am J Ophthalmol* 87: 769-772, 1979.

The P-32 uptake test has gained wide acceptance as an aid in differentiating benign from malignant lesions of the eye. Choroidal hemangiomas are occasionally difficult to differentiate from choroidal melanomas but usually show a negative P-32 uptake test. To evaluate the possibility that the difference in P-32 uptake between these lesions was due to the smaller size of the hemangiomas, 19 cases of choroidal hemangioma and 21 cases of malignant melanomas of comparable size were reviewed. The average percentage uptake over the lesion compared to the control area was 160% in choroidal melanomas and 23% in choroidal hemangiomas. There were no false-negative results, but two choroidal hemangiomas gave false-positive results of 89 and 63%, respectively. The overall results indicate a significant difference in P-32 uptake with these two tumors and suggest that the test plays a helpful role in most cases. The authors stress that the procedure does have definite limitations in the differentiation of small choroidal melanomas from large choroidal nevi. There have been a number of recent cases in which eyes were enucleated because of a positive P-32 uptake test and the lesion proved histologically to be a benign nevus. The authors do not now enucleate most small melanomas but rather manage them by close observation. If highly suspicious, they are managed with photocoagulation, eyewall resection, or cobalt plaque.

Positive Whole-Body Ga-67 Scintigraphy in Dermatomyositis. WP Smith, RG Robinson, AH Gobuty; University of Kansas Medical School, Kansas City, KS. *Am J Roentgenol* 133: 126-127, 1979.

A positive whole-body Ga-67 scintigraph was reported in a patient with histologically proven dermatomyositis. A 63-year old Filipino-American who developed myalgia and progressive arthritis was referred for a gallium scan to search for a possible occult malignancy. His muscles were soft and flaccid, and there was calf tenderness but no evidence of phlebitis. A careful search for occult malignancy was negative. The radiogallium images demonstrated increased uptake of Ga-67 in all extremities and appeared to involve both skin and muscle. There was also uptake of Ga-67 in the thoracic cage musculature. The diagnostic impression from the scan was that of a diffuse inflammatory process involving both skin and muscle, most likely dermatomyositis. A left anterior thigh muscle biopsy was subsequently performed, and the histologic findings were consistent with myositis. An electromyogram also showed myopathy with denervation changes consistent with myositis. The authors feel that gallium scanning serves the additional function of evaluation for the possibility of underlying neoplasm in patients with dermatomyositis.

The Role of Radiocopper in the Diagnosis of Wilson's Disease. I Sternliet and H Scheinberg; Albert Einstein School of Medicine, Bronx, NY. *Gastroenterology* 77: 138-142, 1979.

The authors evaluated radiocopper concentrations in serum in patients with established and suspected diagnosis of Wilson's disease. The diagnosis was made by the levels of serum ceruloplasmin, hepatic, and urine coppers, the presence of Kayser-Fleisher ring and liver biopsy. Fifty-one healthy subjects were also tested for the control. All subjects ingested 2 mg of $^{64}\text{Cu}^{2+}$ cupric sulfate in 150-200 ml of milk after fasting for at least 8 hrs. Aliquots of serum obtained at 1, 2, 4, 24, and 48 hr after administration of the radiocopper were assayed for radioactivity in a scintillation counter. The serum radioactivity at 48 hr was divided by the peak value, usually at 1 or 2 hr, to obtain a ratio (R-value). R-values, calculated in nine of the patients with Wilson's disease

were between 0.016 and 0.370, and in eight of the patients with non-Wilsonian liver diseases R-values were between 0.636 and 2.441. In the 51 control subjects R was between 0.596 and 2.983. One false-positive result was obtained initially, but the repeat study was normal. A time curve of the radiocopper concentration in serum was validated as a criterion for the diagnosis of Wilson's disease and was unequivocally established before the test was performed by a sufficient number of genetic, clinical, biochemical, and histologic data. The authors conclude that in patients with normal serum concentrations of ceruloplasmin, measurement of the incorporation of radiocopper into this protein can aid in the clinically important differentiation of patients with hepatic illnesses that mimic Wilson's disease.

A Simple Technique of Measuring Liver Blood Flow—Intrasplenic Injection of ^{133}Xe . PHM Lam, RT Mathie, AM Harper, and LH Blumgart; Glasgow, Scotland. *Acta Chir Scand* 145:95-100, 1979.

Hepatic blood flow was determined following intrasplenic injection of Xe-133. The results were compared with those obtained after intraportal Xe-133 injection as well as those obtained with electromagnetic flowmeter measurements. Thirteen dogs were used for the studies after insertion of an electromagnetic flow probe into the common hepatic artery and portal vein. Blood flow was recorded continuously. A cannula placed centrally into the portal vein permitted portal pressure measurement and Xe-133 application. After injection of 1.0-1.5 mCi Xe-133 into the liver via portal circulation, the hepatic Xe-133 clearance was determined. Following radionuclide return to base levels, the study was repeated with splenic injection. Radiotracer flow was measured with a 1-in. probe positioned over the right lobe of the liver and recorded with a linear chart recorder. Clearance curves were plotted on semi-logarithmic graph paper, and blood flow was calculated from the clearance rate. The intrasplenic injection technique was tested over a wide range of flow rates, following partial occlusion of the portal vein, and during hypotensive shock. The authors found peak activity to be lower and the distal curve segment to be elevated after splenic injection. After subtraction of the slow component, the $T_{1/2}$ of the fast component was found to be almost identical for both injection sites. A near perfect correlation was obtained for flow values calculated after tracer injection at the different sites. Thirty-one electromagnetic flowmeter measurements were obtained, and a good correlation was found with the isotope procedures. The authors conclude that splenic injection of Xe-133 will permit hepatic blood flow estimation with the particular advantage that the examination can be combined with splenoportovenography.

The Value Of Diagnostic Ultrasound As A Screening Test For Intrauterine Growth Retardation: Comparison of Nine Parameters. BK Wittman, HP Robinson, T. Aitchison, and JEE Fleming, University of British Columbia, Vancouver, British Columbia, Canada. *Am J Obstet Gynecol* 134:30-35, 1979.

The predictive value of nine different measurements in the assessment of intrauterine growth retardation (IUGR) was evaluated. A series of 255 patients was examined at approximately 32, 34, and 36 wk gestation and a multiplicity of measurements obtained at each examination. The authors found that no single parameter reliably separated normal from growth-retarded fetuses; however, the product of the trunkal area and crown-rump length was found to correlate most closely with the occurrence of intrauterine growth retardation. The method missed only 10% of growth-retarded fetuses and displayed an over-all false-positive rate of approximately 6%. The authors were thereby able to es-

establish a group "at risk" for IUGR representing about 11% of the population—nearly half of which ultimately proved to be true-positive results. Methods are described and graphs are provided that correlate the product of crown-rump length and trunkal area with gestational age in days.

Applications of Real Time Ultrasound in Obstetrics: The Linear and Dynamically Focused Phased Arrays. Carlisle L. Morgan, Will S. Trought, Arthur Haney, and William M. Clark; Duke University Medical Center, Durham, NC. *J Clin Ultrasound* 7:108-114, 1979.

The various roles and the advantages of real-time ultrasonography in obstetrics throughout pregnancy are discussed. The dynamically focused phased array systems have the advantage of producing considerably better resolution than the linear; however, they also have the disadvantages of being larger and appreciably more costly. Lateral resolution with the phased array system is some 2-3 mm; that for the linear array is in the range of 6 mm. Fetal cardiac motion can be identified as early as 8 wk gestation and the establishment of fetal viability is best accomplished by real-time imaging. Gestational sac and crown-rump length measurements, biparietal diameter measurements and determination of intrauterine growth retardation by transthoracic, abdominal circumference, or abdominal cross-sectional area are all readily accomplished with real-time imaging. Examination of the central nervous system and the search for neural tube defects are discussed. Guidance of amniocentesis is readily accomplished by this means. Representative examples of both phased array and linear array scans are provided.

Ultrasound of Epigastric Injuries After Blunt Trauma. L. Christopher Foley and Rita Littlewood Teele. Harvard Medical School, Boston, MA. *Am J Roentgenol* 132:593-598, 1979.

Four cases are presented in which ultrasonography was of value in disclosing upper abdominal hematomas secondary to blunt

trauma. Echogenic masses in the hepato-renal space, in the area of the descending duodenum, and in the body and the tail of the pancreas were identified as were secondary effects upon surrounding organs. Compression of the vena cava, dilatation of the duodenum, and enlargement of the common bile duct were seen. Serial examinations helped to confirm gradual regression of the mass effect produced by the retroperitoneal hematoma. Examination of the liver, spleen, and kidneys should be included to detect the sequelae of trauma and to search for peritoneal fluid. Representative ultrasonograms and barium studies are provided.

Gray Scale Ultrasound in Adnexal Thickening. Correlations with Laparoscopy. Rob H. Kirkpatrick, Najmosama Nikrui, Jack Wittenberg, Lucy Hann, and Joseph T. Ferrucci, Jr. Massachusetts General Hospital, Boston, MA. *J Clin Ultrasound* 7:115-118, 1979.

In a study of 70 patients the overall accuracy of sonography as compared with findings at laparoscopy was 75% in the diagnosis of true adnexal thickening. The diagnosis of adnexal thickening was based on an adnexal image larger than could be accounted for by a combination of the ovary (2.5-4 cm) and tissue between ovary and uterus (1-2 cm) in AP dimension. This diagnosis applies in the absence of a sonographically circumscribable mass. The authors conclude that the diagnosis of adnexal thickening by palpation or ultrasound is not substantiated by laparoscopy. Representative sonograms are provided.

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