

ABSTRACTS OF CURRENT LITERATURE

Thallium-201 Myocardial Perfusion Scintigraphy for Clinical Clarification of Normal, Abnormal and Equivocal Electrocardiographic Stress Tests. E. H. Botvinick, M. R. Taradash, D. M. Shames, W. W. Parmley. *Amer J Cardiol* 41: 43-51, 1978.

Sixty-five patients were studied with stress electrocardiography and thallium-201 myocardial perfusion scintigraphy, and the results were correlated with selective coronary angiography. All patients were referred for evaluation of chest pain suspected to be coronary in origin. One minute before the exercise end point was reached, 2 mCi of Tl-201 were injected and the camera scintigraphy was obtained during a 6-8 min recovery period. The anterior, 45° left anterior oblique, and left lateral images were taken (200,000 counts) at 75 keV with a converging collimator. Scintigraphy was more sensitive (85% against 67%), more specific (89% against 63%) and significantly more accurate (87% against 65%) than stress electrocardiography for the diagnosis of significant coronary arterial lesions in patients with isoelectric S-T segments at rest. Stress scintigraphy helped clarify the equivocal stress test due to left bundle branch block, left ventricular hypertrophy, drugs, hyperventilation and other conditions, and was more accurate than the stress electrocardiogram (89% against 53%), even in the presence of a depressed S-T segment at rest.

Myocardial Scintigraphy with Technetium-99m Pyrophosphate during Early Phase of Acute Infarction. B. L. Holman, M. Lesch, J. S. Alpert. *Amer J Cardiol* 41: 39-42, 1978.

To determine the sensitivity of myocardial scintigraphy (1 mCi technetium-99m pyrophosphate) 31 patients were selected for study if they had a clearly defined onset of precordial chest pain that had occurred no more than 8 hr prior to imaging, an uncomplicated course during the first 24 hr after admission, and no previously documented myocardial infarction. Images in anterior, left anterior oblique and left lateral projections were obtained within 4 to 8 hr after the onset of symptoms and again at 24 hr. The extent of technetium-99m concentration was measured from the anterior projection by means of planimetry in the patients with documented acute myocardial infarction, and the percentage change in the area of the uptake between 4 and 24 hr was determined. In 11 of 15 patients with documented acute myocardial infarction, increased focal myocardial uptake was demonstrated on early myocardial scintigraphy; however, focal uptake was observed in only two of 16 patients with unstable angina pectoris. Three of four patients with normal early scintigrams had massive transmural myocardial infarction, and those normal scans may have reflected poor perfusion since the images were abnormal at 24 hr. In four patients the extent of Tc-99m uptake increased more than 20% by 24 hr without other evidence of infarct extension. In another seven patients, there was no significant change in the area of the abnormal uptake between early and delayed scans. This study suggested that acute myocardial infarction can be detected with Tc-99m pyrophosphate within 4 hr of the onset of chest pain and before elevation of serum creatine kinase activity although the sensitivity rate (73%) is less than that at 24 hr.

Post-Exercise Thallium-201 Myocardial Scanning-Clinical Ap-

praisal. A. Rosenblatt, J. M. Lwenstein, W. Kerth, H. Handmaker. *Am Heart J* 94: 463-470, 1977.

In 38 patients with suspected or documented coronary disease 42 consecutive stress and resting myocardial scans using thallium-201 were compared with treadmill exercise electrocardiograms and with coronary and ventricular cineangiography. Within 6 min following i.v. administration of 2 mCi Tl-201 imaging was begun at the point of maximal treadmill exercise. Anterior, 60° LAO and left lateral views were obtained, and required an average of 4 min per view for 200,000 counts. Resting myocardial scans were obtained either by re-injecting a second 2 mCi 48 hr after the first dose or by re-imaging 5-24 hr after the first dose. Twenty of 42 treadmill tests were nondiagnostic, and two of 15 patients with severe coronary disease had false negative treadmill tests. All nine patients with single vessel coronary disease had positive myocardial scans that demonstrated good anatomic correlation between the scan defect location and the site of anatomic disease on the contrast angiogram. Although anatomic correlation was poorer, 83% of those patients with double and triple vessel disease had positive scans.

At rest an underlying segmental wall motion abnormality could not always be excluded as the cause of a scan defect; recognizable alteration of the defect after exercise was rarely detected. One false negative and no false positive scans were obtained in those patients with severe coronary disease. Among post-aortocoronary bypass patients, positive scans were related to graft occlusion, significant unobscured native coronary disease, segmental ventricular wall motion abnormalities, or a combination of these factors.

Changing Values for the Normal Thyroid Radioactive Iodine Uptake Test. E. T. Wong and A. L. Schulz. *JAMA* 238: 1741-1743, 1977.

This report describes changes in mean normal 24-hr thyroidal radioiodide uptake (RAI) tests in the Minneapolis, Minnesota, area at different points in time. Persons with a history of thyroid disease, those taking interfering medications, and those having received iodinated contrast media were excluded. In 1971, 51 subjects had I-131 uptake values of $11.5 \pm 4.4\%$ (s.d.) with a range of 2-24%. In 1975, 29 subjects had I-123 uptake values of $20.4 \pm 6.1\%$ with a range of 13-39%. Two normal subjects and four "patients" had serial I-131 and I-123 RAI tests within a short period of time yielding no significant difference between mean RAI values. Three subjects were each measured in 1971 and in 1975 showing mean RAI's of 7.1 and 18.8%, respectively, with no intervening change in the subjects' dietary habits or medical history. Analyses for iodine were performed in 1976-77 on local commercial white bread, a major source of dietary iodine. Bread from certain bakers contained approximately 3.5 μg iodine per slice, while that from others was approximately 50 μg per slice; sampling over time indicated consistency of bread iodine content for a given baker. In contrast, iodine content in a slice of bread from the Birmingham, Alabama, area in 1969 is reported to be 150 μg . The present authors attribute their reported increase in mean RAI values to a reduction or elimination of iodine in local commercial white bread. These authors suggest that recent changes in dietary iodine intake in other

geographic regions may have similarly affected normal RAI measurements.

Rectilinear Thyroid Scanning as a Predictor of Malignancy. R. L. Nelson, H. W. Wahner, and C. A. Gorman. *Ann Int Med* 88: 41-44, 1978.

To define the reliability of thyroid scanning as a predictor of thyroid malignancy, rectilinear scan findings were correlated with the surgically documented size, location, and histology of thyroid carcinoma in 67 patients. A satisfactory rectilinear scan was obtained with either 2-5 mCi of sodium pertechnetate or 50-100 μ Ci of [¹³¹I] sodium iodide. Only 36 (54%) patients had hypofunction in the area of the surgically proven carcinoma (tumor diameter ranged from 0.4 to 8.5 cm with a median of 2.5 cm) and in only one of these patients did the clinical examination not localize the lesion correctly as well. Of 27 patients with a normal uptake pattern in the area of the malignancy on the scan, 16 (24%) had a palpable nodule in the location of the documented cancer (tumor diameter ranged from 0.3 to 2.5 cm with a median of 1.5 cm). In 11 (16%) both the clinical examination and the scan were normal at the site of the malignancy (tumor diameter ranged from 0.2 to 1.2 cm with a median of 0.5 cm). The 47 papillary carcinomas were smaller (tumor range 0.2-8.5 cm, median 1.9 cm) at the time of initial diagnosis, and only 45% showed hypofunction on the scan. The 20 nonpapillary cancers were usually larger (range 0.4 to 0.6 cm, median 2.5 cm) when discovered, and 85% showed hypofunction on the scan. A literature review established that use of the gamma camera with pinhole collimator does not increase the specificity of carcinoma predictability, despite the enhanced sensitivity. The authors feel that clinical criteria rather than appearance of the scan should contribute most to the decision of whether to treat surgically unless clinically solitary nodule is hyperfunctioning.

Computerized Tomography and Nuclear Imaging of the Liver. U. Scherer, U. Büll, R. Rothe, J. Eisenburg, F. W. Schildberg, P. Meister and J. Lissner. *Eur J Nucl Med* 3, 71-80, 1978.

Computerized axial tomography (CT) of the abdomen offers an alternate, noninvasive approach to liver scintigraphy. The authors compared the results of these diagnostic procedures on 83 patients, in whom both studies were carried out within a few days of each other. The results of the examinations were checked with invasive diagnostic methods: biopsy, laparoscopy, laparotomy, and autopsy. A 2.5-min commercial CT scanner was used. All patients had plain scans, most also had a second examination after i.v. injection of a 65% iodinated contrast media. Camera scintigraphy was carried out after i.v. administration of 3 mCi Tc-99m phytate. Images contained 750,000 counts each and were made in three projections (a.p., right lateral and 30° RAO) while the patient was standing. Data was gathered on line and were stored in a computer system. Scintigram printouts were made with isodose plotter after appropriate BG subtraction. Scintiscan evaluation sought "cold spots," changes in liver contour and size, a changed ratio of liver-spleen isotope concentration, and signs of increased radionuclide concentration in bone marrow. Computerized tomography scans were evaluated for focal or generalized attenuation value and changed liver-spleen shape or size. Invasive diagnostic procedures revealed diffuse liver disease in 21 patients, circumscribed changes in 31, and normal findings in 33 persons. Both methods brought very similar results in organs without pathology, true negative diagnoses

being 94% for CT and 91% for static gamma imaging. The frequency with which pathology was identified in diffuse liver was 76% for both methods. Here, however, each method was shown to be superior in specific areas. Twelve of 13 cirrhotic patients had abnormal radionuclide scans, with typical pathognomonic scintigrams in seven of these. Obstructive jaundice was recognized on CT, whereas radionuclide scintigraphy resulted in unspecific or negative scintigrams. In circumscribed liver disease with single and multiple lesions, CT was more sensitive: 94% of pathologies were revealed, whereas radionuclide scintigraphy identified only 81% of these. The authors conclude that CT scans are more sensitive in identifying circumscribed lesions of the liver, and radiocolloid scintigraphy was superior in the diagnosis of cirrhosis.

Measurement of ¹¹¹In DTPA Clearance during Radionuclide Cisternography. M. V. Merrick, J. D. Simpson and C. Ferrington. *Eur J Nucl Med* 3, 105-108, 1978.

The authors examined the rate of removal of In-111 DTPA from the cerebrospinal fluid (CSF) to determine whether isotope disappearance from the head, after injection into the lumbar theca, can be used to evaluate hydrocephalus, and thereby eliminate the need for imaging. Thirty-six patients referred for cisternography were included in the study, and four were examined twice. Three examinations were made on normals, 26 in patients with cerebral atrophy, six after cerebral vascular bleeding, four cases of normotensive hydrocephalus, and one study was made in a probable case of multiple sclerosis. After lumbar puncture 1 ml isotonic solution containing 750 μ Ci In-111 DTPA was injected. A standard was prepared to correct for radioactive decay and to correct for detector drifting. Whole body counting was performed with a whole body counter fitted with four 153 mm \times 102 mm crystals in profiling mode. The parallel sided collimators were set at a slit width of 2 cm and imaging was carried out with a gamma camera fitted with a medium-energy collimator. The pulse-height analyzer was set to collect the whole of the 247 keV and most of the 173 keV peak. Decay curves for the whole body and the head were calculated from the curves of the profile scan. Blood samples and nasal swabs were counted in a well counter with a window setting of .195 to .3 MeV. Head clearance curves were obtained with a 44 \times 30 mm stationary crystal with cylindrical collimator. Whole body profile scans were made at 6, 24, and 48 hr after radionuclide injection. The authors found the peaks of the profile scan to correspond to activity of the head, the injection site, and the bladder. Whole body clearance was determined by three components: a rapid one due to renal excretion, an intermediate component due to isotope loss from the CSF and a slow component due to detachment of In-111 from DTPA. This detached In-111 had a very slow clearance. There was considerable overlap in clearance rates from the CSF among normals and normotensive hydrocephalus and cerebral atrophy patients. The authors conclude that the In-111 DTPA clearance from CSF and from the whole body has no diagnostic value. Furthermore, the authors failed to find evidence for long term retention of indium in the CSF.

Experimental Study on Tumor Affinity of ²⁰¹Tl-Chloride. Yasuhiko Ito, Akira Muranaka, Tanekazu Harada, Akihiko Matsudo, Tsuneo Yokobayashi, and Hideaki Terashima. *Eur J Nucl Med* 3, 81-86, 1978.

Since Tl-201 chloride has recently been discussed as a

possible soft tissue tumor scanning agent, the authors compared Tl-201 with Ga-67 citrate to determine thallium's potential as a tumor scanning agent. Albino rabbits weighing 2.5-3.0 kg were used in the studies. Tumor-bearing animals had been inoculated with .5 ml of a 20% VX-2 epidermoid carcinoma implanted into the left femoral muscle. A GE(Li) semiconductor detector and a multi-channel analyzer were used. In seven normal rabbits the tissue distribution of Tl-201 was determined 30 minutes after injection. Three animals studied with Tl-201 chloride had tumor implantation 21 days prior to the examination. In these animals a gamma camera was used to determine the time activity concentration over the tumor and femoral muscle of the other side, at intervals up to 24 hr after radionuclide application. Six other VX-2 bearing rabbits were given Ga-67 25 days after tumor implantation, followed on the 28th day of injection of Tl-201, and the animals were killed 30 min later. The distribution of Tl-201 and Ga-67 in various organs and in the tumors was determined. In 14 normal rabbits the Tl-201 incorporation of the thyroid was compared to the histologic picture. Eleven other VX-2 carriers had Tl-201 and K-42 injected intravenously, and 30 min later the distribution of the two radionuclides was determined in various organs. Lastly, .2 ml turpentine oil was injected into the left femoral muscle of five rabbits to induce inflammation. Two days later Ga-67 was given intravenously, followed 1 day later by Tl-201 application. Thirty minutes after the Tl-201 injection, the animals were killed and the isotope accumulation of the inflammatory lesion, normal femoral muscle and blood was determined. Thirty minutes after injection the authors found Tl-201 incorporation to be greatest in the kidneys, followed by the heart, thyroid, small intestine, spleen, lung, liver, bone marrow, bone, skeletal muscle and blood, respectively. Thyroid uptake showed great variability and was positively correlated with the height of follicular cells. The Tl-201 scintigraphic studies of three rabbits show that Tl-201 accumulation peaks within the first hour after application. Tissue affinity of Tl-201 and Ga-67 examined in six VX-2 rabbits showed tissue uptake similar to nontumor carriers. Furthermore Ga-67 accumulation in the tumor was greater than Tl-201 incorporation. Thallium-201 had greater affinity for viable tumor sites than for necrotic tumors or intratumor fluid portions. Gallium accumulation was greater than thallium incorporation in the inflammatory lesions. The tissue distribution of K-42 and Tl-201 in 11 tumor carrying animals was very similar with two exceptions: Tl-201 was greater in kidneys and less in blood. The authors conclude that their study has failed to demonstrate that Tl-201 chloride is superior to Ga-67 as a tumor-imaging agent.

Computerized Tomography, Diagnostic Ultrasound, and Radionuclide Scanning. Diagnosis of Pancreatic Carcinoma. J. Barkin, D. Vining, A. Miale, Jr., S. Gottlieb, D. E. Redhammer, M. H. Kalsner. *JAMA* 238: 2040-2042, 1977.

Forty-six patients, including 33 with proved pancreatic carcinoma, were studied by computerized body tomography (CT), gray scale ultrasonography (US), and radionuclide (RN) scanning. The results of each scanning procedure were compared with the surgical and clinical findings. In the diagnosis of pancreas carcinoma by CT and US, a mass was the most important finding; the detection rate was 82% for CT, and 92% with US. Measurements of the pancreas by CT and US were similar, but visualization of all portions of the pancreas was consistently better with CT. None of the carcinomas were resectable. Radionuclide scans were

abnormal in 96% of the patients with pancreatic carcinoma as well as in 75% of patients without pancreatic disease. In cases of clinically suspected pancreatic carcinomas, the RN scans were of little help in the diagnosis. When CT and US are normal and clinical suspicion remains high, however, RN scans may be useful to define the normal pancreas. This study indicated that a rational approach to evaluation of suspected pancreatic carcinoma should begin with a US scan, and if a mass is seen in the pancreas, further invasive definitive procedures, such as endoscopic retrograde cholangiopancreatography would be indicated.

Symptomatic Osseous Sarcoidosis with Findings on Bone Scan. H. M. Silver, A. Shirkhoda, D. B. Simon. *Chest* 73: 238-240, 1978.

Twenty-one years after the onset of sarcoidosis, a 51-year-old female developed pain in the lower portion of her back, which by bone biopsy proved to be the result of sarcoidosis that involved the pelvis. Roentgenograms of her pelvis demonstrated areas of increased density in both iliac wings and sclerotic changes in the regions of the sacroiliac joints. A bone scan with Tc-99m pyrophosphate revealed several areas of increased activity in the calvaria, left anterior and posterior ribs, and both iliac wings and femurs. Skull radiographs also showed two small round calcific densities. The finding from bone marrow aspiration was consistent with sarcoidosis. The patient improved with steroid therapy, but repeat roentgenograms and bone scan revealed no change. This case report suggests that bony involvement by sarcoidosis may be detected earlier by bone scan than by radiographs and that the bone scan may also indicate areas accessible for tissue diagnosis.

Development of Bragg Diffraction-Imaging for Medical Use. D. Frieda, P. Spiegler, F. Kearly, M. Greenfield, and R. Stern. *Med Phys* 5: 111-114, 1978.

The paper presents experience gained in developing a real-time acoustical imaging system using the principle of Bragg diffraction. In Bragg imaging a sound field is imaged by wedge oriented perpendicular to the direction of sound. The diffracted light contains an optical image of the sound field. The difficulties in assembling a system capable of producing high quality images are discussed. For example, when using an ultrasound beam that is capable of traveling a distance of many centimeters in tissue, the image is highly astigmatic and so distorted that it cannot be viewed with the naked eye. Additional optics are necessary to remove the distortion and make the image viewable. Engineering data on the optical mounting and on the design of the transducer along with representative images are presented.

A Computer Driven Photoscanner for Medical Imaging. P. A. Bottomley, W. S. Hinshaw, and G. N. Holland. *Phys Med Biol* 23: 309-317, 1978.

A computer-driven roster is used to scan a time-modulated light source over photographic print paper mounted on the bed of a conventional X-Y plotter, thereby producing hard copy color and monochrome images from digitized arrays. A matrix board provides control of grey scale and color attribution. Images of NMR scan data are shown. A refinement of the technique that allows two variables to be displayed on one image is also described.

Accuracy of Biliary Duct Ultrasound: Comparison with Cholangiography. H. L. Neiman and R. A. Mintzer. *Am J Roentgenol* 129: 979-982, 1977.

Thirty patients are presented in whom ultrasonography

of the biliary tree was followed by either percutaneous transhepatic or operative cholangiography. Correct identification of the caliber of the biliary ducts was obtained by ultrasound in some 86% of cases and proved most accurate in those patients with dilated radicles (89%). The most precise indicator of obstructive jaundice was found to be dilatation of the intrahepatic biliary radicles; the common bile duct was identified in approximately 65% of cases. The authors describe and illustrate the morphology of dilated intrahepatic radicles and present the corresponding cholangiograms. The results of the study suggest that diagnostic ultrasound is a useful screening tool for obstructive jaundice and is most accurate in the presence of dilated intrahepatic radicles.

Ultrasonic Demonstration of Intrarenal Anatomy. J. H. Cook, A. T. Rosenfield, and K. J. W. Taylor. *Am J Roentgenol* 129: 831-835, 1977.

The authors present studies of cadaver, in vivo normotopic, and transplanted kidneys, as well as a fetal kidney in utero, and include discussions of intrarenal anatomy not previously reported. Since definition of the medullary portions of the kidney was possible, the cortico-medullary junction was distinguished. At relatively high-gain settings, the renal cortex was quite echogenic, compared with the sonolucent medulla, and the differentiation between the two was easier with the technique of white writing on a black background. Interlobar and arcuate arteries were defined on a barium injected specimen. Improved differentiation between cortex and medulla was observed in such entities as diabetic glomerulosclerosis in which the authors believe the increased echogenicity of the cortex was attributable to collagen deposition. When fluid was present between the kidney and the transducer (as in the case of a large ovarian cyst) the cortex and medulla are better appreciated. The authors cautioned against mistaking the medullary portions of the kidney for cystic regions and noted that the regularity of the medullary region and its separation by the surrounding cortex (the septa of Bertin) were valuable differential points.

Ultrasound-guided Drainage of Fluid-containing Masses Using Angiographic Catheterization Techniques. J. Gronvall, S. Gron-

vall, and V. Hegedus. *Am J Roentgenol* 129: 997-1002, 1977.

In 24 diagnostic punctures of intra-abdominal cavities performed over a 1-yr period, identification of the fluid-filled masses was accomplished ultrasonographically, and an aspiration transducer employed for the puncture. Standard angiographic needles were used for superficial lesions and percutaneous transhepatic cholangiography equipment for deeper ones. Upon entering the cavity, specimens were secured and a J-shaped guidewire inserted; a pig-tail angiography catheter was then placed in the cavity over the guidewire to serve as a drainage outlet. Drainage was established in such entities as pancreatic pseudocyst, intrahepatic abscess, perinephric abscess, etc. with encouraging clinical results. The authors recommend the technique particularly in patients who present high operative risks.

Gray Scale Ultrasound Evaluation of Popliteal Artery Aneurysms. T. M. Silver R. L. Washburn, J. C. Stanely, and W. S. Gross. *Am J Roentgenol* 129: 1003-1006, 1977.

Twelve aneurysms of the popliteal artery were demonstrated in eight patients with suspected aneurysms. Because of proximal occlusive disease two of these were not visualized by contrast arteriography. Bilateral aneurysms were detected in half the patients in this series, and ultrasonography proved of particular value by permitting definition of the outer walls of the aneurysm despite the presence of mural thrombus. In the performance of this study the authors caution that the scans be obtained perpendicular to the long axis of the aneurysm to avert erroneous overestimation of the diameter of the lesion.

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ERRATUM

Due to a production error, a line of type was misplaced in the article entitled "Observer Variability: What to Do until Perfect Diagnostic Tests are Invented" by David A. Turner (*J Nucl Med* 19:435-437, 1978).

The first full paragraph appearing on p 436 should begin as follows:

The appeal of this concept of observer variability is that, in actual practice, it seems to account for the lion's share of inter- and intra-observer variation, provided there is general agreement among observers with respect to which kind of findings will be considered potentially abnormal (e.g., a pulmonary nodule in a chest radiograph, or an activity void in a hepatic scintigram). Lusted made the classic observation that when the widely differing values reported for the sensitivity and specificity of chest photofluorograms in the detection of tuberculosis are plotted on an ROC graph, the data fit a single, smooth ROC curve (15). The same is true of data extracted from early reports of the sensitivity and specificity of pyrophosphate myocardial scintigraphy (Table 1) (20-23). In our laboratory we have observed a similar phenomenon in the case of three expert observers independently interpreting hepatic scintigrams*.