ABSTRACTS OF CURRENT LITERATURE

Metabolic Consequences of Beta-Adrenergic Receptor Blockade for the Acutely Ischemic Dog Myocardium. G. Westera, E. E. van der Wall, S. Scholtalbers, W. den Hollander, F. C. Visser, J. P. Ross; Dept. of Nuclear Medicine and Department of Cardiology, University Hospital, Free University of Amsterdam, Amsterdam, The Netherlands. *Nucl Med* 23:35–40, 1984

The myocardial uptake of radiolabeled free fatty acids after beta-blockade was investigated in an experimental study in 50 dogs. Ten untreated dogs served as the control group. Pindolol, metoprolol, timolol, and propanolol were used for the treatment. Each pharmaceutical was investigated in ten animals. In each group six dogs underwent coronary artery occlusion by passing silk ligatures around the left anterior descending coronary artery between the first and second diagonal branch 5 min before injection of the beta-blocker. Twenty minutes after beta-blocker injection (equipotent doses), 0.01–0.02 mCi of I-131 heptadecanoic acid (HDA) and 0.02–0.06 mCi of Tl-201 were administered to each animal. The dogs were sacrificed within 2 min after radionuclide injection, and the left ventricle was sectioned according to a standardized pattern. A significant 36–43% reduction of HDA uptake was observed in animals without occlusion of the coronary artery after treatment with pindolol, metoprolol, or timolol. In dogs with coronary artery occlusion, a reduced uptake of free fatty acids was obtained for pindolol, whereas propanolol treatment raised the I-131 HDA uptake. The myocardial accumulation of Tl-201 decreased in the nonoccluded hearts after beta-blockade except when propanolol was used. The treatment with beta-blockers in animals with coronary artery occlusion did not alter the Tl-201 uptake. The extent of ischemia was significantly reduced after metoprolol treatment. The endocardial uptake of I-131 HDA was raised only in the metoprolol group.

Serial Radionuclide Assessment of Doxorubicin Cardiotoxicity in Cancer Patients with Abnormal Baseline Resting Left Ventricular Performance. B. W. Choy, H. J. Berger, P. E. Schwartz, J. Alexander, F. J. Th Wackers, A. Gottschalk, B. A. Zaret; Yale Univ. Med. School, New Haven, CT. *Am Heart J* 106:638–643, 1983

The usefulness of serial radionuclide angiocardiography (RA) in monitoring doxorubicin therapy has been established in patients with normal baseline left ventricular ejection fractions (LVEF). This study addresses the use of RA in patients with abnormal LVEF before the institution of treatment. During a 3-yr period, 337 patients had determination of LVEF by RA before doxorubicin therapy; of these, 45 (13%) had abnormal LVEF (<55%). Baseline studies were obtained in 41 of the 45 before any dosage of doxorubicin, and in four it was obtained at a dosage of ≤ 100 mg/m^2. Serial studies were obtained in 29 patients, baseline studies in only 16. Patients in the serial study cohort included 14 males and 31 females, age range 17–93 yr, 10 $\geq$ 70 yr. Baseline LVEF ranged from 40%–54%, and no significant differences were seen between patients with antecedent cardiovascular disease (*29*), antecedent thoracic irradiation (*16*), both the preceding risk factors (*4*), or with respect to age, sex, or baseline doxorubicin dose. The mean cumulative doxorubicin dose was 313 $\pm$ 144 mg/m^2 (range 120–600 mg/m^2). No significant difference between baseline and final LVEF was seen in the 17 patients receiving a cumulative dose of <350 mg/m^2 (48 $\pm$ 6 compared with 50 $\pm$ 9%, respectively, p = NS). Slight but significant decrease in LVEF (48 $\pm$ 4 compared with 43 $\pm$ 8%, $p < 0.05$) was seen in the 12 patients receiving $\geq$350 mg/m^2 doxorubicin. Age at onset of therapy correlated with final LVEF ($r = 0.45$, $p < 0.02$). All other comparisons were not significant. All patients except one remained free of adverse cardiac symptoms during 6 mo follow-up. Based on the experience with this group, it is recommended that doxorubicin therapy not be instituted at baseline LVEF <30%; that before each dose sequential studies be obtained in patients with baseline LVEF between 30% and 54%; that doxorubicin therapy should be discontinued if LVEF falls below 30% or declines by ten percentage points.

Radionuclide Angiography and Endomyocardial Biopsy in the Assessment of Doxorubicin Cardiotoxicity. M. N. Druck, K. Y. Gulenchyn, W. K. Evans, A. L. Milband, K. Winter, I. D. Hilton, G. Jablonsky, J. E. Morch and P. McLaughlin. J. R. Gotlieb, B. Z. Srigley, Bar-Shlomo, D. H. Feiglin, P. McEwan, M. D. Silver; Toronto Gen. Hosp. Toronto, Ontario, Canada. *Cancer* 53:1667–1675, 1984

Doxorubicin is used in the treatment of malignant lymphomas, leukemias, and a variety of solid tumors. Congestive cardiomyopathy, however, is a serious toxic effect of the long-term use of this drug. A monitor of the drug therapy is important. The noninvasive systolic time intervals and echocardiography lack both sensitivity and specificity. Although there have been favorable results by the sequential endomyocardial biopsy, it is invasive, technical, and has limited availability. Radionuclide detection of left ventricular ejection fraction (LVEF) has been shown to be of value in guiding the drug therapy, but there have been no data correlating LVEF with myocardial pathology occurring during the drug treatment. This study was designed to determine the relationship between functional and morphologic changes during the doxorubicin therapy. Thirty-eight patients (17 men, 21 women) with a mean age of 52.3 yr (19 to 75 yr) were studied by serial physical examination, chest radiograph, ECG, endomyocardial biopsy (EMB) and rest-exercise LVEF, at doses of doxorubicin ranging from 144 to 954 gm/m^2 (mean, 426 mg/m^2). The grades of EMB were assigned as Grade 0 to Grade 3, based on the number of cells involved and the extent of involvement of each cell (distention of the sacrotubular system, myofibrillar loss, and nuclear and organelle changes). Physical examination, chest radiograph, and ECG proved to be insensitive predictors of doxorubicin cardiotoxicity. Of the 21 abnormal LVEFs, six were normal at rest; but showed an abnormal response to exercise, four of these patients had Grade 1.0 changes on biopsy, one had 1.5 changes, and one had 0.5 changes. Ten patients with normal LVEFs had abnormal EMBs. Eight of these had grade 0.5 pathologic changes. All abnormal LVEFs were associated with abnormal EMBs. It has been concluded: (1) LVEF is a reliable monitor of doxorubicin therapy; (2) An exercise study should be performed when the resting LVEF is normal, but is unnecessary when the resting LVEF is abnormal;

(3) All patients with resting LVEF of less than 45%, exclusive of other cardiac disease, should have doxorubicin discontinued; and (4) EMB is useful in assessing doxorubicin toxicity in patients with other possible causes of an abnormal LVEF.

The High-Risk Acute Myocardial Infarction Patient at 1-yr Follow-Up: Identification at Hospital Discharge by Ambulatory Electrocardiography and Radionuclide Ventriculography. H. G. Olson, K. P. Lyons, P. Troop, S. Butman, J. N. Piters; Long Beach and Irvine, CA. *Am Heart J* 107:358–367, 1984

To determine whether radionuclide ventriculography and 24-hr Holter monitoring at hospital discharge in acute myocardial infarction (AMI) patients are useful in the identification of patients at high and low risk for cardiac death follow-up, 115 patients (all men, age range 39 to 84 yr) were studied. On the day just before hospital discharge (15.8 ± 7.8 day after hospital admission) all 115 patients had a 24-hr Holter monitor recording, and a radionuclide-gated ventriculogram to obtain left ventricular ejection fraction (LVEF). Ventricular ectopic depolarization incidences (VEDs) were characterized as being either uncomplicated or complicated. Complicated VEDs included unifocal VEDs ≥10/1000 beats for 24 hr, multiform VEDs, VEDs in pairs, and ventricular tachycardia. Thirty-eight of the 115 patients (33%) had complicated VEDs. The LVEF was 45 ± 15% (range 12% to 74%). During the 1-yr follow-up period, there were 12 cardiac deaths; eight died suddenly, and four patients died following AMI. Eight of the 38 patients with complicated VEDs had cardiac death, whereas four of 77 (5%) patients with no VEDs or uncomplicated VEDs had cardiac death. LEVF was 29 ± 13% in cardiac death patients as compared with 48 ± 13% in the survivors. Sudden death patients had a LVEF of 24 ± 9% as compared with 40 ± 5% in patients who died of AMI. High-risk patients, defined as those with complicated VEDs and a LVEF of 40%, had 40% mortality rate at one year, whereas low-risk patients, with no VEDs or with uncomplicated VEDs, had a 2% mortality rate. The authors concluded that LVEF determination and 24-hr Holter monitoring at hospital discharge are useful for identifying high- and low-risk AMI patients at follow-up, and sudden death patients had evidence at hospital discharge of profound impairment of LV function.

Prevalence of High-Risk Thallium-201 Scintigraphic Findings in Left Main Coronary Artery Stenosis: Comparison with Patients with Multiple and Single-Vessel Coronary Artery Disease. T. W. Nygaard, R. S. Gibson, J. M. Ryan, J. A. Gascho, D. D. Watson and G. A. Beller; Univ. Virginia Med. Ctr., Charlottesville, VA. *Am J Cardiol* 53:462–470, 1984

Detection of patients at risk for functionally significant left main coronary artery disease (LMCAD) is important because patients with LMCAD have a better survival rate with surgical rather than medical therapy. To determine the prevalence of high-risk Tl-201 scintigraphic findings in patients with LMCAD, 43 patients with a ≥50% diameter reduction by LMCA coronary angiography underwent quantitative exercise Tl-201 scintigraphy. The data from these patients were compared with data from other consecutive patients who had angiographic three-vessel disease (n = 53), two-vessel disease (n = 99), or one-vessel disease (n = 100). Scintigraphy was performed within 1 mo of angiography in all cases. A high-risk scintigram was defined as one that demonstrated: (1) a LMCAD scintigraphic pattern, ≥25% homogenous decrease in activity in the middle and upper septal and posterolateral wall on 45° LAO view; (2) Tl-201 scintigraphic abnormalities in two or more different vascular areas consistent with multivessel disease; (3) abnormal lung uptake of Tl-201. Lung uptake was designated as increased only when the mediastinum appeared as a photon-deficient region in contrast to the medial border of the lung, and the activity was decreased on the delayed images. Forty-one of the 43 patients with LMCAD had abnormal scintigrams. Thirty-three had one or more high-risk scintigraphic findings—29 with multivessel CAD image pattern, six with LMAD pattern, 18 with abnormal Tl-201 lung uptake. The prevalence of a high-risk scintigram in patients with LMCAD was significantly greater than that in the patients with three-vessel disease, two-vessel disease, or one-vessel disease. The prevalence of a high-risk ECG stress test in 43 patients with LMCAD was significantly lower than the prevalence of a high-risk scintigram, but prevalence of a high-risk ECG stress test was significantly greater than that in the 53 patients with three-vessel disease, two-vessel disease, or one-vessel disease. The combination of Tl-201 scintigraphy and exercise ECG stress testing was no better than scintigraphy alone but did improve the overall detection rate of high risk LMCAD patients when compared with stress ECG testing alone.

Clinical Evaluation of ^{99m}Tc-Pyrophosphate Myocardial Emission Computed Tomography: Comparison with Planar Imaging. N. Tamaki, T. Mukai, Y. Ishii, Y. Yonekura, D. Hamanaka, K. Minato, K. Kadota, H. Kambara, C. Kawai, K. Torizuka; Dept. of Radiology and Nuclear Medicine, Kyoto University Medical School, Kawahara-cho, Shogoin, Sakyo-ku, Kyoto, 606, Japan. *Eur J Nucl Med* 9:106–111, 1984

The results of single photon emission computerized tomography (SPECT) were compared with those obtained with planar imaging in 32 patients who underwent myocardial scintigraphy with Tc-99m pyrophosphate. Twenty-three patients suffered from acute myocardial infarction, seven patients had unstable angina pectoris, and two had cardiomyopathy and cardiomegaly. Patients with recurrent myocardial infarction were not included in the study. Planar images were obtained in anterior, left anterior oblique, and left lateral projections 2–4 hr after i.v. injection of 20 mCi of Tc-99m-pyrophosphate. Following conventional imaging, SPECT data acquisition was performed. Thirty-two images were obtained while the camera was rotated from the 135° left posterior oblique to 45° right anterior oblique position. Each reconstructed cross section contained 300–400k counts. Frontal and sagittal slices were calculated from the transaxial images. In 11 of the 23 patients with acute myocardial infarction, a circumscribed nuclide accumulation was observed in the planar images, whereas a diffuse radionuclide uptake was seen in ten patients. A focal nuclide accumulation was recognized in the SPECT images in 20 of the 23 patients with acute myocardial infarction. Four patients, two with angina pectoris and two with cardiomyopathy and cardiomegaly, had a significant increase of diffuse radionuclide uptake in the planar images. SPECT revealed blood pool activity but no pathologic tracer accumulation in these patients. The authors conclude that SPECT cardiac imaging with Tc-99m-pyrophosphate is a valuable technique for the assessment of myocardial radionuclide accumulation.

Quantitation of Perfused Myocardial Mass using Tl-201 and Emission Computed Tomography. B. L. Holman, S. C. Moore, P. M. Shulkin, C. M. Kirsch, R. J. English, and T. C. Hill; Harvard Medical School, Brigham and Women's Hospital and New England Deaconess Hospital, Boston, MA. *Invest Radiol* 18:322–326, 1983

After permanent coronary artery ligation in eight dogs, Tl-201 was administered i.v. Transaxial emission computed tomography (ECT) was performed 10 min after injection and 20 min after occlusion. In an attempt to quantify the perfused myocardial mass, the sectional images were analyzed in three ways. The results were compared with the in vitro activity measured from one or two pieces of the sectioned left ventricle and septum. A specimen was considered perfused only if it contained greater than 75% of the maximum measured Tl-201 concentration. Perfusion defects as small as 3.7 g were found but some as large as 6.5 g were missed (at the base). The best correlation was observed between the in

vitro data and the variable threshold ECT method of measuring perfused myocardial mass: for greater than 75% of maximum perfusion, in vitro weight = 22.6 + 0.69 ECT × weight (r = 0.83). The calculated weight of perfused myocardium was heavily dependent on the threshold when fixed values were used for defining the myocardial borders. Changes in threshold of 5% resulted in a decrease in apparent infarct size by more than 20% for thresholds ranging from 50% to 65%.

Hypothyroidism after Radioiodine Therapy for Graves' Disease. Is Its Incidence Increasing? D. G. Gresham, M. S. Wool; Lahey Clinical Medical Center, Burlington, MA. *Postgraduate Medicine* 75:299–309, 1984

Because of several reports suggesting a recent increased incidence of hypothyroidism in patients treated with I-131 for Graves' disease, the records of selected patients treated in 1968 (*33*), 1973 (*28*), and 1978–79 (*25*) were reviewed. In all cases, the diagnosis was based on clinical findings, the presence of a diffusely enlarged thyroid gland, and elevated serum levels of thyroid hormone. The mean age in each group was approximately 50 yr, with 20% in the first two groups under 40 but only 9% under 40 in the last group. The estimated size of the gland varied little, and four of five of the patients in each group were women. A majority had 3–6 wk of therapy with antithyroid drugs preceding I-131 therapy and one third received these drugs for 1 mo following treatment with I-131. The average severity of disease, as assessed by hormone levels, declined from twice normal in 1968 to about one and one half times normal in 1978–79. The average 24 hr I-131 or I-123 uptake rose from 55% in 1968 to 65% in 1978–79. The average dose of I-131 decreased from 10.9 mCi in 1968 to 8.4 mCi in 1978–79, but the average dose per estimated g of thyroid tissue remained stable. The 1968 group had a slightly lower incidence of hypothyroidism: 48% at 6 mo, 55% at 1 yr, and 61% cumulatively. The later groups had 64% and 60% at 12 mo, respectively, and a higher cumulative incidence of 68%. These percentages are higher than those estimated in the early days of I-131 therapy for hyperthyroidism, but not dramatically changed during the decade studied. The incidence of hypothyroidism was slightly higher in the pretreated patients, 73% compared with 63%. Treatment failures decreased from 21% in 1968 to 14% and 16% in 1973 and 1978–79, respectively.

Detrimental Effects of Hydralazine in Patients with Chronic Air-Flow Obstruction and Pulmonary Hypertension—A Combined Hemodynamic and Radionuclide Study. D. V. Tuxen, A. C. P. Powles, P. N. Mathur, S. O. Pigsley, E. J. M. Campbell; Alfred Hosp. Vic 3181, Australia. *Am Rev Respir Dis* 129:388–396, 1984

To determine the pulmonary hemodynamic effects of hydralazine, nine patients with pulmonary hypertension secondary to chronic air flow obstruction were studied by hemodynamic and gated-radionuclide study. The effect of hydralazine was measured during both normoxia and hypoxia and compared with the effect of hyperoxia. Hydralazine increased cardiac index from 3.7 to 4.5 $l/min/m^2$, but there were no significant changes in pulmonary artery pressure (PA), mean pulmonary vascular resistance index (PVRI), mean right ventricular (RV) stroke work index, and mean pulmonary capillary wedge pressure. Mean RV ejection fraction (EF) and RV end diastolic volume were not changed after hydralazine medication. The lack of correlation between baseline hemodynamic variables and RVEF in this study was probably due to the small sample size and the narrow range of hemodynamic values, because a wide variation in RVEF may exist for any given level of pulmonary hypertension. Authors concluded that hydralazine produced detrimental hemodynamic and symptomatic effects during both normoxia and hypoxia in patients with chronic airflow obstruction and on the levels of pulmonary hypertension found in this study and discouraged its use without individual patient assessment.

Screening for Diffuse and Focal Liver Disease: The Case for Hepatic Scintigraphy. E. C. McClees, R. K. Gedgaudas-McClees; Emory Univ. School of Medicine, Atlanta, GA. *J Clin Ultrasound* 12:75–81, 1984

These authors review and summarize published comparisons of radionuclide hepatic scintigraphy using Tc-99m-sulfur colloid (NM), ultrasound (US), and transmission computerized tomography (TCT) in screening for liver disease. Disease detection sensitivity is defined as true positives/(true positives + false negatives). In 37 studies comprising 1438 patients published between 1971 and 1982, sensitivity was 0.86 by NM. In 675 patients evaluated by US and in 1084 patients evaluated by TCT, sensitivity was 0.75 by each. In those patients studied, actual prevalence of liver disease was 0.52 for both NM and TCT studies and was 0.51 for US. Test specificity, defined as true negatives/(true negatives + false positives), was 0.79 for NM, 0.82 for US, and 0.91 for TCT. The predictive value of a negative test (PVNT), defined as true negatives/(true negatives + false negatives), was 0.83 for NM, 0.76 for US, and 0.77 for TCT. The PVNT value used should be a maximum so that further diagnostic test(s) are avoided after the initial negative screening test. In patients with focal liver disease, NM sensitivity was 0.87, TCT sensitivity was 0.86, and US sensitivity trailed at 0.72; the PVNT was 0.86 for NM, 0.67 for US, and 0.89 for CT. In patients with diffuse liver disease, sensitivity was 0.87 for NM whereas it was only 0.38 for CT. In those patients, PVNT was 0.91 for NM and 0.73 for CT. On the basis of monetary cost, sensitivity, PVNT, and ready availability, these authors conclude that the liver-spleen radionuclide study remains the best hepatic screening examination.

Scintigraphic and Radiographic Findings in Caroli's Disease. A. J. Moreno, A. L. Parker, M. J. Spicer, T. J. Brown; William Beaumont Army Med. Ctr., El Paso, TX. *Am J Gastroenterol* 79:299–303, 1984

These authors describe the use of scintigraphic techniques to initially evaluate two patients with potential Caroli's disease who presented with abdominal pain, fever, and intermittent obstructive jaundice. Patient 1 was a 48-yr-old woman whose laboratory examination revealed only an elevated serum alkaline phosphatase. Liver/spleen scintigraphy with Tc-99m sulfur colloid (Tc-SC) showed numerous well-circumscribed photopenic regions of various size involving the right and left lobes of the liver. Hepatobiliary imaging with Tc-PIPIDA showed dilated intrahepatic bile ducts and a dilated common bile duct with retained radiotracer. It was felt that the latter finding on delayed views (70 min) might be due to the underlying bile stasis. Hepatic cysts within the right and left lobes of the liver that did not communicate with the biliary system and the gallbladder were visualized. At surgery, an edematous gallbladder containing multiple, multifaceted pigmented stones was removed. A repeat hepatobiliary scintigram three years later again revealed dilated intrahepatic biliary ducts with retention of radiotracer. The findings were compatible with Caroli's disease and prior cholecystectomy. Patient 2 was a 19-yr-old man referred to hospital for evaluation of recurrent pancreatitis. Hepatobiliary scintigraphy with Tc-DISIDA showed dilated intrahepatic bile ducts and normal visualization of the gallbladder. On delayed images at 2.5 hr there was retention of radiotracer within dilated intrahepatic and common bile ducts. Ultrasonography, x-ray computed tomography, percutaneous transhepatic cholangiography, and/or endoscopic retrograde cholangiography were also used to evaluate both patients. These authors conclude that nuclear medicine techniques, noninvasive, inexpensive, and safe, could be used initially in the evaluation of patients with potential Caroli's disease.

Scintigraphic Diagnosis of Stress-Induced Incomplete Fractures of the Proximal Tibia. B. D. Collier, R. P. Johnson, G. F. Carrera, K. Akhtar, A. T. Isitman; Milwaukee County Med Complex, Milwaukee, WI. *J Trauma* 24:156–160, 1984

The authors describe the findings in three patients. Patient 1 was a 15-yr-old male who ran 20 miles weekly and presented with exercise-induced pain along medial aspect of proximal diaphysis of left tibia, a site tender to palpation. Radiographic examination revealed a thin periosteal reaction over the posteromedial margin of the proximal tibial diaphysis. A scintigraphic flow study and blood pool image showed increased perfusion and hyperemia at the same site. Anterior and lateral bone scintigrams using Tc-99m methylene diphosphonate (MDP) localized the osteoblastic response at the posteromedial margin of the proximal tibial diaphysis. Restriction of physical activity with aid of crutches led to resumption of vigorous athletic activity without pain or recurrent injury by six weeks. Patient 2 was a 29-yr-old male marathon runner who complained of four weeks of exercise-induced pain at the junction of proximal and middle thirds of left tibial diaphysis. Marked tenderness to palpation along posteromedial margin of left tibia was coupled with minimal tenderness over the right tibia at the same level. Radiographs were normal. The scintigraphic flow study and blood pool image showed increased perfusion and hyperemia over the junction of the proximal and middle thirds of both tibiae. Bone scintigrams showed a bilaterally symmetrical increase in osteoblastic activity over the posteromedial margins of both tibiae. Limited physical activity led to disappearance of left tibial pain by one month, and follow-up radiographs remained normal. Patient 3 was a sedentary 18-yr-old male presenting with pain along medial aspect of proximal left tibia brought on by walking and relieved with rest. There was tenderness to palpation and minimal swelling at that site. Initial radiographs were normal. Bone scintigrams showed a localized osteoblastic response on the posteromedial aspect of the proximal tibial diaphysis, and these scintigrams were similar to those from Patients 1 and 2. The patient was limited to light physical activity, and two months later was free of pain, swelling, and point tenderness, at which time follow-up radiographs showed periosteal thickening with a thin, radiolucent stress fracture running through the medial tibial cortex of the proximal tibial diaphysis. These authors conclude that: (a) incomplete stress fractures of the proximal tibial diaphysis can be diagnosed by bone scintigraphy, whereas roentgenograms may be normal; and (b) bone scintigraphy can dispel unfounded suspicion of tumor or infection that may lead to biopsy or inappropriate therapy.

Radionuclide Estimation of Cerebrospinal Fluid Shunt Flow—Evidence Supporting an Alternative Theoretical Model. A. Kuruc, S. Treves, K. Welch, D. Merlino; Children's Hosp. Med. Ctr., Boston, MA. *J Neurosurg* 60:361–364, 1984

There are several clinical situations in which it is important to estimate cerebrospinal fluid (CSF) flow through a surgically implanted valve. The flow of CSF through the valve may be estimated by analyzing the disappearance curve resulting from the injection of a radiotracer into the valve. The standard method for estimating flow assumes an exponential disappearance of the tracer from the valve. By this method the valve is considered as a single, well-mixed compartment. In this investigation the dependence of flow estimates on the injection technique used was evaluated in order to assess the validity of the well-mixed compartment model. The valve was injected with 500 μCi of Tc-99m in 0.05 ml of saline using a No. 26 needle and a tuberculin syringe. Three injection techniques, proximal angle, middle-angle and middle perpendicular, were used. The output of the gamma camera was recorded, using two-fold magnification, on a 64 × 64 image matrix at 1 frame every 2 seconds for 6 min. Two methods are applied to calculate estimated flow: exponential method and A/H method (A, total area under the disappearance curve; H, the initial height of the disappearance curve). The flow rates varied significantly with injection technique and the similar flow estimates were obtained from the proximal angled and middle-angled injection techniques. A/H method was close to the true flow rates. These findings may be explained by postulating that these injection techniques deposit the bulk of the tracer at the proximal end of the valve and thus the volume that the tracer must traverse is close to the physical volume of the valve. Authors concluded that optimal results are obtained using A/H method, and recommended that injection technique is to inject the valve at an acute angle with needle pointing to proximal end of the valve (to minimize the dependence of flow estimates on needle placement).

Reversible Hydronephrosis in the Rat: A New Surgical Technique Assessed by Radioisotopic Measurements. T. Elam, A. Venot, J. Bariety; Hospital Cochin Inserm U28, CNRS ERA 48, Hospital Broussais, Paris, France. *J Urology* 131:796–798, 1984

To facilitate studies of experimental hydronephrosis, an animal model was developed in which reproducible, reversible, unilateral, ureteral obstruction was produced and assessed by radioisotopic studies and histological examinations. The test subjects included six male, mature rats who underwent obstruction following baseline studies with reversal of obstruction 8 days later and nephrectomy on the 30th day. Two male rats served as controls and had nephrectomy on Day 8. Scintigraphic studies, using 300 μCi Tc-99m DMSA injected i.v. with imaging and computer acquisition of data, were performed on Day 0, Day 7, Day 18, and Day 29 along with measurements of creatinine and body weight. Ureteral obstruction was produced by the surgical implantation of two segments of polyethylene tubing, ends clipped, into the ureter and reversed by removal of the tubing segments. On Day 7, mean Tc-99m DMSA uptake in the obstructed kidney decreased to 20% of the baseline value, with increased mean uptake in the nonobstructed kidney, 174% of baseline. Ten days after release of the obstruction, partial recovery to 71% occurred with values declining to 147% of the preligation value in the opposite kidney. Creatinine values remained stable throughout. Only minimal histological changes were seen in the test kidneys, whereas control kidneys had severe hydronephrosis.

Isotope Scanning in the Irritable Hip Syndrome. H. Carty, M. Maxted, J. A. Fielding, P. Gulliford, R. Owen; Alder Hey Children's Hosp., Liverpool, Merciside, England. *Skel Radiol* 11:32–37, 1984

These authors evaluated 235 children admitted to hospital with acutely painful hips. Children with suspected septic arthritis were submitted to immediate exploratory arthrotomy and thus excluded. Within one week of admission, each child underwent a bone study with Tc-99m methylene diphosphonate (MDP), dose based upon body weight. In the first 71 children studied, anterior and posterior views of the pelvis (300,000 counts each) using diverging collimator disclosed Perthes' disease in five of the eight children so afflicted. Perthes' disease is revealed by one of three image patterns. The classical picture shows no uptake along the lateral two-thirds of the femoral head. Five children had a medial or central photopenic area. Secondly, a diffuse increase in uptake involving a flattened femoral head and growth plate is seen (reflecting repair or revascularization phase). A third picture showing mixed areas of increased and decreased uptake is seen. The diverging collimator yielded insufficient image resolution, and its use was discontinued. In the next 164 children—120 male, aged 3–14 yr—images of each hip (100,000 counts each) by pinhole collimator were obtained. Perthes' disease was found in 35 children (31 male, aged 3–10 yr) six of whom had bilateral disease. There were 129 children (86 male) with irritable hip syndrome (transient synovitis) characterized by either equal uptake of radioactivity in affected and

nonaffected hips (111 children), a diffuse increase in uptake throughout the joint but with normal head contour (16 children), or general diminution of uptake throughout the joint (two children). Persistent symptoms in three of the children with diffuse uptake throughout the joint led to arthrotomy, which yielded murky synovial fluid that cultured *Staphylococcus aureus* in two patients but yielded no growth in the third. The two children whose hips did not show any uptake continued to have pain, and after two years there was no firm diagnosis and no change in the radiographs. These authors conclude that radionuclide imaging with pinhole collimator (a) is a reliable means of diagnosing Perthes' disease, even at a stage when the only radiograph abnormality is slight widening of the joint space, and (b) can reliably distinguish between Perthes' disease and the irritable hip syndrome.

Radiolabelled Leucocytes: A New Diagnostic Tool in Occult Infection/Inflammation. I. Gordon, G. C. Vivian; Hosp. Sick Children, Dept. Paediat. Radiol. London, England. *Arch Dis Childhood* 59: 62–66, 1984

In-111-labeled white blood cells (WBC) have been used diagnostically in adults with occult infection and inflammatory bowel disease. These authors reported their studies with labeled WBC in 30 children (aged 5 wks to 15 yrs). Twenty children with suspected infection and ten children with suspected inflammatory bowel disease underwent the In-111 WBC imaging studies. Images were obtained between 1 and 4 hr and at 20 and 24 hr. Based on the results it was possible to classify the patients into five groups: Group A, renal-carbuncles; Group B, gut—eight of the ten children had suspected inflammatory bowel disease, and of these two had false-negative images; Group C, bone—two of seven patients with osteomyelitis had sequential images to assess the effectiveness of therapy, and five of the other children had skeletal symptoms of long duration, of whom two had normal images and three had positive images (two true positive and one false positive); Group D, immunocompromised—three patients with leukemia in remission, two of whom had normal images and one had a positive image; Group E, miscellaneous—one positive image showing a cerebral abscess and two true negative studies. The overall results showed a sensitivity of 85%, a specificity of 90%, and an accuracy of 86%. The clinical indications include evaluation of patients with suspected occult infection and of patients with suspected inflammatory bowel disease, and determination when to cease use of antibiotics in deep-seated infection. Authors concluded that when used appropriately, this technique forms a valuable back-up investigation.

Preliminary Clinical Images from a Prototype Positron Camera. R. J. Ott, J. E. Bateman, A. C. Flesher, et al.; Institute of Cancer Research and Royal Marsden Hospital, Sutton, Surrey, and Rutherford Laboratory, Chilton, Didcot, Oxfordshire. *Br J Radiol* 56: 773–776, 1983

Because of its high cost, positron emission tomography (PET) is now restricted to a few large research institutions. The authors report the performance of a prototype multiwire proportional chamber (MWPC) positron camera. They believe that such a camera used with generator-produced, as well as cyclotron-produced, longer-lived, positron-emitting radionuclides could be operated at a cost comparable with that of gamma camera/computer systems. The system includes two 30 × 30 cm sensitive areas with approximately 60 cm patient space between them during imaging. Each detector consists of 20 MWPCs containing lead foil cathode planes and anode wire planes covered by a lead shield to reduce background. The detector is relatively insensitive to scatter and has a maximum energy response at about 500 keV. Large areas may be imaged without a collimator. It has high spatial resolution at depth of less than 1 cm. Spatial sampling frequency of 2 mm is possible with the multiwire detectors. No detector motion is required for adequate data sampling, and both high-resolution tomographic imaging and dynamic studies are possible. Image reconstruction is achieved by backprojection of lines joining each of the coincident photon detection points into the planes of interest. These preliminary images are Fourier transformed. Each plane is filtered with a Fermi-Dirac window function, and the final images are produced by an inverse Fourier transform of each plane. The detector is limited in area and is best suited to imaging the skull, brain, thyroid, and extremities. The authors believe the images to be clinically acceptable and can be compared favorably with equivalent SPECT images. Anticipated improvements in the system will make it suitable for use in smaller hospitals.

A Simple Technique for Quantitative Cholecystokinin—HIDA Scanning. P. Newman, M. K. Browne, and M. Mowat; West of Scotland Health Board's Department of Clinical Physics and Monklands District General Hospital. *Br J Rad* 56:500–502, 1983

The authors describe a procedure for the quantitative evaluation of gallbladder function with Tc-99m labeled HIDA, scintillation camera, and computer. They studied twenty-five patients who had intermittent right hypochondriacal pain, nausea, and vomiting but normal cholecystograms and ultrasound scans. The patients were injected with 4.3 mCi (160 MBq) of Tc-99m HIDA. The gallbladder area image was acquired in the supine anterior projection with a scintillation camera through a high-resolution collimator and digitized as a 256 × 256 matrix until the gallbladder was clearly defined, usually at about 30 minutes. Subsequently, images were acquired with 30-sec frames. After about 3 min, one unit of pancreozymin per kg body weight was administered over the next 2 min, imaging was continued for a further 8 min. Regions of interest were marked with the light pen at the gallbladder, common bile duct, duodenum, and a background area in the liver superior and lateral to the gallbladder. Time-activity curves were generated and corrected for background, and the ejection fraction was calculated. Of 12 patients with an ejection fraction of 30% or less, seven have had surgery, and abnormal gallbladders found in six of them. The authors consider this procedure to be simple, fast, and objective. Problems with respiration motion artifact or the use of motion correction devices were not discussed.

Grading of Vesicoureteral Reflux by Radionuclide-Cystography. A. Fretzayas, A. Korpathios, P. Dimitriou, P. Nicolaidou, N. Matsoniotis; Athens Univ. Children's Hosp., Athens, Greece. *Ped Radiol* 14:148–151, 1984

Radiological investigation is considered essential in the diagnostic investigation of urinary tract infections in children. The most commonly discovered abnormality is vesicoureteral reflux (VUR) requiring multiple follow-up examinations. In an effort to reduce radiation exposure, the usefulness of radionuclide cystography (RNC) was evaluated by comparison with conventional voiding cystourethrography (VCU). The patient group, 36 children (23 females, 13 males), ranging in age from 6 mo–14 yr (mean 4.5 yr), was studied by VCU and RNC 4 wk after recovery from infection (patients with bladder outlet obstruction or megaureters were excluded from the comparison). Immediately after VCU, the RNC was performed by filling the bladder with 0.3–0.5 mCi (depending on age) of Tc-99m in a volume of normal saline equal to that used for the VCU. The bladder and kidneys were imaged by gamma camera during filling of the bladder, voiding, and after voiding. Estimation of the volume of refluxed urine and residual urine after voiding were obtained from counts taken over the regions of interest. There was no statistically significant difference in the detection of VUR by the two methods. When VUR was detected by both methods, RNC was superior in the postvoiding phase. The degree of VUR could be estimated from the RNC, with overlapping between international Grades II and III. The major

disadvantage of RNC was poor resolution compared with VCU. The authors recommend that VCU be used for the initial study to obtain precise anatomic detail with follow-up studies done by RNC to greatly lessen radiation exposure.

Evaluation of Kidney Grafts with ^{99m}Tc-Methylene Diphosphonate within 36 Hours After Transplantation: A Marker of Ischemic Damage. H. S. Thomsen, H. Løkkegaard, O. Munck; Department of Diagnostic Radiology, Herlev Hospital, University of Copenhagen, DK-2730 Herlev, Denmark. *Eur J Nucl Med* 9:115–120, 1984

The value of Tc-99m-methylene diphosphonate (Tc-99m-MDP) for the assessment of kidney grafts was evaluated in 30 patients. Each patient received 15 mCi Tc-99m-MDP within 36 hours after transplantation. The renal uptake was monitored for 100 sec at 10 min intervals up to 90 min after injection. The background-corrected total number of counts over the transplants was expressed as a percentage of the activity on the 10 min scintigram. Then the scintigraphic results were compared with the clinical data. No significant correlation was found between the nuclide accumulation and the times of warm or cold ischemia, maximal function (ml/min), rate and time of the reversible rejection, and ureteral obstruction. The authors calculated a correlation coefficient of 0.485 between the average radionuclide uptake ratio and the onset of renal function. The onset of function was shorter than 10 days in 76% of the grafts with a low radionuclide accumulation and in 15% of the renal transplants with a high-tracer uptake. The graft had to be removed in 12% of the patients with a low-average uptake, compared with 54% of the renal transplants with increased Tc-99m-MDP accumulation. The authors conclude that Tc-99m-MDP is useful for the prognostic assessment of renal transplants.

Radiation Risk of Thyroid Scintigraphy in Newborns. H. Beekhuis, D. A. Piers; Dept. of Nuclear Medicine, University Hospital, Groningen, The Netherlands. *Eur J Nucl Med* 8:348–350, 1983

The radiation risk of thyroid scintigraphy with [^{99m}Tc] pertechnetate, I-123, and I-131 in newborns with suspected congenital hypothyroidism was estimated. Assuming normal thyroid function, the total body radiation dose was seven times higher for I-123 than for Tc-99m. In patients with congenital hypothyroidism, the thyroid uptake is reduced. Therefore, the thyroid radiation dose is lower than in normals. The probability for thyroid malignancy induction after scintigraphy is 3×10^{-6} for Tc-99m, 2×10^{-5} for I-123, and 9×10^{-4} for I-131. The probability of any malignancy in newborns with suspected congenital hypothyroidism is 1.4×10^{-5} for Tc-99m, 3×10^{-5} for I-123, or 2×10^{-3} for I-131. The authors conclude that Tc-99m or I-123 iodine should be used for thyroid scintigraphy, since neither radionuclide considerably increases the spontaneous tumor frequency. I-123 should be preferred because of the higher specific uptake and the possible detection of organification defect.

(Reprinted with corrections from the January, 1984, issue)

PEGGY DOMSTAD
JOHN J. COUPAL
WEI-JEN SHIH
University of Kentucky
Med. Ctr. and
VA Hospital
Lexington, Kentucky
DAVID W. PALMER
Medical College of Wisconsin
Milwaukee, WI 53226
RALPH ADAMS
Loma Linda University
Loma Linda, California
LUDWIG STRAUSS
Klinikum Mannheim
Mannheim, West Germany