ABSTRACTS OF CURRENT LITERATURE

The Detection of Squamous Cell Tumours of the Head and Neck Using Radio-Labelled Antibodies. R. M. D. Tranter, D. S. Fairweather, A. R. Bradwell, P. W. Dykes, S. Watson-James, S. Chandler; Dept. Immunol, Birmingham, W. Midlands, England. *J Laryngol Otol* 98:71–74, 1984

The use of radiolabeled anti-CEA in the detection of primary and metastatic squamous cell tumors of the head and neck was investigated in five patients (four males, one female, age range 48–62). Radiolabeled antibodies to carcinoembryonic antigen (CEA) were prepared by labeling anti-colon tumor cell specific IgG of sheep origin with I-131. Thyroidal and salivary gland uptake of I-131 was blocked using orally administered KI, (180 mg/day), starting 1 day before the patients' studies began and continuing for 1 wk after. After ruling out anaphylactic hypersensitivity, each patient received 400–600 μCi I-131 labeled anti-CEA, containing not more than 130 μg of sheep IgG, by intravenous injection. Before each image was obtained, patients were given 500 μCi Tc-99m and 500 μCi Tc-99m-labeled human serum albumin to simulate the distribution of free iodine and facilitate the computer subtraction technique. Gamma camera images were obtained at 24 and 48 hr following the injection of radiolabeled antibody. Computer subtraction techniques were used to enhance image quality. The procedure was successful in demonstrating the primary and metastatic tumors in the five patients, and all except one tumor area were confirmed by other techniques. Only one false-negative site of microscopic size was encountered. Radiolabeled anti-CEA scans offer a simple means of obtaining positive evidence of tumor sites in the head and neck areas.

Simultaneous Maximal Exercise Radionuclide Angiography and Thallium Stress Perfusion Imaging. K. A. Narahara, I. Mena, J. C. Maublant, M. Brizenidine, M. Oriley; Univ. Calif. Los Angeles City Harbor Med Ctr., Torrance, CA. *Am J Cardiol* 53:812–818, 1984

When both Tl-201 perfusion study and radionuclide angiography (RA) are performed in the same patient, coronary artery disease (CAD) is determined with high sensitivity and specificity. Because of the relatively lower energy of Tl-201 and physical half-life of Tc-99m, both studies must be performed on separate days. Gold-195m is a new ultra-shortlived (30.5 sec) radionuclide that makes possible simultaneous dual-radionuclide imaging. To assess the feasibility and possible benefits of performing dual-radionuclide studies, 24 patients with known CAD and 20 normals were studied during a single exercise stress test. When the subjects' end point was reached, 2 mCi of Tl-201 were injected i.v. and exercise was continued for 1 min longer. Immediately after the injection of Tl-201, 20 mCi of Gold-195m was injected, and exercise first-pass images were obtained requiring 30 sec of acquisition time. Within 5 min after the first-pass images and the termination of exercise, Tl-201 images were obtained. An 83% sensitivity and 95% specificity for detecting CAD with Tl-201 imaging was noted in this investigation, suggesting that its diagnostic accuracy was not altered by simultaneous dual-radionuclide imaging. When segmental left ventricular (LV) wall motion was compared with Tl-201 imaging, divergent results were noted in 15 of 44 subjects. An analysis of LVEF results at rest and stress provided additional information that could be useful in assessing the clinical significance of such difference in segmental wall motion and perfusion. Gold-195m RA scintigraphy allows simultaneous study with Tl-201 perfusion study in a single exercise. Thus, it will reduce the cost and time required for noninvasive evaluations of patients with CAD.

Gallium-67 Scanning: A New Diagnostic Approach to the Post-Pericardiotomy Syndrome. V. J. Bufalino, J. A. Robinson, R. Henkin, J. O'Connell, R. Gunnar; Loyola Univ. Med Ctr., Maywood, IL. *Am Heart J* 106:1138–1143, 1984

These authors studied 16 patients (13 male, aged 45–72 yr, mean 58) after their first intrapericardial surgery, aortocoronary bypass, ventricular aneurysmectomy, or valve replacement. They had presented with documented postpericardiotomy syndrome. Patients bearing evidence of recent myocardial infarction or clinical hemodynamic instability were excluded from study. At 72 hr after i.v. administration of 5 mCi gallium-67 citrate, each patient underwent cardiac imaging by large field-of-view gamma camera fitted with 300 keV parallel-hole collimator in anterior, 45° and 60° left anterior oblique and left lateral projections. Nine of the patients, whose elapsed time from surgery to Ga-67 imaging was five to eight days (mean 6.3), showed no Ga-67 uptake over the heart (Group I). Six of the remaining seven patients, whose elapsed time from surgery to Ga-67 imaging was 18–64 days (mean 34.4), showed moderately increased diffuse (four patients) or focal (two patients) Ga-67 uptake over the pericardium and or myocardium. The seventh patient had mildly increased diffuse Ga-67 activity over the heart (Group II). Of another group of 20 patients imaged by the Ga-67 (by protocol above) for reasons other than chest pathology, none showed significant radioactivity over his cardiac silhouette. Antiheart antibody in serum was present at a titer of 1:5 or greater only in one of four of the Group I patients tested, but in none of four Group II patients tested. Fever (over 37.5°C) was present in eight and in four of the Groups I and II patients, respectively. Erythrocyte sedimentation rate was over 40 mm in eight and in six of the Groups I and II patients, respectively. White blood cell count was over 10,000 in seven of the Group I patients and in four of the Group II patients. The results suggest that "early" pericarditis may have a different mechanism than "late" pericarditis, and that early pericarditis is more traumatic than immunologic. The classic postpericardiotomy syndrome, which may occur quite late after surgery, probably does not occur until a latent period has elapsed during which an immune-inflammatory response has developed. These authors conclude that Ga-67 imaging of the heart will prove to be a useful tool in differential diagnosis of chest pain and fever occurring in patients two or more weeks following cardiac surgery.

Thallium-201 Scintigraphy in Complete Left Bundle Branch Block. H. O. Hirzel, M. Senn, K. Nuesch, C. Cletner, A. Pfeiffer, O. M. Hess, and H. P. Krayenbuehl; Univ. Hosp. Zurich Ch8091, Zurich, Switzerland. *Am J Cardiol* 53:764–770, 1984

The use of Tl-201 scintigraphy in patients with persistent or rate-related left bundle branch block (LBBB) was investigated in 37 patients, 19 of whom were symptomatic and also underwent cardiac catheterization. Rest and stress Tl-201 scintigrams were obtained using a standard protocol and anlayzed by "blinded" readers. Digitized images were used for calculation of Tl-201

uptake in the myocardial segments. Dog studies were also performed in which the animals were examined by Tl-201 scintigraphy during atrial pacing and during LBBB simulated by right ventricular pacing, 1 wk being allowed between examinations. In the LBBB dog studies, hemodynamic data and Tl-201 concentrations in the myocardial segments were also determined. Results of Tl-201 scintigraphy in the asymptomatic patient group revealed six patients with perfusion defects in the anteroseptal wall after exercise, which disappeared with redistribution at rest. All 19 symptomatic patients had perfusion defects in the anteroseptal wall with Tl-201 stress imaging (73 ± 2% of maximal Tl-201 activity compared with 96–100% in the lateral wall, $p < 0.001$), which redistributed to normal Tl-201 activity (88 ± 2%) after rest. Patients with persistent LBBB showed decreased peak left ventricular pressures, diminished left ventricular ejection fraction, and septal asynchrony. Coronary artery disease was ruled out by selective angiography in 15/19 patients. Findings of Tl-201 scintigraphy and regional myocardial blood flow in 6/7 days confirmed the high rate of false-positive Tl-201 scintigraphy in LBBB.

Thallium Scintigraphy During Dobutamine Infusion: Non-Exercise-Dependent Screening Test for Coronary Disease. J. R. Mason, R. T. Palac, M. L. Freeman, S. Virupannovar, H. S. Loeb, E. Kaplan, R. M. Gunnar; VA Med. Ctr., Portland, OR. *Am Heart J* 107:481–486, 1984

The value of exercise Tl-201 myocardial perfusion scintigraphy in detecting coronary artery disease (CAD) has been well documented, but there remains significant variability in specificity. Two important factors that reduce sensitivity are early redistribution of Tl-201 and inadequate exercise. Dobutamine, which can induce and maintain myocardial perfusion defects, is an advantageous pharmacological agent for this purpose. In this study dobutamine was infused in doses of 5, 10, 15, and 20 μg/kg/min in 24 patients (age 59 ± 6) being evaluated for chest pain. At the maximal tolerated dose of dobutamine, 2.0 mCi Tl-201 was injected i.v., and dobutamine infusion was continued during imaging. After 4 hr, redistribution images were obtained. Significant CAD was present in 16 patients; the remaining eight had normal coronaries. Exercise ECG was obtained in 23 patients. During the study, reversible perfusion defects occurred in 15 of 16 CAD and in one of eight non-CAD (sensitivity, 94%; specificity, 87%). Exercise ECG had a sensitivity of 60% and a specificity of 63%. Authors concluded that dobutamine Tl-201 study: (a) can reduce the problems of early redistribution and inadequate exercise; (b) appears to be a sensitive method for detecting significant CAD and a more sensitive screening test than exercise ECG; and (c) is especially useful in patients who cannot exercise.

Sources of Variability in the Radionuclide Angiographic Assessment of Ejection Fraction: A Comparison of First-Pass and Gated Equilibrium Techniques. S. Kaul, C. A. Boucher, R. D. Okada, J. B. Newell, H. W. Strass, G. M. Pohost; Massachusetts General Hospital, Boston, MA. *Am J Cardiol* 53: 823–829, 1984

Two radionuclide methods, first-pass and gated-equilibrium; are used to measure left ventricular (LV) and right ventricular (RV) ejection fractions (EF). Measurements of EF by both methods are believed to be equivalent. No study has compared EF values obtained in the same patients by two techniques. To compare RVEF and LVEF measurements obtained by these techniques, 135 patients were entered into the study. The two methods were performed within 1 hr: first-pass with patients upright using a multicrystal camera in anterior projection and gated-equilibrium with patients supine using a single-crystal camera in the left anterior oblique projection. Eighteen (15 men and 3 women, aged 49 ± 9 yr) of 135 patients were considered normal subjects. Of 117 patients (96 men and 21 women, aged 56 ± 13 yr), with a variety of cardiopulmonary disorders, 89 had coronary artery disease, 35 valvular heart disease, six pulmonary disease, and five cardiomyopathy with dilatation. The first-pass and gated-equilibrium LVEF correlated well ($p < 0.001$), but the slope of the regression line was different from unity. The first-pass EF values were lower than gated-equilibrium values (0.51 ± 0.16 compared with 0.56 ± 0.15). Among the 45 patients with gated LVEF of ≤0.50, the correlation was better than that for the 90 patients with an LVEF >0.5. In the latter group, however, the correlation remained good in the 15 patients with cardiomegaly due to aortic or mitral regurgitation. Inter- and intraobserver error was similar for both methods. For evaluation of RVEF there was a poor correlation between the results obtained from first-pass and gated equilibrium (0.51 compared with 0.43). Intraobserver error was less for the first-pass method. Since there may be considerable variability in the EF at rest in the same patient because of different techniques, caution must be taken when EF values have been obtained using the different radionuclide methods as compared.

Comparison of Two-Dimensional Echocardiography with Gated Radionuclide Ventriculography in Evaluation of Global and Regional Left Ventricular Function in Acute Myocardial Infarction. R. E. VanReet, M. A. Quinones, L. R. Poliner, J. G. Nelson, A. D. Waggoner, D. Kanon, S. J. Lubetkin, C. M. Pratt, W. L. Winters, Jr; Methodist Hospital, Houston, TX. *J Am Col Cardiol* 3:243–253, 1984

In acute myocardial infarction, two-dimensional echocardiography (2D) and gated radionuclide ventriculography (RV) have been used to assess the extent of myocardial damage and its eventual effect on prognosis. In the early diagnosis of acute myocardial infarction (MI), the detection of dyssynergy remote from EKG site of infarction, and the recognition of mechanical complications, such as papillary muscle rupture, 2D has been particularly useful. RV has become a standard for left ventricular ejection fraction (LVEF) and for the serial assessment of global function after an MI. This study examines the usefulness and limitations of two imaging modalities as performed during routine practice in detecting areas of myocardial involvement, assessing global function, and determining prognosis in acute MI. Ninety-five consecutive studies obtained within 48 hr and at 10 days after an acute MI were evaluated by the two techniques in 93 patients (66 men, 27 women, mean age 61 years). The sites of infarction by EKG analysis were: 35 anterior, 49 inferoposterior, and 11 nonlocalized. Abnormal motion of the anterior wall, septum, or apex was observed in 97% and 100% of anterior MI by RV and 2D, respectively. Abnormal motion of an inferior or posterior wall segment was seen in 61% and 91% by RV, and 2D, respectively. LVEF by 2D and RV correlated well and did not change from the first 48 hr to 10 days after MI. LVEF determined by the two noninvasive tests were highly predictive of in-hospital mortality: 37% for RV, 42% for 2D occurred in patients with initial LVEF of 0.35 or less. No mortality was seen in patients with LVEF above 0.40 by either test. Mortality was lowest in patients with an LVEF above 0.49, and worse in those with LVEF below 0.36 by either test. A numerical score was assigned for each wall motion classification as follows: +4 for hyperkinesia, +3 for normal, +2 for mild hypokinesia, +1 for hypokinesia, 0 for akinesia, −1 for dyskinesia, and a wall-motion score derived as the sum of all the individual segments (anterior, apex, inferior, lateral, posterior, septum). The scores were normalized for the number of segments visualized. An initial score of 0.50 or less was associated with a mortality rate of 40% by 2D and 35% by RV; for scores greater than 0.50, 2% by 2D and 3% by RV. There were no deaths in patients with a score of 0.80 or greater by either test. Both 2D and RV provide a comparable assessment of LV function and wall motion in anterior MI. In detecting inferoposterior wall abnormalities, 2D appears more

sensitive. Data from either test clearly distinguish a subgroup of lower-risk patients from a group with high probability of cardiac death during the acute event as well as 1 yr after acute MI.

Early Evaluation of Coronary Artery Bypass Grafts: CT or Selective Angiography. P. C. Wilson, O. Gutierrez, A. Moss; Dept. of Diagnostic Radiology and Medicine, The University of Rochester Medical Center, Rochester, NY. *Eur J Radiol* 4:22–27, 1984

Transmission computerized tomography (TCT) and selective angiography were performed in 27 patients to assess coronary artery graft patency in the early postoperative period. A rotating fan-beam scanner was used for the TCT examination. The appropriate cross section was selected from a "scout view" image where opaque markers around the grafts origins were identified. At each level four to six transverse scans were obtained using a nongated 4.8 sec scanning time and 1.4 sec interscan delay. Twenty-two cc of contrast medium were injected i.v. during the first scan. Conventional selective angiography was performed within 24 hr of the TCT examination. Fifty (85%) of the 59 patent grafts were correctly classified with TCT. Nine grafts were occluded, and moderate-to-severe stenoses were observed in six cases at angiography. All six narrowed grafts were patent on the TCT examination. Furthermore, time-density curves of these grafts were not significantly different from those of normal grafts. Two complications occurred during angiography: one patient had dysrhythmia after contrast medium injection, in another patient the origin of the graft was dissected. No complications occurred during the TCT examination. The authors conclude that TCT is the procedure of choice for graft evaluation in the early postoperative period.

Significance of Increased Lung Thallium-201 Activity on Serial Cardiac Images After Dipyridamole Treatment in Coronary Heart Disease. R. D. Okada, Y-H Dai, C. A. Boucher, G. M. Pohost; Massachusetts General Hospital, Boston, MA. *Am J Cardiol* 53:470–475, 1984.

The evaluation of Tl-201 activity in the lungs observed on exercise myocardial images correlates with the extent of coronary artery disease (CAD) and left ventricular (LV) dysfunction. Increased Tl-201 uptake in the lungs has not been observed in normal control patients. Dipyridamole, a patent vasodilator, has been used as an alternative approach to exercise stress for detecting CAD. To determine the significance of lung Tl-201 uptake in the lungs after administration of dipyridamole, initial and delayed (2 to 3 hr) Tl-201 imaging was performed in 40 patients with CAD and in 26 normal subjects. All patients underwent cardiac catheterization within 1 wk of the Tl-201 dipyridamole study. The lung Tl-201 index was defined as the ratio of the average count/pixel for the pulmonary region to that for the myocardial region. The mean initial Tl-201 activity in the lungs was 42 ± 2% in 26 control subjects, 56 ± 2% in 25 patients with two- or three-vessel CAD and 54 ± 2% in 15 patients with one-vessel CAD. From the initial to the delayed images, lung Tl-201 activity decreased relative to the myocardium in patients with CAD but not in control group. When a lung index of 58% was chosen as the upper limit of normal, 14 of 40 of the CAD patients (35%) had abnormal values, whereas all control patients had values within normal limits. Resting left ventricular ejection fraction (LVEF) in 14 patients with CAD had abnormal lung Tl-201 indices that tended to be lower than those for patients with CAD and normal indices (58 ± 4% compared with 63 ± 2%, respectively). The differences, however, were not significant. Of nine segments scored, patients with four or more abnormal segments had lung Tl-201 indices that tended to be higher than those for the patients with fewer than four abnormal myocardial segments (mean lung index 56% and 53%, respectively), but the differences were not statistically significant. The author concluded that although abnormally increased lung Tl-201 uptake does not relate to the severity of CAD, its presence in initial images after a dipyridamole Tl-201 infusion greatly increases the certainty that CAD is present.

Regional Lung Function in Patients with a Complete Radiographic Regression of Small Cell Bronchogenic Carcinoma. S. Sörenson, B. Bake; Dept. of Pulmonary Medicine, Renströmska Hospital, Göteborg, Sweden. *Eur J Cancer Clin Oncol* 20:61–67, 1984

Functional lung examinations were performed in 21 patients with small-cell carcinoma who demonstrated a complete radiographic regression 3 mo after chemotherapy. The mean vital capacity (VC) and mean forced expired volume in one second (FEV_1) were 89% and 88% of the estimated normal values. In 15 patients VC and FEV_1 were within the normal range. Examinations with Xe-133 demonstrated impairment of ventilation and/or perfusion at the site of the tumor in 13 patients. The reduction in blood flow was more severe than the decrease in ventilation. The median survival time and the disease-free 2 yr interval did not correlate with the alterations of the regional lung perfusion or ventilation.

Continuous Aerosol Inhalation Scintigraphy in the Evaluation of Early and Advanced Airways Obstruction. T. Weiss, P. Dorow, R. Felix; Dept. of Radiology and Cardiovascular-Pulmonary Division, Klinikum Charlottenburg der Freien Universität Berlin, Spandauer Damm Berlin. *Eur J Nucl Med* 9:62–67, 1984

The regional mucociliary removal rates of inhaled Tc-99m human serum albumin minimicrospheres were determined in 15 healthy volunteers, 20 asymptomatic smokers with early small airways obstruction, and in 30 patients with advanced chronic obstruction of large airways. A jet nebulizer was used to produce the aerosol, which was inhaled for 5 min. Using 5 mCi Tc-99m of labeled minimicrospheres, a retention of approximately 200–260 μCi was obtained. Successive scintigrams were obtained in the anterior position at 1-min intervals for a total of 120 min. Each lung was divided into five regions, and an aerosol distribution index was calculated from the data. A homogenous distribution of activity was observed in healthy volunteers and the nuclide accumulation increased in the main bronchi about 40 min after aerosol application. In 12 of 20 smokers no mucociliary particle transport was visualized. The radionuclide distribution was inhomogenous in patients with chronic obstructive lung disease. The central bronchial system was visualized approximately 30 minutes after aerosol inhalation. The peripheral clearance was delayed in all patients with airway disease. The central clearance rate was normal in healthy volunteers and patients with small airways disease, whereas a faster decrease in activity was observed in patients with chronic obstructive lung alterations. The mean aerosol distribution index was significantly different for the three groups. The reduction of peripheral mucociliary particle transport appears to be an early sign of small airways disease in smokers. The authors propose the use of qualitative and quantitative aerosol lung ventilation imaging as a diagnostic procedure for early airway obstruction.

Computed Tomography in the Evaluation of Thyroid Disease. P. M. Silverman, G. E. Newman, M. Korobkin, J. B. Workman, A. V. Moore, R. E. Coleman; Duke University Medical Center, Durham, NC. *Am J Roentgenol* 141:897–902, 1984

Radionuclide thyroid scintigraphy has been the primary method for evaluating the functioning of the thyroid tissue. Sonography has been used primarily to differentiate cystic and solid masses of the thyroid. Limited experience has been obtained in evaluating the thyroid gland by computed tomography (TCT). To evaluate the TCT appearance of various thyroid abnormalities, TCT ex-

aminations were performed using a Siemens Somatom II or GE 8800 CT/T scanner. Eighteen patients were retrospectively studied. Fifteen of the 18 patients had a radionuclide examination of the thyroid. These patients included 12 with multinodular goiters, two with Graves' disease, one Hashimoto thyroiditis, one thyroid adenoma, and two with thyroid carcinoma. Scintigraphy results were correlated with surgical findings and clinical and laboratory findings. In multinodular goiter, areas of decreased tracer on radionuclide imaging generally corresponded to areas of decreased density on TCT. In all eight patients with adequate TCT and radionuclide imaging, there was good correlation in homogeneity of appearance of thyroid parenchyma. In four patients enlarged inhomogenous glands were found on both radionuclide and TCT scans. One of two patients with Graves' disease had enlarged homogenous gland identified on radionuclide and TCT studies. In the second patient a substernal component of thyroid was identified on TCT but not on the radionuclide image. The patient with Hashimoto thyroiditis with substernal extension had nonhomogenous uptake, but TCT showed a homogenous thyroid gland of a tissue density similar to that of surrounding muscle. The two photopenic nodules of thyroid carcinoma had a lower density mass displacing the normal high density thyroid gland on TCT. The TCT scan more completely defined the anatomic extent of tumor, when the neck was involved and there was metastatic lymphadenopathy. One patient had a TCT scan showing a densely calcified mass in the thyroid with a benign adenoma. The authors concluded that TCT provided additional anatomic information not available on radionuclide scintigram by defining the retrosternal extension of tumor, its relation to normal anatomic structures, and presence of metastatic lymphadenopathy in the neck.

Malignant Pheochromocytoma: Clinical, Biochemical and Scintigraphic Characterization. B. Shapiro, J. C. Sisson, R. Lloyd, M. Nakajo, W. Satterlee, W. H. Beierwaltes; University of Michigan Medical Center, Ann Arbor, MI. *Clin Endocrinol* 20:189–203, 1984

Of 270 patients referred to this medical center for evaluation of known or suspected pheochromocytoma (PCC) between June 1980 and January 1983, 30 patients fulfilled the criteria for diagnosis of malignant PCC. Of the 30 patients, 21 were male with age at diagnosis ranging from 10–57 yr (mean 32)—11 diagnosed under age 18 yr. The malignancies were indolent: time elapsed from initial diagnosis to this evaluation ranged from 0–33 yr (mean 9.2), whereas time elapsed from discovery of metastases to this evaluation ranged from 0–18 yr (mean 3.7). Each of the 30 patients received an i.v. dose of I-131-labeled metaiodobenzylguanidine (I-131 MIBG) and underwent scintigraphic imaging comprising anterior and posterior views of the head, thorax, abdomen, pelvis, and upper femoral regions to assess location and extent of tumor dissemination. I-131 MIBG structurally resembles norepinephrine and is taken up by PCC by a mechanism believed to be similar to that by which norepinephrine is taken up following secretion. I-131 MIBG scintigraphy reflects anatomic localization of a function specific to adrenergic tumors and therefore represents a new index of nature and growth of PCC. Other radionuclide scintigraphic techniques sometimes used for anatomic orientation were kidney studies (Tc-99m-pentetate), liver/spleen (Tc-99m-sulfur colloid), bone (Tc-99m-medronate), heart (Tl-201 chloride), and vascular structures (Tc-99m-red blood cells). Other techniques used for detection of metastases were chest radiograph, skeletal radiography, i.v. pyelography, abdominal ultrasound, abdominal and/or chest computerized tomography, angiography, liver/spleen study, and bone image. Each patient had at least three of those eight procedures. I-131 MIBG scintigraphy was found superior to the other techniques for detection of metastases in 16 of the 30 patients. I-131 MIBG scintigraphy performed equally as well as other techniques in seven patients. I-131 MIBG scintigraphy was inferior to other techniques in seven patients—minimal or no uptake of I-131 MIBG occurred in three cases (four of the patients had received external beam radiotherapy to principal tumor deposits). There were no false-positive studies by I-131 MIBG. I-131 MIBG revealed skeletal metastases in 19 of the 20 known cases. I-131 MIBG was either superior to Tc-99m-medronate at disclosing skeletal metastases (six patients) or inferior (six patients). These authors conclude that multi-millicurie doses of I-131 MIBG may prove therapeutic for malignant pheochromocytomas, an hypothesis they are currently testing.

Sodium Pertechnetate Tc-99m Antral Scan in the Diagnosis of Retained Gastric Antrum. C. H. Lee, F. K. Fang, P. H. H. Yeh; Veterans Gen. Hosp., Taipei, Taiwan. *Arch Surg* 119:309–312, 1984

Retained gastric antrum (RGA) following partial gastrectomy with Billroth II reconstruction often produces medically intractable, severe, recurrent peptic ulcer disease. This study investigated the use of radionuclide antral imaging in 121 patients with single or multiple recurrent ulcers occurring 3 mo to 29 yr after surgery. The presence of anastomatic ulceration and confirmation of the type of previous surgical intervention was confirmed by endoscopy and/or upper gastrointestinal series in all patients. Gamma camera images were obtained at 5 min, 15 min, 30 min, 1 hr and 2 hr after i.v. injection of 10 mCi of Tc-99m sodium pertechnetate. An area of increased radioactivity to the right of the midline and separate from the body of the stomach constituted a positive image for RGA. Surgical intervention was required in 59 of the 121 patients, and 22 were confirmed as having RGA. The antral image was positive in 16 of the 22 patients (sensitivity 72.7%). No patient with absence of RGA at surgery had a positive antral image (specificity 100%). Of the six patients with false-negative antral images, many showed hemorrhage gastritis in the RGA.

Computed Tomography of the Liver: Evaluating Focal Defects on Radionuclide Liver-Spleen Scans. W. T. Djang, S. W. Young, R. A. Castellino, R. Lantieri; Stanford Univ. School of Medicine, Stanford, CA. *Am J Roentgenol* 141:937–940, 1984

False-positive radiocolloid liver scintigrams may occur because the scintigram is an integration of radioactivity in three-dimensional object projected into a two-dimensional image. Anatomic variations in the size and shape of the liver and interference from adjacent extrahepatic structures may result in "filling defects" that can erroneously be interpreted as focal defects. Computed tomography (CT) of the liver may be used in such a potentially false positive radiocolloid scan. To evaluate the contributions of CT in detecting false-positive liver scintigrams, 523 consecutive liver-spleen radiocolloid scans were retrospectively reviewed. One hundred twenty-four patients with focal abnormalities on hepatic scintigrams were identified. Thirty-eight out of the 124 had subsequent CT examinations of the liver. Of this group, 11 patients had false-positive radiocolloid scans. The criteria for the positive examinations were: (1) radionuclide studies that were interpreted as containing abnormal focal hepatic defects; (2) subsequent CT of the liver interpreted as normal; (3) subsequent negative follow-up for hepatic disease by clinical course or biopsy. False-positive radiocolloid scan abnormalities related to anatomic variation of the liver (one thinned left lobe, three prominent portal vein and periportal fat Riedel lobe thinned distally) or adjacent extrahepatic structure (one severe scoliosis; one interposed stomach containing barium, one renal impression, one anteriorly spaced loops of bowel, one wrapped around stomach, prominent fat around falciform ligament, one tenting of R diaphragm) are readily recognized and explained on the basis of the CT study. The "vulner-

able" areas are confined to the left lobe, the porta hepatis, the gallbladder fossa, or the tip of the right lobe of the liver. The authors recommended the abnormalities seen in the above vulnerable areas require reexamination by CT.

Comparison of Radiography and Radionuclide Bone Scanning in the Detection of Child Abuse. P. K. Joudes, Univ. Chicago School of Medicine, Chicago, IL. *Pediatrics* 73:166–169, 1984

The presence or absence of fractures is a significant factor in determining the legal disposition of children suspected of being victims of child abuse/neglect. This prospective study was undertaken to determine the relative merits of radiographic skeletal surveys and radionuclide bone scintigraphy in this setting. During the 4-yr period 1978–1982, 121 children were referred for examination. All had either radiographic or scintigraphic skeletal examinations, and 50 children had both. In the overall group of 121 patients (aged 2 mo–15 yr, 73 males, 37 females), 20% had multiple fractures. In the 50 who underwent both studies, 41 fractures were detected, 22 (54%) by skeletal survey and 36 (88%) by bone imaging. Normal radiographs were found in five children who had fractures detected by bone image, and two children had negative bone images but one fracture each was revealed by x-ray. A total of 12 children had some fractures that would not have been detected had not both modalities been used. The incidence of fractures detected by radiography was significantly greater in children less than old as 3 yr compared with those older (49% compared with 26%, <.0005). Foster home placement was ordered in 63% of children with any fracture and in 73% with multiple fractures. If the initial study (radiographs or scintigrams) is negative, an additional study should be performed to yield the greatest accuracy in fracture detection.

A Prospective Study Comparing Nuclear Scintigraphy and Computerized Axial Tomography in the Initial Evaluation of the Trauma Patient. L. B. Uthoff, P. L. Wyffels, C. S. Adams, G. F. Zwicky, Jr., B. C. Berg; Dakota Clin., Univ. Dr., Fargo, ND. *Ann Surg* 198: 611–616, 1983

Between April and October 1982, 85 stable patients (58 male) aged 3–71 yr (mean 29) presenting to hospital with specific signs suggestive of intraabdominal injury subsequent to acute blunt trauma were prospectively evaluated. Each patient underwent immediate transmission computerized tomography (TCT) of the abdomen and radionuclide imaging of liver and spleen with Tc-99m-sulfur colloid (Tc-SC), with or without renal imaging using Tc-99m-glucoheptonate (Tc-GH). Scintigraphy was performed with a small- and large-field-of-view gamma cameras. Tc-SC study routinely included posterior, anterior, right and left lateral, and right and left anterior oblique projections; right and left posterior oblique views were sometimes added. Renal imaging began immediately after bolus injection of Tc-GH with vascular phase measurement from 0 to 42 (or 48) sec at 1-sec intervals. Three static images were then obtained and the process continued until labeled urine was seen within the urinary bladder. Patients nonoperatively managed for single-organ injuries of the liver, spleen, or kidneys were followed by renal scintimaging until traumatic imaging abnormalities resolved completely or stabilized. Radionuclide imaging was found to be most valuable for these patients: (a) children, (b) pregnant women, (c) those using a spine board, (d) those with multiple splinted extremities, (e) those allergic to contrast media, (f) the uncooperative or combative patients, and/or (g) those with single injury suspected by nature of accident. Addition of TCT examination was warranted in patients with: (a) concomitant head injury; (b) suspicion of severe retroperitoneal injury; (c) pelvic fracture with pelvic hemorrhage; and/or (d) suspicion of lesser sac injuries. Either or both diagnostic modalities may suggest need for additional plain radiographs, arteriography, admittance to hospital, peritoneal lavage, and/or surgery. No patient with assumed isolated liver, spleen, or renal injury on the basis of TCT and radionuclide imaging, who was managed nonoperatively, required subsequent laparotomy.

Assessment of Tissue Viability in Frostbite by Tc Pertechnetate Scintigraphy. Z. Salaimi, W. Vas, B. P. Tang, R. G. Eachempati, L. Morris, M. Carron; St. Louis City Hosp., St. Louis, MO. *Am J Roentgenol* 142:415–421, 1984

To demonstrate objective assessment of the viability of involved tissue in severe frost bite, six patients (aged 14 to 62 yr) with severe frostbite of the hands (six cases) and feet (one case) were studied with Tc-99m scintigraphy. The hands were centered with palms down on the face of a large-field-of-view gamma camera. The digits were spread apart as much as possible with strips of gauze. Sequential images with 2 sec/frame and immediate static images were obtained. In five of the six patients, perfusion defects in their fingers resulted in surgical removal of these areas. One patient with hyperemia of the hands but no perfusion defects and another with hyperemic changes in the feet required only conservative treatment. There was good correlation between the scintigraphic findings and the extent of deep tissue ultimately requiring surgical resection. The authors concluded that in frostbite Tc-99m imaging distinguishes viable from nonviable tissues in a simple, noninvasive procedure. The scintigraphic procedures provide more specific information than clinical examination. The study is recommended within 24–48 hr after the injury with repeat imaging 7–10 days later.

A Method of Comparing the Areas under Receiver Operations Characteristic Curves Derived from the Same Cases. J. A. Hanley, B. J. McNeil, McGill University, Montreal, Canada and Harvard Medical School and Brigham and Women's Hospital, Boston, MA. *Radiology* 148:839–843, 1983

With increasing frequency, receiver operating characteristic (ROC) curves are being used to describe observer performance in diagnostic technology. There have been limitations in the understanding of the statistical properties of these curves, especially in situations where two curves are based on the same set of subjects or objects. A popular index for comparing two ROC curves is the area under the curve. This article presents an equation for calculating the standard error of the difference between the areas under two curves for the special situation where the curves were obtained from the same set of patients or objects. The Dorfman and Alf maximum likelihood estimation program was used to calculate area and to output the standard error associated with the area. To calculate the critical ratio z (to test the null hypothesis) when two curves are compared, two intermediate correlation coefficients are required. Tables are provided by the authors to facilitate this calculation. The use of these tables to calculate the critical ratio, z, is illustrated with the aid of a study using phantoms to evaluate the accuracy of two different computer algorithms used in transmission computed tomography reconstructions. The authors demonstrate the statistical economy that is to be gained by using the paired design, i.e., the same set of patients for both variables, in contrast to the unpaired approach.

The Use of a Nuclear Medicine Computer as a Multichannel Pulse-Height Analyzer. C. C. Harris; Duke University Medical Center. *Radiology* 148:857–859, 1983

Although some scintillation cameras have built-in multi-channel analyzers (MCA), many lack this capability, and purchase of a laboratory-type MCA may not be cost-effective. With the addition of a relatively inexpensive interface, however, the minicomputers found in most nuclear medicine laboratories can be operated as a 256 channel MCA. A buffered energy signal must be made

available, e.g., by the camera serviceman. The author provides a description of the additional electronic modules that are required to convert the computer into a multi-channel analyzer and presents a block diagram of a simple specialized interface. Once the spectra are collected, standard region-of-interest programs and curve manipulation algorithms can be utilized for processing, or special applications programs can be written. Up to eight spectra can be acquired in one image frame. With modifications it is also possible to add the capability of a multi-channel scaling mode. The availability of these modes of operation provide several capabilities: 1) The measurement of energy resolution of scintillation cameras and other detectors such as well counters; 2) Acquisition of scattered-photon spectra for use in calculations of attenuation factors for single-photon ECT; 3) Spectrum plots for teaching purposes; 4) Automatic data reduction of multi-nuclide well counter data; 5) Absolute assay of I-125 sources from well counter data.

JOHN H. COUPAL
PEGGY A. DOMSTAD
WEI-JEN SHIH
Univ. of Kentucky Med. Ctr. and VA Hospital
Lexington, Kentucky
L. STEPHEN GRAHAM
VA Medical Center and UCLA School of Medicine
Sepulveda, California
LUDWIG STRAUSS
Klinikum Mannheim
Mannheim, West Germany