ABSTRACTS OF CURRENT LITERATURE


To assess the value of radionuclide ventriculography at rest and during submaximal exercise testing as predictors of major cardiac complications in patients with single or multivessel coronary disease, 42 patients (31 men, 11 women) underwent radionuclide ventriculography. These patients were diagnosed as having myocardial infarction (MI) based on ECG, enzymatic, and Tc-99m PPI scintigraphic criteria. Coronary angiography and submaximal exercise testing with radionuclide ventriculography were performed at 2-day intervals on each other in these 42 patients. Eleven of the 16 patients with single-vessel coronary stenosis had major cardiac complications. The subsequent courses of these 16 patients were correctly predicted by left ventricular ejection fraction (LVEF) ≤ 40% in eight patients, by LVEF < 55% in seven patients, by failure of LVEF to increase by 0.05 units in 13, and by an increase in LV end-systolic volume index (LVESVI) during exercise > 5% above baseline in patients. Of the 26 patients with multivessel coronary artery disease, 24 had major cardiac complications. The subsequent courses of these 26 patients were correctly predicted in 13 by LVEF ≤ 40%, in 20 by LVEF < 55%, in 25 by a failure of LVEF to increase by 0.05 units during exercise, and in 20 by an increase in LVESVI by > 5% during exercise. Based on these data, the authors concluded that submaximal exercise testing with radionuclide ventriculography may provide valuable prognostic information regarding the occurrence of major cardiac complications after myocardial infarction in patients with single-vessel disease as well as in those with multivessel disease.


In-111 labeled platelet scintigraphy has been used to identify intravascular thrombi in various locations including the left ventricle (LV). This retrospective study defines the optimum time (window) after injection of the labeled platelet suspension for detection of LV thrombi, identifies the most useful imaging veins, and determines the reproducibility of this technique. The patient data base consists of 662 images obtained from 64 patients with LV aneurysm (n = 38) or mitral valve disease (n = 23) and three patients with acute myocardial infarction. All three observers agreed that the left anterior oblique (LAO) view in the time period 3 to 4 days after injection of platelet suspension was the optimum time for imaging. By adding other views, the parameters of accuracy were not significantly enhanced. There was significant enhancement of sensitivity and diagnostic accuracy on the 3rd and 4th days of imaging. Two major situations may create difficulty with interpretations: (1) elevated left hemidiaphragm with result- lent elevation of the spleen (needs interpretation with chest radiograph); and (2) increased blood pool activity due to a large LV volume or aneurysm, which is diffuse in nature and decreases with time (whereas activity due to a thrombus increases). The authors concluded that: (1) In-111 platelet imaging is a reproducible and specific technique for identifying LV thrombus; and (2) imaging should be performed on the day of injection and 3 or 4 days thereafter.


Detection of the patency of distal splenorenal shunts is difficult. Conventional scintiplenoportography is an invasive and high risk procedure. Selective splenic arteriography is impossible if the splenic artery has been ligated, and cavaography does not always permit opacification of the shunt by retrograde filling. Catheterization of the shunt through the renal vein is also a difficult procedure. To evaluate the efficacy and safety of the alternative, scintiplenoportography with Ciba needle, 28 cirrhotic patients underwent 33 procedures. The techniques involved in the procedures were: (1) splenic puncture with Ciba needle; (2) 5 mCi In-111 in 2 ml of saline injected through the needle; (3) images obtained every 1 sec or recorded on a PDP 11/34 computer. Satisfactory images were obtained in 29 of the 33 procedures. In the remaining four procedures a subcapsular injection occurred. Scintigraphic patterns were divided into three categories: Group I—normal flow to the liver without portasystemic collaterals; Group II—presence of portasystemic collaterals but hepatic flow maintained; Group III—complete diversion of the splenic flow without liver image. Three of 12 patients without a surgical shunt corresponded to Group I, five to Group II, and four to Group III. All patients with a functioning surgical distal splenorenal shunt showed a pattern of Group II with visualization of spleen, left kidney, and inferior caval veins. The images of patients with thrombosed splenorenal shunts showed abnormal retention of the tracer in the spleen, nonvisualization of the inferior venacava, and the presence of significant splenorenal circulation. The authors concluded the scintiplenoportography is a useful, reproducible, safe method to assess the patency of distal splenorenal shunts.


Normally, paraumbilical or umbilical collaterals are not functional but remain patent. In the presence of portal venous obstruction or hypertension, the collaterals may be developed. The authors presented the Tc-99m sulfur colloid scintigraphic study of a 54-yr-old with alcoholic cirrhosis and portal hypertension. A functioning embryologic collateral vessel, thought to be paraumbilical or umbilical channel, was demonstrated in both dynamic and static images.


One hundred and twelve pediatric patients with upper abdomi-
Inal pain were retrospectively reviewed. Seven patients (aged 2–14) with abnormal cholecystoscionsograms were selected for the study. The abnormal cholecystographic findings included: (1) increased gallbladder wall thickness; (2) abnormal echo pattern of the gallbladder wall; (3) increased gallbladder wall size; and (4) presence of either shadowing or nonshadowing echogenic intraluminal material within the gallbladder. Five of the seven patients also underwent hepatobiliary scintigraphy using Tc-99m disofenin. Three of the five cases were positive for cystic duct obstruction (two cholecystitis, one cholangitis with presumed cholecystitis). One patient had nonvisualization of hepatobiliary system (fulminant hepatitis with cholecystitis), and another had only enlarged gallbladder (serum hepatitis). In liver echogenicity, there were two cases of cholecystitis with normal images, one case of acute hepatitis showing increased brightness, marked accentuation of portal venous radicles, and decreased liver echoes. In other cases these criteria were of little benefit. The etiologies of the abnormal findings included three patients with hepatitis, one with acalculous cholecystitis, one with calculous cholecystitis, one with cholangitis with associated cholecystitis, and one with chronic active hepatitis. The authors stated that the combined use of the sonogram and cholescintigraphy is helpful in predicting and distinguishing between cases of cholecystitis and uncomplicated hepatitis.


The gamma-variate function was applied to dynamic Tc-99m HIDA hepatobiliary examinations in 24 patients with liver disease and in ten normal volunteers. The function: C(t) = K(t)(t/A-B) was fitted to the time-activity curve of every matrix element, and functional images were generated using the parameters A and B. In addition, the mean transit time (MTT) was calculated for each pixel according to the equation: MTT = (A + 1)/B and a parametric image of the MTT was displayed. Regions-of-interest were placed over the lateral part of the right liver lobe to obtain numerical values for A, B, and MTT. In 11 patients with biliary obstruction the parameters A and B were decreased (A = 0.46 ± 0.12, B = 0.02 ± 0.011) compared with the control group (A = 0.62 ± 0.038, B = 0.06 ± 0.003). The MTT was 28.4 ± 1.03 in normal persons and significantly prolonged in patients suffering from biliary obstruction (MTT = 146.3 ± 181). Six patients with chronic hepatitis had normal values for parameter A (A = 0.67 ± 0.13), whereas B was reduced (B = 0.037 ± 0.011), and MTT was increased (MTT = 50.3 ± 18.8). Cirrhosis (seven patients) was associated with a lowered value for parameter A (A = 0.49 ± 0.15) and B (0.028 ± 0.013). The MTT was increased (MTT = 64.4 ± 30.7) compared with normals. The authors assume that parameter A is mainly dependent on the first part of the gammavariate curve, thus representing the radionuclide uptake, whereas parameter B describes the downslope of the function and hence the elimination of HIDA. A high correlation coefficient (p = 0.87) was found to exist between the ranking of the patients by a hepatologist on the basis of clinical, laboratory and histological data and the classification according to the decrease or increase of the parameters A, B, and MTT. Thus, a quantitative analysis of hepatobiliary scintigrams might be a promising tool in the diagnosis of liver disease.


Complications in the postoperative course of patients suffering from Crohn's disease suggest the presence of alterations in the potassium homeostasis. Serum potassium levels are irregularly altered in these patients, since approximately 98% of the total body potassium (TBP) is intracellular. In 94 patients with Crohn's disease, the TBP was estimated, using a scanning multidetector whole-body counter. The window was centered at the 1.46 MeV photopeak of natural K-40. The absolute overall error for one examination was lower than 9%. All measurements were compared with reference values depending on age, weight, height, and sex, so that relative TBP values were obtained in each patient. The total body water (TBW) was determined by a radiotracer dilution method. All patients were classified according to a Crohn's disease activity index (CDAI), which includes three subjective and five objective parameters. Twenty-four normal volunteers formed the control group. In 27 patients with Crohn's disease the authors attempted to assess the role of the Na-K pump mechanism by measuring the number of ouabain binding sites per red blood cell. The TBP and the TBP/TBW ratio, a parameter for the mean intracellular potassium concentration, were significantly decreased in patients with Crohn's disease (TBP 87%, TBP/TBW 73%) compared with the control group (TBP 97%, TBP/TBW 84%). No significant correlation existed between the serum potassium concentration and TBP; similarly, the correlation between TBP and patient weight loss was not significant. A low correlation coefficient of 0.4 was calculated for CDAI and the number of ouabain binding sites. The authors suggest that the intracellular potassium deficiency might increase the ouabain binding sites. Different types of potassium deficiency were proposed: a decrease of TBP as the result of weight loss or secondary changes of TBP, e.g., due to alterations in the active and/or passive membrane permeability. The clinical importance of TBP measurements in patients with Crohn's disease is discussed.


In this investigation, 5-(131I)-iodo-derivatives were chosen to measure Greene melanoma in Syrian golden hamsters. The biological behavior of these compounds was significantly uniform. After 1 hr I-131 activity had distributed to most tissues, but with preference for the kidneys, liver, and intestines. Generally rapid elimination of the radioactivity was observed (1/2 1–3 hr). Although the thiouracil compounds apparently did not localize at the binding sites in the melanoma cells, I-131 activity was retained in the tumor and high tumor-to-nontumor ratios were observed. The authors concluded that I-123 labeling of several of these compounds might be useful as melanoma imaging agents.


Bone scintigrams were obtained with Tc-99m MDP in 16 patients who had histologically proven histiocytosis X. Images were performed to be positive if a localized increase or decrease of radionuclide uptake was noted. Positive scintigrams were followed by radiographic evaluation of the involved regions and those areas where clinical symptoms were present. A biopsy was performed also in doubtful cases. In patients with multifocal eosinophilic granuloma, with or without extraskeletal dissemination, bone scintigraphy did not reveal lesions of increased or decreased uptake in more than 50%. In contrast, no false-negative result occurred in patients with unifocal eosinophilic granuloma, since these lesions
were visible as a focal radionuclide accumulation. Follow-up examinations of the lesions showed that the scintigrams became negative before the radiographs. With radiotherapy bone image normalization was delayed when compared with the scintigrams obtained after surgery. The authors conclude that bone scintigraphy should be used for follow-up examinations after local treatment in patients with unifocal eosinophilic granuloma. The radiographic examination was more reliable in patients with multifocal eosinophilic granuloma, since bone imaging gave a high rate of false-negative results.

A Comparison Between the Diagnostic Efficacy of $^{99m}$Tc-MDP and $^{99m}$Tc-DPD and $^{99m}$Tc-HDP for the Detection of Bone Metastases.


The recently marketed bone-seeking radiopharmaceuticals, hydroxymethylene diphosphonate (HDP) and dicarbonylpropenephosphonate (DPD), were reported to show some improvement of scintigraphic quality in animal study and in early clinical studies. To determine the clinical usefulness of Tc-99m HDP and Tc-99m DPD for the detection of skeletal metastases compared with Tcmethylene diphosphonate (MDP) (most commonly used tracer for routine examination), 20 patients with various malignancies were cross-over studied with Tc-99m MDP and Tc-99m DPD (ten patients), and Tc-99m MDP and Tc-99m HDP (ten patients). All scintigrams were obtained 3 hr after tracer injection. Quantitative analysis included calculation of normal bone-to-soft tissue ratios, lesion-to-soft tissue ratios, and lesion-to-normal bone ratios for all three radiopharmaceuticals. Visual reading of the second bone scintigram (Tc-99m HDP or Tc-99m DPD) of all 20 patients revealed exactly the same number and location of bone lesions detected with the first radiopharmaceutical (MDP). The normal bone-to-soft tissue ratio for MDP was not significantly different from this ratio for DPD, and HDP. No significant differences in the uptake in normal bone or in the metastatic lesions were found among the three agents. The authors concluded that DPD and HDP do not possess clinical advantages over MDP for the detection of bony metastases.

Prostatic Acid Phosphatase Comparison of Radioimmunoassay and Enzyme Activity Assay.


Measurements of prostatic acid phosphatase are now part of the routine evaluation of patients with prostatic carcinoma. Currently, determination of the enzyme is made by an enzyme assay. Because of the immunologic specificity of acid phosphatase of human prostate, a number of radioimmunoassay kits have become available. This investigation compared detection of prostatic acid phosphatase by an enzymatic assay and by a double antibody radioimmunoassay. Blood samples were obtained mainly from two groups—patients with prostatic carcinoma and a control group. The results showed no substantial advantage in use of a radioimmunoassay. There was no difference between radioimmunoassay and enzymatic activity assay used during follow-up in the study. Thus, the authors do not advocate a change to use of radioimmunoassay for measurement of prostatic acid phosphatase.

Kinetics of Technetium 99m Labelled Macroaggregated Albumin in Humans.


The distribution of Tc-99m MAA was followed with a scintillation camera and computer for 36 hr following injection for lung imaging or venography. The radiopharmaceutical was prepared with a labeling efficiency of approximately 99%. Patients for lung imaging were given a single injection of 3.5 mCi (130 MBq). For venograms 2.5 mCi (90 MBq) were injected into each foot. Significant activities were shown at various times in the lungs, stomach, kidneys, GI tract, bladder, and thyroid; however, no accumulation was observed in the liver or spleen. The lung activity curve showed a bieponential slope corresponding to half lives of 0.9 and 4.6 hr. The integration of the various curves, together with MIRD tables, yielded absorbed doses for the various organs, which the authors tabulate. The whole body dose for venography was 0.14 rem 0.0014 Sv.

Influence of Background and Absorption Correction on Nuclear Quantification of Left Ventricular End-Diastolic Volume.


A method to calculate left ventricular end-diastolic absolute volume from gated blood pool data is reported. The authors compare this method with single-plane cineventriculography in 38 patients and 15 normal subjects. Corrections are made for background, LV blood self-absorption, and for absorption by the thoracic and LV walls. Volume calibration was performed with the gamma camera measurement of the patient's venous blood contained in a syringe. They describe the influence of different background models on end-diastolic volume quantification. Conventional in vivo red cell labeling was used, achieving approximately 95% label. Gated blood pool acquisition was performed within 8 days of the cardiac catheterization. Imaging with patient supine and at rest equilibration was performed 30°–40° LAO with 0°–15° caudal tilt, with high-sensitivity, parallel-hole collimator, and zoom mode (zoom factor not stated). Cineventriculography was performed at 50 frames/sec. The ventricle model assumed was a rotational ellipsoid (volume = $\pi LR^2/6$), where L is the long diameter, aortic valve to apex. In the gated blood pool method three background models were investigated: (a) uniform background subtraction; (b) parabolic background subtraction; and (c) no background subtraction.

The details of the corrections for background and absorption and the calculation of the end-diastolic volume are outside the scope of this review. Without background correction, EDV was overestimated; without uniform background it was underestimated. The parabolic background model yielded the best correlation with cineangiography. The authors conclude that absolute measurements of end-diastolic volume may be performed with standard gated techniques by drawing blood and measuring its activity with the gamma camera without much prolongation of the procedure.

Work in Progress: Methods of Contrast Enhancement for NMR Imaging and Potential Applications.

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Early clinical studies with nuclear magnetic resonance (NMR) have shown it has considerable promise. The availability of contrast agents would improve its usefulness significantly by providing additional diagnostic information. The basic principle is that of altering T1 and T2 values and/or hydrogen concentration. A number of potential clinical applications of contrast enhancement have been identified. First, contrast enhancement could be useful in separating magnetically similar but histologically dissimilar tissues such as normal muscle and liver. Second, NMR contrast enhancement could be useful in determining tissue function. For example, an NMR-active glucose derivative might be helpful in defining regional metabolic activity within the brain. Although there are many paramagnetic materials, only a few of them can
be used as contrast media for clinical studies. The class of materials that is particularly interesting are those that have strong paramagnetism with unpaired electrons. T1 and T2 values can also be changed by altering the physical properties of the tissue, such as temperature and viscosity, but the degree of change that is required makes this an unlikely prospect. Another approach to contrast enhancement is to increase the hydrogen concentration. Changes in the state of hydration of a patient alters hydrogen density, T1, and T2, but relatively marked changes in hydration are required. Parenteral hypertonic agents appear to be a more effective method of producing overhydration. Lipids and liposomes have also been studied as contrast-enhancing agents because of their high hydrogen content, but they appear to be less effective than paramagnetic agents. Molecular oxygen has been demonstrated to increase T1 in living subjects, but it is difficult to control for changes in blood flow. A number of paramagnetic ions such as manganese, cobalt, nickel, and copper may prove useful, but their use is handcapped by their toxicity. Perhaps the most attractive group of compounds are the stable free radicals. Some of them can be covalently bonded to specific groups of biomolecules. These have been covalently attached to numerous drugs such as propranolol and steroids for the in vitro study of drug metabolism.


Because of the rapid increase in cardiovascular nuclear medicine, specialty training in this field of expertise has been incorporated into departments of nuclear medicine in teaching hospitals. However, many general radiologists who are responsible for nuclear medicine procedures in small community hospitals may have only limited experience in the interpretation of these studies. A teaching program involving telephone transfer of cardiovascular nuclear medicine studies from community hospitals was developed to assist in the training of radiologists. A course is also offered for technologists in the methods of performing these studies. After receiving the study, it is analyzed and interpreted, and the interpretation is dictated into a special radiology reporting system. The referring physician can call a special number, dial in the patient’s ID number, and listen to the interpretation. Weekly meetings are held with the radiologists to review the interpretations and to provide further instruction. The modem and interfaces for the computer rent for about $150 per month or can be purchased for about $2000. The radiology reporting package is a turnkey system, which can be purchased for $35,000. Several commercially available systems provide the necessary hardware and part of the software. Additional software was developed by the authors. The receiving computer and modem are set for 24-hr unattended operation. Transfer of a compressed, four-view cine study and an unmodified MLAO view requires approximately 10 min. If the modem and interfaces are rented, the cost of the remote interpretation program is about $16 per study, based on four studies per week. The short transfer time and the rapid availability of the interpretation make this a useful technique.

An All-Digital Nuclear Medicine Department. J. A. Parker, H. D. Royal, R. F. Uren, et al; Charles A. Dana Research Institute and Department of Radiology, Beth Israel Hospital and Harvard Medical School, Boston, MA. Radiology 147:237–240, 1983

When film is used for hard copy of nuclear medicine images, there are several disadvantages. Films can easily be lost or misfiled and require substantial amounts of storage space. The images cannot be manipulated to change contrast or gray scale and occasionally must be repeated. In addition, gated cardiac studies cannot be stored in this mode so comparison with previous studies is difficult. The principal advantage of digitized images is that they can be manipulated and superimposed or displayed in cine format. Furthermore, access is rapid and the images can be displayed on video monitors in various locations within the hospital. This article describes an all-digital department involving several different commercially available computers and includes dictation and selective telephone retrieval of digitized voice interpretations. The hardware consists of four scintillation cameras each with a dedicated computer. Each computer is connected to a remote display in the reading room where images can be manipulated. After interpretation the report is dictated and digitized so that referring physicians can dial the patient’s identification number to hear the report. A central computer is used for analysis of complicated studies and has two 300 MB discs that are used for long-term (3 mo) storage. Floppy discs or a serial line is used to transfer images from the individual computers to the central mass storage device or to the display computer that is used for more recent (~1 wk) studies. The authors estimate photographic storage costs at approximately $3.46/study. If it is assumed that the nuclear medicine department already has a computer, the cost of digital storage ranges from $1.19 to 2.19/study, depending on the hardware used. Even in the latter case, the savings would be $1.27/study. Although approximately 2 man-years of software development was necessary, the authors report relatively few problems and have found the system to be easy to use on a day-to-day basis.


The authors studied 92 hydrouretonephrotic kidneys in 73 patients to determine the accuracy of sonography in distinguishing between simple hydrenephrosis and pyonephrosis. The presence of internal echoes within the collecting system, dispersed or gravity dependent, was taken to indicate pyonephrosis. In 38 patients without clinical evidence of infections sonography revealed no internal echoes. In a second group of 34 patients, nine out of ten cases with internal echoes proved to have pyonephrosis (sensitivity 90%). The single false positive (3%) was caused by hemorrhagic debris. In the remaining suspected cases, sonography predicted the absence of pyonephrosis with a specificity of 97% and false-negative rate of 10%. Overall accuracy of the technique using the criterion of internal echoes was 96%, and the authors conclude that ultrasound is an effective means of distinguishing between these two entities. Sonographically guided needle aspiration can also be used in selected cases to establish the diagnosis.


In a study of 169 infants with vomiting, the authors successfully diagnosed hypertrophic pyloric stenosis in 86 of 93 patients subsequently proven to have this condition. Best evaluated with the beam oriented along the long axis of the gastric antrum, a pylorus with wall thickness exceeding 4 mm was considered abnormal. Of the seven false-negative cases, five had persistent elongation of the pyloric channel to greater than one centimeter, a finding seen in 77% of patients with hypertrophic pyloric stenosis but in only 21% of normals. The authors stress the need for proper geometry of the scan plane, noting that off-axis sections (long axis or cross-sectional views of the pylorus) may distort the true muscle thickness. High-resolution, small parts scanners are ideal instruments with which to assess this condition.

A dense, tapering trail of echoes distal to a strongly reflecting structure has come to be known as the “comet tail artifact.” This reverberation phenomenon is a product of marked differences in acoustic impedances between the object and its surroundings and is commonly seen at the interface between diaphragm and aerated lung, bowel wall and the gas-filled lumen, and, at times, with calcifications and their surrounding soft tissues. The clinical usefulness of the “comet tail” is manifest in such situations as displacement of the “comet tail” from the chest wall, indicating the presence of pleural effusion and identification of the “comet tail” in confirming the presence of an IUD. Representative sonograms and radiographs are provided.


The authors present four cases of omphalocele diagnosed in utero. The appearances ranged from a purely cystic mass, through a combination of cystic and solid elements to solid tissue, depending upon the contents of the sac. Continuity between the sac and the umbilical cord is characteristic of omphalocele. The thin membrane of amnion and peritoneum found in omphalocele is lacking in gastroschisis. Accompanying polyhydramnios is common, presumably due to the high incidence of associated gastrointestinal malformations such as malrotation and midgut volvulus. Other associated congenital anomalies are common as well, cardiac defects having been reported in 20% of infants with omphalocele. In the case of a ruptured omphalocele, the distinction from gastroschisis may be difficult at best. The presence of polyhydramnios or of elevated amniotic fluid alphafeto protein should prompt a sonographic search for omphalocele as well as other gastrointestinal abnormalities and neural tube defects.

Erratum

In the article entitled “The Derivation of the Gamma Variate Relationship for Tracer Dilution Curves,” October 1983, pp. 945–948, two corrections should be noted.

On p. 947, the third and fourth sentences of the second paragraph are transposed. The middle section of the paragraph should read:

"From Eq. (15) we see that \( \beta \) is the ratio of the volume of a theoretical mixing chamber to the rate of flow. It has dimensions of time, and can be thought of as the time required to empty a theoretical mixing chamber at a given flow rate."

In the fourth line of Equation 32 on p. 947, the exponent in the denominator should read \( \alpha_1 + \alpha_2 + 2 \).