Abstracts for the Technologist Section Scientific Papers:
30th Annual SNM Meeting Program—St. Louis, Missouri, 1983

A Note on the Scientific Papers

The Scientific and Teaching Sessions Committee of the Technologist Section, Society of Nuclear Medicine, is pleased to present the abstracts of the scientific papers for the 30th Annual SNM Meeting. The scientific papers will be presented on Wednesday, June 8, in simultaneous sessions that will begin at 8:30 am.

I urge you to attend the scientific paper sessions, support your fellow technologists, and share the knowledge these excellent papers afford.

—Frances Neagley, Chairman

Wednesday, June 8, 1983

INSTRUMENTATION/COMPUTERS I

8:30–10:00 am **Room 260**

Moderator: Heather S. Dickson
Co-moderator: Susan E. Brown

VISUALIZATION AND MEASUREMENT OF I-131 ACTIVITY IN SMALL SOURCES. L.M. Thorson, E.M. Frischmann, C.A. Gorman, Mayo Clinic, Rochester, MN.

Therapeutic decisions in thyroid cancer patients depend on accurate visualization and quantitation of low level I-131 activity in thyroid remnants and metastases. We compared performance characteristics of 5 instruments used for these purposes.

I-131 sources containing 0.5, 1.0, 2.0 μCi dispersed in volumes of 1 and 10 ml were immersed (in a lucite step phantom) in an I-131 solution containing 0.05, 0.5 and 2.5 μCi/100 ml to simulate tissue background and were scanned at depths of 5, 10, 15 cm with the Searle 37 GP camera, Picker Rectilinear Magnascanner, Ohio-Nuclear Sigma 410 camera, General Electric 400T camera and the Searle PhoCon Tomographic Scanner. For the cameras we also studied the effects on count rates of increasing region of interest, varying depth of lesion, varving distance between adjacent sources and we defined fractional and specific sensitivity for each camera.

The performances of the gamma cameras were similar but none matched the PhoCon in ability to detect a 0.5 μCi source dispersed in 1 ml at 5, 10, 15 cm against 0.05 and 0.5 μCi/100 ml background activity. For the cameras, increasing region of interest from 15 to 30 pixels increased recorded counts by 50% and a change in depth of lesion from 15 cm to 5 cm increased count rate 450%.

We conclude that with 3 mCi scanning doses all instruments tested should easily visualize I-131 uptake at a level of 0.2% of dose/cc of tissue. Carelessness in defining area of region of interest, inaccuracy in estimating depth of lesion and failure to compensate for uptake in adjacent tissues can lead to major errors in dosimetric calculations.

COLLIMATOR COMPARISON FOR SPECT IMAGING USING A WHOLE BODY PHANTOM. M. DeLaney, J. Weber, and S.J. Goldsmith. Mount Sinai Medical Center, New York, N.Y.

Three collimators for a rotating gamma camera SPECT system were evaluated for line source resolution vs. depth on transaxial tomographic slices. Collimators evaluated: 0.104" x 1.6" round hole (OEM HI-R); 0.062" x 1" hexagonal hole; 0.048" x 0.95" hexagonal hole.

^{99m}Tc line sources, mounted in a water filled whole body phantom at a 45° angle to the axis of rotation, were imaged in 64 locations through 360° using a 22cm radius of rotation. Acquisition was repeated for each collimator with the stepping time adjusted for decay. At each acquisition, count density was 500 cts/cm^2 (low I.D. study) or 4000 cts/cm^2 (high I.D. study). Profile analysis of the reconstructed slices yielded a range of FWHM measurements near the center of the phantom from 16.3mm (0.048" collimator with a high I.D.) to 23.3mm (OEM collimator with a low I.D.).

At all depths and I.D.'s, both hexagonal collimators were superior to the OEM collimator. For low I.D. studies near the center of the phantom, the 0.062" collimator had better resolution than the 0.048" collimator. For medium to high I.D. studies, the 0.048" collimator was superior at all depths.

With this data, it is possible to select the collimator best suited to the study following determination of the count density.

EFFECT OF VARYING ACQUISITION PARAMETERS ON SPECT IMAGE QUALITY. B.A. Harkness, W.L. Rogers, N.H. Clinthorne, and J.W. Keyes, Jr. University of Michigan Medical Center, Ann Arbor, MI

The resolution of transaxial SPECT images is dependent on the radius of rotation, the number of stops per projection image set, and the acquisition matrix size. The effect of these parameters was studied by imaging a Derenzo phantom that consists of six pie shaped sections that contain 'hot' rods separated by 'cold' spaces. The phantom was filled with 10 mCi Tc-99m pertechnetate and imaged using a rotating gamma camera interfaced to a commercial computer with tomographic capabilities. Projection data was obtained for a period of time sufficient to obtain one million counts/transaxial image. The effect of changing radius of rotation was measured by imaging at radii of 15 and 19 cm. The effect of the number of projection images was tested at 15 cm for 64 and 128 stops. To test the effect of matrix size on resolution, projection data were obtained using a software zoom factor of 1.69 to yield an effective matrix of 108 x 108 pixels. Zoom was used because 128 x 128 acquisition is not an option on some tomographic systems. The images were compared to data obtained using an unzoomed 64 x 64 matrix. Comparisons were made at radii of 15 and 19 cm. The results were as follows: 1) smaller radii yield images of higher resolution, 2) increasing the number of stops does not increase resolution but does reduce background noise caused by insufficient sampling angles thus improving image quality, and 3) a greater matrix size increases the resolution regardless of the radius of rotation or the number of stops. In conclusion, the maximum image resolution and quality was obtained by employing the minimum radius of rotation, the maximum (128) number of projection images and the finest matrix size.

SPECT CARDIAC IMAGING: THE NECESSITY OF CONSISTENT METHODOLOGY DURING TRANSVERSE/LONGITUDINAL PROCESSING. R. J. English, J. F. Polak, B. L. Holman, Brigham and Women's Hospital, Boston, MA

The clinical utility of planar Tl-201 and Tc-99m pyrophosphate myocardial scintigraphy is continuously increasing in importance despite certain limitations. The accurate determination of the extent of either infarcted or ischemic myocardium with Tl-201 is limited by the geometry of the heart and variations in the attenuation due to overlying tissues. These same constraints impair the accurate sizing of acute myocardial infarcts with pyrophosphate. In addition, the uptake of this pharmaceutical by the ribs, sternum and spine restricts the proper delineation of infarct borders.

SPECT overcomes many of these problems. Reconstructed transaxial slices through the chest eliminate much of the overlapping activity due to tissues adjacent to the heart. Further processing of the tomograms by aligning the reconstructed images parallel and perpendicular to the long axis of the heart (left ventricle), is used to accurately identify the different walls of both ventricles.

With Tl-201 most of the ventricle picks up isotope and is thus available as a reference. Tc-99m pyrophosphate poses a more formidable problem since, in general, a small portion of the myocardium will show uptake. It is thus necessary to acquire a second tomographic study after labelling the red blood cells in the blood pool of the left ventricle. The overlap between the blood pool and pyrophosphate reconstructed slices is used to localize the sites of pyrophosphate accumulation.

PET: POTENTIAL IN THE INVESTIGATIVE STUDY OF DYNAMIC PHYSIOLOGICAL PROCESSES. E.Y.East. University of Virginia Medical Center, Charlottesville,VA

Positron emission tomography (PET) is a highly promising methodology in the development of a third dimension to the realm of nuclear medicine. This noninvasive imaging technique is currently becoming a quantitative measure of various biochemical and physiological processes. Annigilation coincident detection improves depth resolution and the high energy photons emitted minimize tissue attenuation.

Biologically useful short-lived radionuclides such as; ^{11}C, ^{13}N, ^{15}O, and ^{18}F, may be substituted into the structure of numerous physiological compounds without significantly altering their biochemical path. The expense of cyclotron production and operation however, is a definite disadvantage. Attempts are currently being made to utilize positron-emitting radionuclides which do not require cyclotron production. One such nuclide, ^{68}Ga (t=68min), is a commercially available as an alumina generator product. It is useful in certain chelating reactions. There has also been increasing interest in the ^{82}Sr-^{82}Rb (t=75sec) generator for myocardial imaging. ^{52}Mn (t=21min) has also been produced in a generator system from ^{52}Fe. It may prove useful in the assessment of kidney function since the physical and biological half-times are quite similar. If more widespread use of PET is to occur, adequate generator systems must be developed to furnish positron-emitting radionuclides.

Present efforts are being focused mainly on the evaluation of metabolic rates in the brain and myocardium of the heart. New areas of diagnostic sophistication in psychiatric disorders,stroke,aging are being evaluated.

MEASUREMENTS OF DIASTOLIC FUNCTION IN HEART DISEASE: A COMPARISON OF METHODS. D.Loge, I.Inouye, D.Rothenberg, J.Tubau, B.Massie; VAMC and Univ. of Calif., San Francisco.

Blood pool scintigraphy is useful in measuring diastolic as well as systolic function. Various parameters of diastolic filling have been examined in the literature and related to disease states. For example, in hypertension patients we have found that while resting ejection fraction (EF) is not significantly different from normal controls, diastolic function most definitely is. Three indices of diastolic filling have been employed;peak filling rate(PFR), time to peak filling rate (TPFR) and fraction of filling occuring in the first 1/3 of diastole(FF1/3). Of note is that PFR is more abnormal in coronary artery disease while in hypertension FF1/3 is more reduced.

Unfortunately, these analyses are time consuming when the usual varying (V) region of interest (ROI) is employed. Therefore, we evaluated a simple fixed (F) ROI method for these measurements. Two observers analyzed scintigrams from 11 normals using both F and V ROI. Ejection fraction and PFR were lower for the F-ROI (48 ± 9 vs 66 ± 9% and 2.4 ± .6 vs 2.8 ± .4 EDV/sec, both $p < .001$), while TPFR and FF1/3 were similar with both methods. The advantages of the F-ROI method were convenience, since it took only 25-50% of the time of V-ROI, and a significantly higher interobserver reproducibility. Correlation coefficients between observers for various diastolic indices ranged from 0.95 to 0.99 for F-ROI compared to 0.75-0.80 for V-ROI and the regression lines were closer to the line of identity.

In conclusion, our experience indicates that assessment of diastolic filling is valuable, that multiple indices should be measured, and the use of a F-ROI may facilitate these analyses.

CLINICAL I

8:30–10:00 am **Room 263**

Moderator: Barbara L. Mardesich
Co-moderator: Kenneth T. Study

Tc-99m LABELED RED BLOOD CELLS (RBC) SCINTIGRAPHY IN THE DETECTION AND LOCALIZATION OF GASTROINTESTINAL BLEEDING (GIB) SITES: TECHNICAL CONSIDERATIONS. A.J. Rousseau, H.D. Royal, J.A. Parker, G.M. Kolodny, Division of Nuclear Medicine, Beth Israel Hospital, Boston, MA.

Arteriography is only likely to yield diagnostically useful information if the patient is actively bleeding at a rate of greater than 1.0cc/min at the time of the procedure. Unfortunately, acute GIB is often intermittent. To avoid the unnecessary morbidity of a negative arteriogram we have studied the usefulness of using Tc-99m in vitro labeled RBC scintigraphy as a screening test for arteriography.

57 of 111 patients (51%) have had RBC scans consistent with active GIB. 23/57 patients (40%) with positive scans had arteriography. 12 of these 23 arteriograms (52%) were positive. 12 arteriograms were performed in the 54 patients with a negative scan. One of these 12 arteriograms was positive for active bleeding in the rectum. In retrospect, the scan was also positive but rectal activity was initially confused with bladder activity.

RBC scans are a reliable screening test for arteriography and they provide useful localizing information in patients with negative arteriograms. The prolonged imaging times possible with RBC is desirable due to the intermittancy of GIB. Technical factors which will affect the results include 1. obtaining high labeling efficiency by using in vitro labeled RBC; 2. frequent acquisition of images over a 24 hr time period; 3. acquisition of dynamic images to localize confusing patterns of activity; 4. acquisition of views to separate rectal and bladder activity.

USE OF PYP IN DETECTION OF SKELETAL MUSCLE INJURY. P. Matin, G. Lang, G. Simon, R. Carretta, and T. Malekian. Roseville Community Hospital, Roseville, CA.

Technetium 99m pyrophosphate (PYP) scintigraphy has been proven to be an excellent method for determining early myocardial muscle damage. We have used this radiopharmaceutical to detect skeletal muscle injury in long distance runners performing vigorous exercise.

Fifteen ultramarathon runners who competed in 50 and 100 mile races were studied. Blood samples were obtained before, during, and after the race for measurement of CPK level, including CPK (MB), which had been thought to be a specific indicator of myocardial injury. Skeletal scintigraphy was performed within 48 hours of the race. Total body scintigraphy was performed with spot views of the heart.

The study showed mild-to-moderate skeletal muscle

uptake of PYP due to rhabdomyolysis and markedly elevated CPK (MB) levels in almost all of the runners. None of the runners had increased myocardial uptake of PYP. The degree of abnormality was correlated with the intensity of pain and other symptoms.

The study showed that nuclear medicine techniques can be used to detect soft tissue injury due to extreme exercise and that CPK (MB) levels can be elevated due to skeletal muscle injury as well as myocardial damage.

IN-HOUSE PREPARATION OF 133-XENON FOR INTRAVENOUS ADMINISTRATION. T.J. Herold, M.K. Dewanjee, and H.W. Wahner, Mayo Clinic and Foundation, Rochester, MN.

Nuclear medicine laboratories use Xe-133 in gas form for ventilation studies and occasionally dissolved in saline for intravenous injection. Because of the higher cost and difficulties in supply of Xe-133 in saline from commercial companies, we have developed a kit procedure for in-house preparation of Xe-133 for intravenous use from gas ampules. Since human albumin contains fatty acid and triglyceride, solubility of Xe-133 in albumin was compared with that in isotonic saline at 4°C and 25°C in search of the best solvent. A 25 and 5% sterile solution of human serum albumin and isotonic saline were used for extraction of Xe-133. Three milliliter fractions of these solutions were filled in ampules and stored at 4°C. A Xe-133 vial was filled with 3 ml of either of these solutions without leaving any air bubble in the Xe-133 vial and incubated for 5 minutes at room temperature. The dissolved Xe-133 was then withdrawn with a syringe for analysis. The results of extraction with saline and human serum albumin measured with an ionization chamber are tabulated below:

Extraction Medium	Temp.	Extraction (%) (Mean ± S.D.)
Isotonic Saline (n=4)	4°	11.6 ± 6.1
Isotonic Saline (n=6)	25°	23.0 ± 3.8
5% Human Serum Albumin (n=5)	25°	8.1 ± 3.0
25% Human Serum Albumin (n=4)	25°	3.0 ± 1.5

This study shows that Xe-133 gas can be prepared by a simple procedure for intravenous use. Isotonic saline at room temperature is a suitable carrier and superior to other carriers tested. Only about one-fourth of the Xe-133 present in the ampule as gas can be extracted.

XENON BLOOD FLOW AND TcMAA EXTERNAL CAROTID ARTERY SCINTIGRAPHY FOR THE EVALUATION OF HEAD AND NECK TUMORS. L. Wu-Connolly, R. Ackermann, H. Ziessman, J. Thrall. University of Michigan Medical Center, Ann Arbor, MI

A 2-phase imaging technique has been developed to measure tumor and scalp blood flow, to determine chemotherapy catheter position, to demonstrate regional flow distribution, and to quantify shunting to the lungs. For the Xenon Blood Flow (XBF), Xenon 133, in saline, is injected into a surgically implanted catheter in the external carotid artery. A 3 second per frame dynamic flow acquisition is computer acquired for 100 frames. Time activity curves (TAC) are generated from regions of interest (ROIs) drawn over the tumor(s) and scalp. The initial downslope of the TAC represents clearance of Xenon and is directly proportional to the blood flow. The rate is calculated using the slope from the TAC and is measured in ml/100 gm tissue/min. Tc-99m-MAA is injected into the same catheter for the External Carotid Artery Perfusion (ECAP). Static analog and digital images of the anterior head and appropriate lateral projection are obtained with and without spot markers for anatomical reference. A posterior image of the lungs is also acquired. All images are obtained for equal time. ROIs are drawn to include the entire anterior head and neck and the posterior lungs. The percent shunting to the lungs is calculated utilizing the following formula:

$$\text{Lung Shunt Index (\%)} = \frac{\text{Counts (Lung)}}{\text{Counts (Lung)} + \text{Counts (Head)}} \times 100$$

Intra-arterial chemotherapy increases the amount of drug delivered to the tumor and reduces systemic toxicity. The XBF and ECAP techniques are rapid, non-invasive methods for evaluating the efficacy of regional chemotherapy in patients with tumors of the head and neck.

RADIONUCLIDE CISTERNOGRAPHY IN THE NEONATE. L.J. Meyers, L. Wu-Connolly, J.W. Keyes, Jr., S. Donn. University of Michigan Medical Center, Ann Arbor, MI.

Intraventricular hemorrhage is a common complication following premature birth. The management of these patients is difficult because there is no good way to follow the progress of the disease or therapy. The technique of radionuclide cisternograpy was modified to make it suitable for use in these tiny (1500-2500 gm) infants and is evaluated. Indium-111 DTPA was chosen for its relatively short physical half life (27.9 hrs) given the unknown dynamics of neonatal hydrocephalus. Intrathecal injection of Indium-111 DTPA in 0.1 ml was followed by immediate 30-50,000 count images due to rapid flow patterns. Imaging continued at 1,2,6,24 and 48 hour intervals. An anterior and one lateral were adequate. Outlining the head with a marker on each image was useful in interpretation. A mobile camera with a low energy, i.e. technetium, converging collimator was used. The converging collimator yielded higher quality images with respect to head size than a standard high resolution collimator without image distortion and proves to be the most important item in performing this study. Excessive septal penetration with the 245.4 keV gamma made imaging necessary on the 171.3 keV gamma with a 30% window. Single photopeak imaging was necessary due to the lack of a second energy channel on our mobile camera. The study has produced invaluable images in 28 of 31 cases due to the fact that until this study, virtually nothing was known about cerebrospinal fluid dynamics in the neonate.

It is a safe, feasible and useful study in the newborn with no adverse reactions demonstrated. The study is useful in deciding the need for shunt placement surgery and the evaluation of serial lumbar punctures and diuretics as treatments.

BOWEL PREPARATION AND FREQUENCY OF REPEAT IMAGING IN GALLIUM-67 WHOLE BODY TOMOGRAPHIC SCANNING. S.M. Stefan, M. Basden, U.Y. Ryo, C. Bekerman, and S.M. Pinsky. Michael Reese Hospital and Medical Center, Chicago, IL.

The effect of various bowel preparations (prep.) on the quality of gallium-67 scans has been studied by several groups. However, opinions on the usefulness of the prep. remains somewhat controversial. We have studied the effect of bowel preparation on the frequency of repeat imaging of the abdomen requested by resident physicians. Every week, 2 to 3 patients (pts.) selected at random by the scheduling nurse were not given the bowel prep. while other pts. received the bowel evacuant (magnesium citrate, citric acid & potassium citrate). Staff physicians were not aware of pts. chosen for the study until it was concluded 6 months after initiation.

Of 59 pts. without prep., 29 (48%) had one repeat scan, 2 (3%) had two or more repeat scans, and return visit was not necessary in 28 (47%). Of 62 pts. with prep., on the other hand, the first day scan was approved by the initial reviewer in 22 (36%), while 33 (53%) needed one repeat and 7 (11%) had two or more repeat scans. In the group with prep. more repeat scans were performed in pts. with suspected infection than in pts. with suspected malignancy. Frequency of repeat imaging was not significantly different between pts. over or below age 60. There was no difference in the frequency between populations with a negative scan and with positive chest lesions.

Review of images showed that intestinal activity was definitely more pronounced in pts. without prep. The major reason for less repeat abdominal views in pts. without prep. appeared to be the clearer bowel images of the initial scan thus reducing the degree of suspicion for abdominal lesions.

CLINICAL II

10:30-12:00 pm **Room 263**

Moderator: Barbara L. Mardesich
Co-moderator: Kenneth T. Study

IMAGING WITH IN-111 PLATELETS: TECHNICAL AND CLINICAL APPLICATIONS. K.T. Hopkins. Washington University School of Medicine, St. Louis, MO.

The current availability of In-111 platelet imaging, at this institution, has initiated considerable interst in a variety of potential clinical applications. The clinical situations in which In-111 platelets have been utilized include 1) evaluation of arterial grafts; 2) determination of platelet deposition on various lesions; and 3) platelets incorporated into newly forming and previously formed thrombi. In clinical situations utilizing labeled platelets it is desirable to distinquish between In-111 platelets circulating in the blood pool and In-111 platelets incorporated into lesions, thrombi, and grafts. A subtraction technique has been developed using Tc-99m red blood cells (labeled by the modified in vivo method) as a blood pool marker. The subtraction method requires simultaneous computer acquisition of the In-111 images and the corresponding Tc-99m RBC images. The scintigraphic images were collected by using a medium energy collimator attached to either a L.F.O.V. gamma camera or a L.E.M. portable gamma camera. The computer acquisition and processing of the images was performed on either a OHIO NUCLEAR 560 computer or on a VARIAN digital computer. In most imaging studies, a summation image of both photopeaks of In-111 is obtained. When using the Tc-99m RBC subtraction method, only the upper peak of In-111 is obtained. The time of acquisition varies from 5-30 min, depending on the study being performed. The imaging intervals post injection of 250-550 μCi of In-111 platelets varies from immediately to up to 72 hr post. With increasing availability of In-111 platelet imaging and technical improvements, the clinical results obtained will determine the role of In-111 platelets in nuclear medicine.

TECHNICAL FACTORS INFLUENCING GLOMERULAR FILTRATION RATE MEASUREMENTS BASED UPON THE SINGLE COMPARTMENTAL/THREE BLOOD SAMPLE TECHNIQUE. M.S. Lerner. Children's Hospital National Medical Center, Washington, DC.

This study was conducted to demonstrate the effects of various technical factors on the calculation of glomerular filtration rate (GFR) using the single compartmental/three blood sample technique. The factors investigated include: (1) underestimating the activity contained in the standard or patient dose, (2) the failure to correct standard activity assayed at the start of the GFR measurement to the time that the patient is injected, and (3) the undetected partial infiltration of the patient's dose.

In order to complete this study, a mathematical model was constructed representing the accurate determination of a GFR. Next, the first factor was introduced into the model, and the GFR was re-calculated. This procedure was repeated for each of the above factors. The GFR results were computed using the equation: GFR =

$$\frac{\text{pt. dose activity}}{\text{plasma cts (t=0)}} \times \frac{\text{std. cts} \times \text{std. vol}}{\text{std. activity}} \times \frac{0.693}{T\frac{1}{2} \text{ plasma curve}}$$

The findings of this investigation are: (1) underestimating the activity in the standard overestimates the calculated GFR, (2) underestimating the activity in the patient dose underestimates the GFR, (3) failure to correct standard activity to the time that the patient dose is injected overestimates the standard activity and therefore underestimates the GFR, and (4) the effect of undetected infiltration on GFR measurements is difficult to predict since infiltration will raise the plasma curve $T\frac{1}{2}$ at the same time that it lowers the plasma cts at t=0.

RADIONUCLIDE GASTRIC EMPTYING: A COMPARISON OF THREE LABELING TECHNIQUES. Michael W. Plankey, Diane Errico, Robert C. Lange. Yale-New Haven Hospital, New Haven, CT.

Widespread clinical utilization of radionuclide gastric emptying studies of solids necessitates a convenient and easy-to-prepare meal. Intracellularly labeled chicken liver with 500 uCi ^{99m}Tc-S-colloid (SC), although the optimal choice, requires time, storage facilities for live chickens and dedicated personnel to prepare the meal. Therefore, we investigated three different methods of labeling the chicken liver: 1) intracellular (IR) (intravenous injection of the SC via a wing vein with excision of the liver and subsequent cutting of the cooked liver into 1 cm cubes); 2) sprinkled (SP) (commercially purchased chicken liver with the SC squirted uniformly on the surface of the cooked 1 cm cubes); and 3) injected (IN) (commercially purchased chicken liver cut into 1 cm cubes with the SC injected into the center of each cooked cube). Five to 8 subjects randomly underwent a solid gastric emptying study utilizing the aforementioned labeling techniques. Each subject fasted at least 8 hours before the study and each study was performed on different days with 3 days separating each test date. The meal consisted of chicken liver (average weight 30 grams), a 7 1/2 oz. can of commercial beef stew, 100 ccs of water and 2 crackers. The percent isotope remaining ($\bar{x}$ + ISEM) in the stomach was measured over 120 minutes.

We conclude that: 1) there is no significant difference between the three labeling techniques at any time during the study; 2) gastric emptying of a solid meal may be easily performed with the sprinkled or injected technique in virtually any nuclear medicine department.

THE USEFULLNESS OF DACRYOSCINTIGRAPHY IN YOUNG CHILDREN D. Smith, and S. Heyman The Children's Hospital of Philadelphia, Philadelphia, Pa.

Dacryoscintigraphy is a useful, procedure for evaluating abnormalities in the lacrimal system in children since it may obviate the need for further invasive procedures.

A pinhole collimator, with a special 1mm. insert, is positioned 1.0 to 2.0 cm. in front of the patient's nasal bridge to include both eyes and tip of nose. (Fig. 1) A micropipette is used to deliver 100 microcuries of Tc-99m pertechnetate, in 10-20 microliters, as a single drop into each eye. Analogue images are obtained at 1 minute intervals for 20 minutes. Computer acquisition is at a rate of 4 frames/minute.

We studied 36 patients, 19 males and 17 females, (aged 22 months - 20 years). Of the 36 patients, 4 required sedation because of their young age. All 4 were given an oral dose of chloral hydrate and the study was completed successfully. 5 patients showed normal transit through the nasolacrimal duct, (Fig. 2), 14 patients had unilateral obstruction, and 9 patients had bilateral obstruction. (Fig. 3) In 8 of the patients studied we demonstrated a delay in the drainage of the duct. In these cases physiological maneuvers such as forceful blinking and deep nasal inspiration, may distinquish abnormal functional drainage from an anatomic block.

Darcyoscintigraphy is a simple, physiological means of evaluating lacrimal drainage. Its usefullness may obviate the need for dacryocystography in young children which requires an anesthetic, injection of a contrast material through the ducts and a higher radiation dose to the patient.

USE OF I-123 CAPSULE IN ESTABLISHING NORMAL ESOPHAGEAL TRANSIT TIME AND PATTERNS. D.E. Kotun, R.D. Borchert, P.R. Rosen, J.L. Floyd, and F.L. Weiland, Wilford Hall USAF Medical Center, TX.

The esophageal transit of a #2 gelatin capsule containing 100 uCi I-123 in patients referred to Nuclear Medicine for thyroid uptake and scans was recorded. Patients with a history of prior esophageal dysfunction or other gastrointestinal disorders were excluded from the study. A Technicare portable camera with a diverging collimator and a V.I.P. 550 computer was used. Five frames per second were obtained for 980 frames.

One of four swallowing protocols was randomly selected:
(1) Patient supine, swallowing capsule with 60 cc water.
(2) Patient seated, swallowing capsule with 60 cc water.
(3) Patient supine, swallowing 60 cc water prior to, with and after capsule.
(4) Patient seated, swallowing 60 cc water prior to, with and after capsule.

Three regions of interest were created: proximal esophageal, distal esophageal and stomach.

Our patient population completed esophageal transit of #2 gelatin capsules in less than 10 seconds using methods 2, 3, and 4. Method 1 (supine with water) resulted in variable and prolonged esophageal transit in this apparently normal population. We therefore recommend that particulate esophageal transit be evaluated using method 2 or 3 with #2 capsules containing Tc-99m Sulfur Colloid (100 uCi). Current studies evaluating these methods' sensitivity and specificity in the evaluation of esophageal dysmotility are being performed.

THE INTRA-HEPATIC INFUSION PUMP AND NUCLEAR MEDICINE. S.B. Kantor, Penrose Hospital, Colorado Springs, CO

The intra-hepatic infusion pump is an experimental instrument which is now being used to treat metastatic disease of the liver. It consists of two parts: the pump itself, and the catheter, which is surgically implanted at the site of interest in the liver.

The primary advantage of the pump is that it carries the chemotherapeutic agents directly to the cancer site, thus decreasing the toxic effects of therapy on the rest of the body. When the pump is implanted, the nuclear medicine technologist performs a flow study to determine whether the proper amount of chemotherapeutic agent is proceeding through the pump, and whether the catheter is placed properly in the liver. Before the patient is discharged from the hospital, a recheck scan is performed in the nuclear medicine department. For use in the pump scan, the radiopharmecutical of choice is Tc-99m Human Albumin Microspheres (H.A.M.). H.A.M. is preferred over sulfur colloid because of its larger size, which better simulates the diffusion of chemotherapeutic agents and thus yields the most reliable information on the working of the pump and placement of the catheter.

Preliminary results show that 50-60% of patients receiving treatment with the intra-hepatic infusion pump have survived longer than patients treated with more conventional methods; however, the F.D.A. requires more conclusive data before approving the pump for use in other areas of the body.

INSTRUMENTATION/COMPUTERS II

10:30-12:00 pm **Room 260**

Moderator: Heather S. Dickson
Co-moderator: Susan E. Brown

AN INTERACTIVE SEGMENTAL ANALYSIS TECHNIQUE FOR PHYSIOLOGIC TIME-ACTIVITY HISTOGRAMS. M. Tuscan, J. Juni, J. Thrall, J. Froelich. The University of Michigan Medical Center, Ann Arbor, MI.

Segmental quantitative analysis of physiologic time-activity histograms (TAH) may play an important role in the clinical evaluation of specific organ function. Conventional TAH analysis fails to accurately quantify specific physiologic functions, especially brief physiologic responses to pharmaceutical or mechanical intervention. We have developed an interactive computer technique which allows quantitative analysis of segmental portions of a TAH using a Medical Data Systems A^2 computer.

The TAH is plotted on the video display in semi-logarithmic (ln) form. An exponential equation is fitted by least squares to the TAH segment specified by the operator and plotted adjacent to the segment. If the operator rejects the fitted curve it is erased from the video display. If the fitted curve is approved, the corresponding functional parameter is calculated from the fitted slope and the results displayed. The process may be repeated as desired by the operator.

The technique has been successfully applied to quantify blood flow using Xe-133 and the emptying rate of gastric contents with and without the use of the motility drug metaclopramide.

There are several advantages of this technique compared to conventional methods. First, the entire TAH is presented with the Y value coordinates adjusted to maximize apparent curve resolution enhancing the operator's ability to discern discrete physiologic events. The technique is interactive in that the user may readjust TAH boundaries repeatedly before quantification. Lastly, the slope of the fitted line is automatically translated to appropriate functional units (ml/min, T 1/2 (sec), gm/min, etc).

CLINICAL APPLICATIONS OF DECONVOLUTIONAL ANALYSIS. L.J. Meyers, J.E. Juni, C. Samosik-Mast, M.J. Tuscan, J.H. Thrall. University of Michigan Medical Center, Ann Arbor, MI.

The evaluation of organ tracer kinetics is often complicated by systemic recirculation of the tracer. Deconvolutional analysis (DCA) is a mathematical technique which corrects for the effects of recirculation in a wide range of nuclear medicine studies. It 1) eliminates the "blurring" effect of recirculation on organ time-activity histograms (TAH), 2) compensates for poor bolus injection or delivery and 3) corrects for tracer removal from the blood pool by organs other than the one of interest.

The technique can be used to analyze various blood flow studies (renal, cerebral, and cardiovascular shunt) and to quantitate tracer transit time through various organs such as the kidney (DTPA, Hippuran) and the liver (-IDA derivatives).

In our institution, DCA can be perfromed routinely with an automated computer program requiring <10 mins. total processing time. Dynamic computer acquisition begins immediately prior to bolus injection of tracer with the gamma camera positioned over the organ of interest and representative blood pool e.g. heart or aorta. Framing rates vary from 0.25 sec/frame for cardiac shunt studies to 60 sec/frame for renal or hepatobiliary studies. Organ and blood pool TAH's are generated and the automated program then performs deconvolution by a modified Fourier transform technique yielding a curve which is corrected for the changing pattern of blood pool activity.

DCA is a technique yielding data comparable to that achieved by direct injection into an organ and requires <10 mins. of operator time.

IMAGE SUBTRACTION IN SERIAL SPECT SCANNING OF DYNAMIC, PHYSIOLOGIC PROCESSES. K.L. Greer, R.J. Jaszczak, D. Osborne and R.E. Coleman. Duke University Medical Center, Durham, NC.

The purpose of this study was to determine if dynamic physiologic processes can be studied using two or more administrations of the same radiopharmaceutical and serial SPECT imaging. The ability to accurately subtract one SPECT study from another was demonstrated using Tc-99m in a phantom. "Hot" and "cold" spheres surrounded by various concentrations of uniform background activity were scanned and processed. Subsequently, the technique was applied to the study of temporal changes in pulmonary perfusion after occlusion of a bronchus by imaging Tc-99m microspheres in dogs. Various size bronchi were occluded. Increasing amounts of activity were used for the serial studies (1 mCi at occlusion, 3 mCi at 3 hours and 6 mCi at 6 hours). Since the Tc-99m microspheres remain in the lungs, a background scan was obtained immediately prior to administration of the radiopharmaceutical. Subtraction of the background was made on a slice to slice basis. The subtracted images better demonstrated the changes associated with the bronchial occlusion, ie., decreased perfusion in the area of the obstruction. The phantom and animal studies showed that while image subtraction using serial SPECT scans is possible, there do exist significant limitations, notably statistical considerations and patient motion. This processing and data acquisition technique may have its greatest potential in experimental applications to determine how various disease processes evolve with time in animal models. By scanning in immediate succession without moving the animal, SPECT could be of use in relating regional pulmonary blood flow to regional ventilation using Tc-99m labeled microspheres and aerosols respectively.

PHASE ANALYSIS AMPLITUDE IMAGES USED TO CALCULATE REGURGITANT FRACTION. Lauren Little, Mary Osbakken. The Pennsylvania State University, Hershey, PA.

Phase analysis was performed on routine gated blood pool scans collected in 8 normals (N, mean age $\pm$ SD, 52 $\pm$ 11), in 10 patients with known valvular regurgitation (VRe, 58 $\pm$ 11) and in 8 patients with suspected VRe (SVRe, 63 $\pm$ 19). Regions of interest were placed over the right and left ventricular (RV, LV) amplitude images to determine relative RV and LV stroke volumes via count activity. LV/RV ratios were calculated and used to reflect regurgitant fraction. Ejection fractions (EF) were also determined for all patients via threshold and second derivative methods. LV/RV ratios of the known and suspected valvular disease patients were significantly greater than N (N = 1.53 $\pm$ .34; VRe = 2.6 $\pm$ 1.15; SVRe = 2.9 $\pm$ .94) $P<0.05$. The EF's of both regurgitant groups were significantly lower than N (N = 61 $\pm$ 2.5;

VRe = 45 ± 5.5; SVRe = 43 ± 5.7) P<0.05. Thus, phase analysis amplitude image LV/RV stroke volume ratios can be effectively used to determine the existence of valvular regurgitation.

APPROACHES TO ARRHYTHMIA FILTRATION IN GATED RADIONUCLIDE VENTRICULOGRAMS. J. Botti, J. Juni, J. Froelich, J. Clare. University of Michigan Medical Center, Ann Arbor, MI.

Irregular cardiac cycle lengths due to arrhythmias may prevent the use of Gated Radionuclide Ventriculograms (GRV) in many patients. In order to study patients with irregular heart rates a method of arrhythmia filtration(AF)is needed.

We are currently evaluating a new method: Dynamic Arrhythmia Filtration (DAF). With this method, only data from cardiac cycles that fall within an operator selected R/R interval range are stored, thus allowing "on-the-fly" AF. DAF is a method of AF that employs two memory buffers and a high speed disk. DAF requires minimal disk space, permitting data collection on small (portable) computer systems. No additional reformatting steps are required and acquisition time is only slightly increased compared to standard GRV.

The most commonly used method of AF is List Mode (LM) acquistion. Although LM has many useful capabilities it has not enjoyed widespread use. The LM method stores all camera, EKG and timing events necessitating large disk storage capabilities. Following acquisition, data must be reformatted with operator selected cycle length, windows and timing intervals. Reformatting typically takes one to three times longer than the initial collection of data making it impractical for routine clinical application.

Although LM techniques are versatile they require large mass storage devices and significantly increased processing times. We have successfully studied 15 patients with varying degrees of arrhythmias using DAF. This new technique, is less time consuming, requires less computer memory and can be utilized routinely. Institutions performing GRV's should consider the use of DAF in order to obtain useful and meaningful studies of arrhythmic patients.

A TECHNIQUE FOR QUANTITATIVE ANALYSIS OF HEPATOBILIARY SCANS BY DECONVOLUTIONAL ANALYSIS. C. Samosik-Mast, J.E. Juni, J.W. Keyes, Jr., W. Carter, and R. Bowers. University of Michigan Medical Center, Ann Arbor, MI

Separating obstructive jaundice from hepatocellular dysfunction is a significant clinical problem. Hepatobiliary scan data analyzed by deconvolution eliminates the effects of tracer recirculation in the blood pool, thus permitting quantitative analysis of hepatocyte function. Deconvolution is a mathematical technique which corrects organ time-activity curves for the changing pattern of blood pool activity, resulting in the same pattern of activity that would have occurred had tracer been injected directly into the liver vessels. We have implemented a computer program for deconvolution which is simple and executes in approximately 30 seconds. Patients received 5-15 mCi Tc-99m Disofenin IV adjusted to serum bilirubin. Imaging of the heart and liver is performed anteriorly with a large field-of-view gamma camera and LEAP collimator. Sixty second images are acquired on a computer beginning one minute prior to injection and continuing for 32 minutes. Separate time-activity curves are generated for the heart and liver, taking care not to include gallbladder, large bile ducts or kidneys. The liver curve is smoothed and deconvolution performed. Tracer delivery to the liver and subsequent tracer uptake and excretion by hepatocytes is then quantitated from the deconvolved curve. Results for patients with hepatocellular disease and those with obstruction fell into two separate groups. Patients with cellular dysfunction show hepatocyte uptake to be only a fraction of the total tracer administered. Hepatocyte uptake in obstructed patients is nearly 100% of that delivered. This technique is simple, rapid in execution and practical in the clinical setting. It appears to be useful in the evaluation of jaundiced patients.

ONCOLOGY

1:30–2:30 pm **Room 260**

Moderator: Deborah B. Behrendt
Co-moderator: Roy E. Aldridge

METHODS OF TUMOR IMAGING AND BLOOD CLEARANCE EVALUATION OF I-131 LABELLED F(ab')$_2$ FRAGMENTS OF MONOCLONAL ACTIVITY. M.R. Beardsley, P.A. Fogel, P.J. Moldofsky, N.D. Hammond, C.B. Mulhern, Fox Chase Cancer Center/Jeanes Hospital, Philadelphia, Pa.

F(ab')$_2$ fragments of a non-circulating monoclonal antibody associated with a cell surface antigen of colon carcinoma are radiolabelled with I-131(Iodogen method) to be used for imaging and evaluation of their biologic behavior in patients with colon carcinoma. The radiopharmaceutical is passed over a sterile, pyrogen-free Sephacryl column to remove free iodine and aggregates of the antibody fragments. The radiolabelled fragments are tested for sterility, pyrogenicity, relative immunoreactivity and are administered intravenously. Images obtained daily up to 168 hours post-injection demonstrate localization of I-131 F(ab')$_2$ monoclonal antibody fragments which is readily evident both with and without computer subtraction of simultaneous images made with Tc-99m labelled red blood cells.

Blood samples are obtained at regular intervals and blood clearance of total I-131 and protein bound I-131 each fit a two-compartment model with half-lives of 4.3 and 29 hours(total) and 3.5 and 19.3 hours(protein-bound).

INTRAARTERIAL HEPATIC INFUSION OF Tc-99m MAA. R. Kenelia. University of Virginia Hospital, Charlottesville, VA.

Response to the intraarterial chemotherapy involves such qualities as sensitivity of the tumor to the chemotherapeutic agent and adequate delivery of the drug to the tumor site. In the past contrast angiography has been used to evaluate catheter placement, tumor perfusion and tumor vascularity. Recently Tc-99m MAA has demonstrated a better indicator for catheter placement and monitor for drug distribution. This method aids in the evaluation of initial catheter placement and approximate tumor perfusion in pre-therapy as well as post-therapy placement and perfusion followup studies. This technique also allows one to differentiate between nonresponse due to lack of drug perfusion or drug effect failure. Response to therapy is evaluated when perfusion patterns are compared to previous liver/spleen images acquired using Tc-99m S.C. intravenously. Accurate perfusion studies are obtained using Tc-99m MAA intraarterially via a catheter at slow flow rates where those rates for drug administration is mimetic. Such a material localizes within the liver by capillary blockade which allow first pass intraarterial perfusion imaging, closely reflecting therapy drug perfusion.

Tumor arteriovenous shunting patterns using Tc-99m MAA may prove to be of great importance, since tumor diminution has been found to correlate with decreased shunting.

The potential role of this technique is still in question, but looks very promising for future use. This method allows us to accurately evaluate catheter placement and evaluate patient response to intraarterially infused chemotherapy by examination of the patterns of perfusion acquired.

Tc-99m TAGGED RED BLOOD CELLS (RBCs): PROCEDURE FOR EVALUATION OF HEMANGIOMA. M. Sheakley, L. Gordon, M.Ricciardone. Medical University of South Carolina, Charleston, SC

The current method of choice in the evaluation of suspected hemangioma is contrast angiography. This examination is hazardous, expensive, invasive, and the findings may mimic those seen in malignancy. Radionuclide scintigraphy using Tc-99m-labeled RBCs (Tc-RBCs) distinguishes these and is non-invasive.

Six patients, all of whom had angiographic correlation were studied. We used a modified in vivo labeling technique

(all doses ranged from 10-20mCi Tc-99m pertechnetate). Dynamic camera images with a 5.0 sec/frame format were taken of the suspected areas with concurrent computer acquisition. Static images ranging from 500K-1000K (according to area of interest) were then taken immediately, at 10 minutes, 1 hour, and occasionally up to 12 hours post-injection. In all patients there was normal or decreased perfusion of the hemangioma, with increasing activity over time resulting in either isodense or slightly increased activity of those areas at 10 minutes. Further increased activity was apparent on delayed images which exhibited focally "hot" areas corresponding to the abnormal regions seen on angiography.

Tc-RBC scans on 2 patients with known liver metastases and 1 patient with simple hepatic cyst (all having photopenic areas on Tc-99m Sulfur Colloid scans) showed decreased perfusion at 15-30 minutes. Delayed images up to 12 hours later revealed persistent decreased perfusion to these areas.

Conclusion: Tc-RBC scintigraphy appears to be a simple, effective method for diagnosis and evaluation of hemangiomas. In addition, RBC scanning provides a non-invasive, cheaper alternative to contrast angiography.

SCINTIGRAPHIC INTRAOPERATIVE ASSESSMENT OF INTRA-ARTERIAL CHEMOTHERAPY. M.T. Clarke and B. Kumar. Washington University School of Medicine, St. Louis, MO.

Twenty-one patients with metastatic hepatic neoplasms from colorectal primaries and one patient with a primary hepatic tumor received intraarterial chemotherapy using a totally implantable freon activated slow flow pump. All patients were studied intraoperatively using 2 mCi of Tc-99m-MAA injected via the side port of the pump to check for adequate catheter placement and hepatic perfusion. 16 patients demonstrated adequate hepatic perfusion on the initial study. 6 patients required repositioning of the catheter as the initial intraoperative study demonstrated malposition. In 2 of the patients only the right lobe was perfused, in 2 only the left lobe, and in 2 only the spleen and stomach were perfused. Repeat imaging after repositioning showed good hepatic perfusion. Post surgical follow-up studies were performed in 5 patients to check for changes in catheter position. No change was demonstrated in 2 patients. Pooling outside the liver consistent with hepatic artery perforation resulted in pump removal in one patient. Pump blockage was demonstrated in one patient, which necessitated installation of a new pump. A change in catheter position with perfusion of the spleen and other abdominal organs was noted in one patient. The implantable pump has numerous advantages including patient acceptance and a high response rate. Radionuclide evaluation appears to be the best method available to check catheter tip position in the arterial tree. The degree of perfusion by the chemotherapeutic agent can also be evaluated. The metastatic lesions were hypoperfused in 16 of 21 patients with increased or normal perfusion in 5 of 21 patients. Follow-up evaluation is underway to determine the prognostic significance of this finding.

CARDIAC I

1:30-3:00 pm **Room 263**

Moderator: Debra L. Loge
Co-moderator: Arthur J. Hall

CALCULATION OF RIGHT AND LEFT VENTRICULAR EJECTION FRACTION USING FIRST PASS AND GATED BLOOD POOL SCANS. Lauren Little, Mary Osbakken. The Pennsylvania State University, Hershey, PA.

Right and left ventricular (RV, LV) ejection fractions (EF) were calculated from first pass and gated blood pool scans in 23 patients (mean age = 55.6 $\pm$ 3.5) with different cardiac diseases. Both types of scans were obtained after a single adequate bolus injection of Technetium pertechnetate. First pass scans were collected in serial format and subsequently reformatted into gated mode prior to collection of gated equilibrium scans.

EF's from both data collection modes were calculated with routine threshold and second derivative computer algorithms (MDS Corp.). RVEF via first pass was 26 $\pm$ 2.6 (mean $\pm$ SEM); RVEF via gated equilibrium scan was 34 $\pm$ 2.1. LVEF via first pass was 26.7 $\pm$ 2.8; LVEF via gated equilibrium scan was 44.4 $\pm$ 2.9. EF data from first pass and gated equilibrium scans were correlated with linear regression analysis. The correlation coefficient (R value) for RVEF's via the two methods of collection was 0.52; a similar correlation coefficient, 0.53, was obtained for LVEF's. Although both of these values were statistically significant at the 0.05 level, there was wide scatter between EF values obtained via the two methods. Thus, one method cannot be substituted for the other to provide reproducible and reliable information concerning either right and/or left ventricular function.

CORRELATION OF LEFT VENTRICULAR VOLUME (LVV) MEASUREMENT BY RADIONUCLIDE AND ANGIOGRAPHIC TECHNIQUE. S. White, L. Von Dollen, V.R. Bobba, D. Cox, H. Demots, E. Murphy, L. Ritzmann, G.T. Krishnamurthy. VA Medical Center and Oregon Health Sciences University, Portland, OR.

This investigation compares non-geometric radionuclide (RN) LVV measurement with the Sandler and Dodge Biplanor geometric method applied to contrast ventriculography. Gated equilibrium blood pool scintigraphy was performed in 14 patients 5-10 minutes prior to left ventricular cineangiography.

Twenty-five millicuries of Tc-99m-In-Vivo labeled red blood cells were utilized. A scintillation camera fitted with a low energy all purpose collimator, in the left anterior oblique position was used to acquire a multigated acquisition study. A seven milliliter (ml) heparinized blood sample was drawn half way through the acquisition and the time recorded. At the completion of acquisition, room background and a pipetted 5 ml blood sample were counted for 5 minutes at the collimator face. The time and counts were recorded. The end diastolic (ED) and end systolic (ES) counts were recorded from time-activity curves generated over the left ventricle. Ventricular volume units were calculated:

$$\text{VOLUME UNITS} = \frac{\text{ED or ES COUNTS}}{\text{HEARTBEATS}} \times \frac{0.04 \times \text{TIME/FRAME} \times 10{,}000}{\text{NET DECAY CORRECTED BLOOD SAMPLE COUNTS}}$$

Correlation of the RN LVV with biplanar angiographic volumes were r = 0.983 ($P<.001$) for the ED volumes and r = 0.989 ($P<.001$) for the ES volumes. Absolute LVV are routinely calculated utilizing regression equation:
VOLUME UNITS X SLOPE (7) - Y INTERCEPT (7) = LVV in ccs
It is concluded that the RN technique is an accurate method to measure LVV non-invasively.

AN ACCURATE RADIONUCLIDE METHOD FOR DETERMINATION OF LEFT VENTRICULAR VOLUME. P.D. Purves, V.A. Gebhardt, M.A. Darragh, W.J. Kostuk. University Hospital, London, Ontario, Canada.

Many commercially available cardiac volume programs tend to be cumbersome and their reproducibility poor. Accordingly a new algornythm for volumes was developed on a Technicare 550 computer. Twenty-five patients had resting radionuclide wall motion (RN) studies immediately prior to LV cine-angiography. Three key components for accurate analysis are: 1) grading of the quality of the study; 2) subtracting the proper amount of background (bkgd); 3) accurate drawing of ventricular regions of interest (ROI). All studies were graded as excellent (E), good (G), or bad (B) on the basis of tagging efficiency. Bkgd subtraction was: E study 25%, G study 28%, B study 33%. The study was viewed in cine mode to improve visualization of the LV borders. RN volumes were correlated to biplane contrast studies. Both two and four minute acquisitions were obtained. Results (mls) mean $\pm$ SD, (correlation coefficient R):

Study	ED	ES	SV
4 min	190$\pm$77 (1.0)	89$\pm$70 (0.98)	101$\pm$29 (0.97)
2 min	188$\pm$75 (1.0)	89$\pm$71 (1.0)	100$\pm$28 (0.97)
Catheter	191$\pm$76	89$\pm$71	102$\pm$30

We conclude that: 1) This program gives accurate and reproducible LV volumes; 2) Technical quality determines the bkgd to be subtracted; 3) A cine mode markedly assists in establishing the LV edge; and 4) Various acquisition lengths were equally accurate.

THE USE OF DRUG INTERVENTION AS AN ALTERNATIVE TO EXERCISE FOR QUANTITATIVE ASSESSMENT OF LEFT VENTRICULAR FUNCTION. K. Wilkins, G. Wisenberg, A. Zawadowski, K. Mitton, F. Prato and L. Reese, St. Joseph's Hospital, University of Western Ontario, London, Ontario, Canada.

To examine the efficacy of drug intervention as an alternative to exercise for determination of left ventricular functional reserve, 26 patients - 8 normal and 18 with documented Coronary Artery Disease - underwent Radionuclide Angiography. Eleven were done following the IV injection of Dopamine, a positive inotropic agent, and an additional 15 following the injection of Dopamine with Atropine, a positive chronotropic agent.

After routine rest and exercise gated synchronous acquisition followed by a 30 minute rest period, a repeat rest image was acquired. Then, two minutes after the infusion of 2.5 µg/kg/min of Dopamine, a three minute acquisition was initiated and subsequently the dose of Dopamine was increased by 2.5 µg/kg/min for each stage for a total of six stages. Those patients that received both drugs were given 0.6 mg of Atropine IV prior to the Dopamine infusion and at every second dosage increment.

The responses of Heart Rate, Systolic Pressure, Double Product and Ejection Fraction were significantly different when exercise and drug intervention with Dopamine alone were compared in patients with Coronary Artery Disease, $p < 0.02$, (e.g. the ejection fraction decreased with exercise, but, increased on Dopamine alone, $p < 0.0001$). However, these same parameters were statistically similar to those at exercise when both Dopamine and Atropine were given, in both the normal group and the diseased group. This indicates that the use of Dopamine with Atropine shows promise as an alternative to exercise for determination of left ventricular functional reserve.

COMPARISON OF LEFT LATERAL AND LEFT POSTERIOR OBLIQUE VIEWS FOR EVALUATING REGIONAL WALL MOTION WITH GATED EQUILIBRIUM CARDIAC BLOOD POOL IMAGING. Michael Plankey, Diane Errico, Jay L. Meizlish, Barry L. Zaret, Harvey J. Berger. Yale University, New Haven, Connecticut.

Previous studies using gated equilibrium cardiac blood pool imaging have demonstrated the importance of including a steep lateral view for evaluation of regional wall motion (RWM), especially of the inferior wall. The left lateral (LL) and L posterior oblique (LPO) views visualize similar L ventricular (V) regions. However, the degree of right (R) V or L atrial overlap, the distance of the LV to the camera, and the degree of LV foreshortening differ among patients (pts). Therefore, the LPO and LL were compared in 47 pts with acute transmural myocardial infarction (MI) with high-resolution resting multigated imaging. The LPO and LL views were obtained in the R side down decubitus position. The LV was divided in 5 segments on these views: 2 anterior (ANT), 1 apical (AP), and 2 inferoposterior (IP). The clarity of visualization of these segments, as well as the observer's confidence in assessment of RWM and the presence of aneurysm were assessed by 2 blinded observers. All pts had ≥ 1 abnl LV segment. The IP segments were better visualized on the LL in 11/47 (23%) pts and on the LPO in 23/47 (49%). Similarly, the ANT-AP segments were better visualized on the LL in 5/47 (11%) and on the LPO in 26/47 (55%). In the remaining pts, the LL and LPO were comparable. Technically poor studies only occurred in 3 LPO and 4 LL.

Thus, both the LL and LPO views are essential for optimal evaluation of RWM in MI. They provide critical data on IP RWM, which is not apparent from standard 2-view studies, and improve delineation of ANT RWM, especially aneurysmal deformity.

RADIATION SAFETY/QUALITY ASSURANCE

3:00-5:00 pm **Room 260**

Moderator: Deborah B. Behrendt

Co-moderator: Roy E. Aldridge

AUTOMATED FLOOD FIELD EVALUATION TO DETERMINE SIZE, SHAPE, CENTER AND UNIFORMITY. J.L. Lancaster, S.R. Bunker, D.W. Shosa. Brooke Army Medical Center, Ft. Sam Houston, TX.

A computer program was written in FORTRAN for processing of gamma camera floods acquired into a digital computer. Data is acquired in 64x64 word mode utilizing predefined sequences for all cameras in the department. Processing is then accomplished for all acquired floods under program control to yield a hard copy result using a film formatter. The hard copy images contain information concerning date, day of the week, camera identification, week of the test, and an image of the flood. Additionally, the flood height, width, and center are reported out in pixels. Finally, the flood for both a central area and a peripheral area. The data for all camera floods is stored on a single film and placed in the quality control log. The processing program was written for a MDS A2 computer. All floods are acquired with 2 million total counts. The average count per pixel in the center of the image was determined from a 21 pixel row and 21 pixel column centered on image pixel location 32,32. Image top, bottom, left and right were selected as the pixel first exceeding half the average count starting from the matrix edges on row and column 32. Next, the center of the flood was calculated to be the mid point of top, bottom, left and right. Once the center was determined, height and width were calculated along the row and column associated with the center using the half count threshold method as above. Flood uniformity was quantitated for eight equal areas totally enclosing the useful field of view and reported as the percent of pixels out of range. The range accepted for routine flood testing was +/-10% of the central average.

A COST-EFFECTIVE METHOD FOR THE DISPOSAL OF RADIOACTIVE WASTE FROM IN-VIVO PROCEDURES. J.P. Capuzzi. Crozer-Chester Medical Center, Chester, PA.

One of the most time consuming responsibilities of administering a nuclear medicine laboratory is the disposal of the radioactive waste that is generated. Use of a commercial disposal firm is popular, but expensive, requires special permits for the dumping site, places most of the risks and responsibility for potential problems upon the generator, even though much of the control is transferred to the carrier, and does not lessen the paperwork. Additionally, it serves to increase the public misconception of the hazards of medical radioactive waste, as opposed to reactor or military radioactive waste and it does nothing to stimulate long-range planning or solutions. In-house disposal, although preferable, has been shyed away from in many institutions because of the initial expense, lack of space, inadequate planning, paperwork, NRC and state licensing amendments, etc. We have developed a non-complex in-house decay and disposal system with a low to moderate initial cost, a modest amount of paperwork and which utilizes limited floor space. The long-term benefits are a reduction in cost, the elimination of the carrier and the inherent risks, and better control. Crisis management resulting from the whimisical decisions rendered from time to time by governmental agencies concerning the transporting and dumping of medical radioactive waste no longer exists.

AN ITERATIVE METHOD FOR VERIFYING SYSTEMATIC NON-UNIFORMITIES IN REFILLABLE FLOOD SOURCES. R.J. English, J.F. Polak, B.L. Holman. Brigham and Women's Hospital and Harvard Medical School, Boston, MA

Accurate reconstructions of data derived from rotating gamma cameras require strict quality control of camera field uniformity. Uniformity correction algorithms rely on floods acquired from the commercially available solid, or refillable sources. Solid flood sources typically show variations on the order of ±4%, while refillable flood sources may achieve volumes of -2 to +11% of a theoretically ideal volume. Using the property of shift invariance of a truly uniform source, we have demonstrated the applicability of a simple method of estimating the ideal volume of refillable flood sources.

A flood source filled above and below its ideal volume, was imaged in the middle of, and with lateral displacement from the center of the camera face. The derived difference images reveal the effects of systematic overfilling or underfilling of the flood source. In the former case, a difference image obtained by subtracting the shifted image from the

center one, reveals increased isotope in the center of the image. In the latter case, increased counts are seen in the direction towards the flood displacement. Cross-sectional profiles through these derived difference images, confirm the systematic distortions due to inaccurate filling. A quantitative index is derived by calculating the slope of the profile through the center of these images.

QUALITY CONTROL CONSIDERATIONS IN SINGLE PHOTON EMISSION TOMOGRAPHY. R.J. English, J.F. Polak, B.L. Holman, Brigham and Women's Hospital, Boston, MA

Increased interest and use of the rotating gamma camera in single photon emission tomography, has generated a unique quality control environment. An understanding of the steps involved, and associated reasons, in correct instrument preparation prior to SPECT aquisition, is a necessity.

Accuraie cross-sectional reconstructions depend on the scintillation camera's ability to rotate around a fixed reference point. During detector rotation, collimator and/or crystal movement may occur. With prior aquisition of a point source in a tomographic mode, its movements in an x,y plane may be tracked and plotted. Deviations from a sinusoidal plot represent shift artifacts not attributed to the circular pattern of the gantry's rotation. Utilizing the GE 400T rotating gamma camera, various patterns of the center of rotation were evaluated. Shifts in the x plane versus time were plotted, and center of rotations for LEAP and medium energy collimators evaluated.

Improperly applied floods introduce additional and unwarranted reconstruction noise to the final images. To rule out any statistical error, floods of 30 million counts or more are required. It is also necessary that tomographic studies using 67-Ga or 123-I be unitormity corrected with floods of their respective isotope. It is also noted that transmission phantoms tend to bulge and distort with time, causing increased counts in the center of the field of view. This inhomogeneous distribution will also cause reconstruction artifacts when applied.

A THREE-PARAMETER STATISTICAL SYSTEM FOR QUALITY CONTROL IN THE RADIOIMMUNOASSAY LABORATORY. S.G. Sarno. Indiana University Medical Center, Indianapolis, IN.

An efficient quality control (QC) system for RIA improves quality of results, detects problems promptly, prevents repeat assays, establishes concrete criteria for evaluating assay validity and can be used by any technologist.

We have implemented a system using three statistical parameters: a Z-score plot for each control pool, a Z-sum plot which combines the Z-scores, and an Average of Normals graph. Monthly updates of mean values and s.d.'s of each control pool for each assay compensates for small shifts in control ranges. Concrete criteria were laid down for evaluation of assay validity. The entire system was streamlined to minimize technologist time spent in this activity.

The use of these three parameters improves quality of results by detecting shifts in the RIA system that are within 2 s.d., but in the same direction, thus indicating a systematic error. Such a situation may go undetected by other QC systems, but could have a significant effect on the evaluation of borderline results.

Biodegradation of control pools is probably the most wasteful problem in the RIA lab. This system of QC allows rapid detection of this problem and continued release of patient results during evaluation of new control lots since this is a random rather than systematic error. Systematic errors as equipment failure or reagent deterioration can be detected within days. Review of the graph will show when the problem was identified and corrected.

This system of QC has resulted in improved reliability of results, fewer repeat assays, and rapid problem recognition and solution with a negligible increase in time spent on QC procedures.

REDUCTION OF OCCUPATIONAL AND PATIENT RADIATION EXPOSURE IN THE NUCLEAR MEDICINE LABORATORY. K.D. Stumpf, A.S. Holly. University of California, San Francisco, CA.

One of the main objectives in a Nuclear Medicine Department is to keep the occupational radiation exposure as low as reasonably achievable (ALARA). Because radiation exposure carries some risk, all unnecessary exposure should be avoided. Nuclear Medicine personnel should be aware of their radiation exposures and constantly strive to reduce exposure not only to themselves, but also to the patient. During any procedure, good radiation safety practices will mimimize exposure. Most whole body exposure to the technologist occurs while imaging the patient. Patients receive added exposure from repeat injections necessitated by infiltrated doses.

Radiation exposure can be significantly reduced by using a "cold start method" (CSM) versus the "straight stick method" (SSM) for the injection of the dose. We implemented the CSM in July 1981. The radiation exposure to personnel over eight months since this method was instituted was compared to the radiation exposure for the same 8 months of the prior year. Radiation doses to the hand and the whole body of the technologists were compared. The exposure to the hands and the whole body was reduced by 69%. The hand exposure using the SSM was .36 mR/mCi and using the CSM was .25 mR/mCi. The body exposure using the SSM was .048 mR/mCi and using the CSM was .033 mR/mCi. To assess the reduction in patient exposure bone scans performed during 1 month were graded for infiltration of the dose and comared with the scans of the same month of the prior year. For the SSM scans the infiltrations were none 37%, slight 23%, moderate 23%, large 18% and for the CSM scans the infiltrations were none 91% and slight 9%.

MARY IS PREGNANT. D. L. Johnson, M. E. Thompson, T. D. Kay, D. Romo, L. M. Holt, S. J. Riahi, G. M. McGranahan, and J. L. Hodge. USAF School of Aerospace Medicine, Brooks Air Force Base, Texas 78235

As more women are assigned to nuclear medicine and other jobs requiring occupational exposure to ionizing radiation, supervisors, radiation safety officers, and the employee herself can be faced with the problems of the pregnant woman working in nuclear medicine. In the civilian community the employee is usually given three choices if she does not wish to continue working in a radiation area:

1. Apply for a transfer to another department
2. Take a leave of absence
3. Quit her job

In the Air Force, the regulation is clear. It states, "A suspected pregnancy may be evaluated and, if confirmed, the individual be immediately removed from duties requiring occupational exposure to ionizing radiation until the pregnancy is concluded." Faced with the loss of highly trained and skilled technologists, we assembled a management team to answer the questions:

1. Is there a place in the nuclear medicine department for the pregnant worker?
2. Can she do meaningful work, maintain her skills, and keep abreast of new technology?

At the USAF School of Aerospace Medicine, we have experienced this problem and arrived at a workable solution. The problem solving process used by the team, and the management tools developed, will be analyzed as well as psychological and physical problems of the pregnant radiation worker and those of her co-workers.

PLAN DEVELOPMENT FOR HANDLING RADIATION ACCIDENTS. J.P. Capuzzi, H.P. Rothenberg. Crozer-Chester Medical Center, Chester, PA.

Radiation accidents can and do occur, yet most institutions rarely do more than the perfunctory planning required by JCAH or some governmental agency. Our objective was to develop a comprehensive plan for dealing with radiation accidents and for treating the victims of radiation accidents. We utilized four major constituents in constructing our plan. A careful review of the literature revealed how other institutions that have faced the problem have handled it, and in some cases that same incident was analyzed from several different perspectives. Solicitation of the plans of several power companies and of hospitals that have major decontamination facilities provided a second source. First-hand experience in dealing with other hazardous materials accidents and participation in workshops pertaining to radiation accidents were the

final compenents. From these we were able to identify the problems and the hazards that may occur. We then examined our strengths and weaknesses as a medical center relative to these problems. This enabled us to match our resources to the particular areas of concern. As a result we have a plan that coordinates and integrates the activities of the various services in the hospital and defines the duties and responsibilities of each. This effectively reduces the possibility of complicating the problem and of not rendering immediate and proper medical care.

CARDIAC II

3:30-5:00 pm **Room 263**

Moderator: Debra L. Loge
Co-moderator: Arthur J. Hall

PROBLEMS WITH AND SOLUTIONS FOR RADIONUCLIDE VENTRICULOGRAPHY IN PATIENTS WITH VENTRICULAR ASSIST DEVICES. D.J. Phegley, A.L. Ryan, C.M. Sherry, P.E. Yost, R.F. Brecklin, J.E. Ho, and L.D. Samuels. St. Louis University, St. Louis Missouri.

Ventricular ejection fraction and wall motion studies were requested on cardiac surgery patients who were unable to be removed from cardiopulmonary bypass. These patients were selected for placement of ventricular assist devices (VAD) connected from right atrium to pulmonary artery and/or left atrium to aorta. All patients had severe ventricular failure not manageable with drugs and intraaortic balloon pumping.

A method had to be developed that would allow an accurate and reproducable ejection fraction study to be done in less than 2 minutes. Patient and camera positioning had to be modified to allow for clearance of the VAD components which are located on and through the left chest wall obstructing the normal 45° LAO position for a parallel hole collimator.

A modified invitro RBC labeling technique was decided upon in order to maximize the target to non-target ratio. A 15° LAO acquisition position was used in conjunction with a 30° slant hole collimator allowing for a chest contact 45° LAO image that would not interfere with VAD components on the left chest wall.

Our results were remarkable and unexpected in that ejection fraction decreased with the VAD operational and decreased further with the VAD at maximum assist.

The results of this work were felt to be useful in 1) understanding the hemodynamics of cardiac output, 2) improving the performance of VAD's and 3) monitoring the progress of patients on VAD's.

INTRACORONARY Tl-201 EVALUATION OF ACUTE CHANGES IN MYOCARDIAL PERFUSION AFTER THROMBOLYSIS WITH STREPTOKINASE. P.A. Wright, D. Jansons, G.V. Heller, J.A. Parker, H.D. Royal, G.M. Kolodny, Division of Nuclear Medicine, Beth Israel Hospital, Boston, Ma.

This study was conducted to determine the acute effects of streptokinase thrombolysis in restoring acutely ischemic myocardium. During cardiac catheterization 31 patients were given streptokinase in conjunction with 80MBq (2.2mCi) of intracoronary Tl-201. 3/8th's of the Tl-201 dose was for the right coronary artery and 5/8th's of the dose was for the left coronary artery. The dose given after streptokinase therapy is 10 times the dose given before therapy, so that there is minimal contribution of activity from the initial study to the study after thrombolysis. Pre and post thrombolysis studies were evaluated for myocardial perfusion improvement.

Patients were divided into 3 groups: 1) successful thrombolysis by angiography and successful Tl-201 perfusion 2) successful thrombolysis by angiography, but unsuccessful Tl-201 perfusion 3) unsuccessful thrombolysis and unsuccessful Tl-201 perfusion.

In 70% of the patients there was evidence of thrombolysis. Of these patients, 55% showed evidence of reperfusion on their Tl-201 scans and 45% did not. Unsuccessful thrombolysis and no reperfusion on the Tl-201 scans was noted in 29%.

Thus, a method of assessing the acute effects of thrombolysis has been developed and intracoronary thrombolysis results in acute improvement in myocardial perfusion in a fraction of the patients.

BUILD UP FACTOR DETERMINATION OF LEFT VENTRICULAR VOLUME. J.A. Siegel, A.H. Maurer, R.K. Wu, K.M. Blasius, and L.S. Malmud, Temple University Hospital, Philadelphia, PA.

We have previously employed the build up factor (BF) to measure absolute activity of a distributed source. In the present study we have used this technique to calculate left ventricular (LV) volume in both phantom and patient studies. In the phantom study anterior and posterior views of a 155 cc volume source were obtained at varying depths of tissue equivalent material using a gamma camera and digital computer. Computer regions of interest were used to obtain the count rate (C) from the volume source for each view. A 10 cc aliquot of the volume source was counted by the same camera. The phantom thickness was measured and the volumes at each depth (d) were calculated using an iterative scheme based on previously calculated BF's. The BF's were defined by C/Co exp (μd) and measured in tissue equivalent material using a thin volume source of 10 cm diameter to approximate the size of the LV. The source volume was correctly predicted to within $\pm$ 3% in a 19 cm phantom for depths from 3 - 9.5 cm. This method was tested in 5 patients referred for cardiac catheterization. The correlation for end diastolic volume with contrast ventriculography (CV) and BF was 0.94 (BF=0.69 (CV) + 20.4 ml; SEE= 14.7 ml) and for end systolic volume it was 0.93 (BF= 0.95 (CV) + 8.9 ml; SEE= 9.2 ml). The BF method is geometry independent and corrects for scatter and attenuation without the need for independent measurement of attenuation. It can accurately predict LV volumes.

DETECTION OF CORONARY ARTERY DISEASE AT REST USING PEAK SYSTOLIC PRESSURE-END SYSTOLIC VOLUME INDICES. A.H.Maurer, J.A.Siegel,B.A.Denenberg,P.S.Robbins, K.M.Blasius, J.F. Spann and L.S.Malmud. Temple University Hospital, Philadelphia, PA.

Measurement of resting ejection fraction (EF) is a poor method for the detection of coronary artery disease (CAD). We have attempted to measure peak-systolic pressure/end - systolic volume (PSP/ESV) indices in patients with CAD. Twenty-three consecutive patients with suspected CAD had cardiac gated blood pool (GBP) studies performed within 24 hours of cardiac catheterization. Four minute GBP images were obtained in the LAO 40° projection at rest (R), during isometric handgrip (ISO), and after sublingual nitroglycerin (NTG). ESV was calculated using a previously described count based technique which uses a venous blood sample and an esophageal point source to correct for attenuation. Average PSP was obtained using an arm cuff averaging pressures obtained after each minute of GBP. A resting PSP/ESV ratio was calculated as well as the slope of the line determined by three PSP/ESV points (R,ISO,NTG). The mean values $\pm$ 1 standard deviation (SD) obtained were:

	PSP/ESV(R)	Slope	EF(R)
Normals (n=4)	4.8 ± .27	4.2 ± .36	68 ± 6
CAD patients (n=19)	2.2 ± .92	1.1 ± .61	58 ± 9

Of 19 patients with CAD only 4 had abnormal resting GBP studies and EF's. Using the PSP/ESV (R) ratio alone 18/19 were abnormal (outside ± 2SD) while 19/19 were abnormal using the slope calculations. We conclude that PSP/ESV indices can detect abnormal LV function in patients with CAD who have normal resting wall motion and EF's.

TECHNICAL VARIABLES AFFECTING THE REPRODUCIBILITY AND QUANTIFICATION OF THALLIUM 201 MYOCARDIAL IMAGING. D. Romo, T. D. Kay, D. L. Johnson, L. M. Holt, G. M. McGranahan, S. J. Riahi, and J. L. Hodge. USAF School of Aerospace Medicine, Brooks Air Force Base, Texas 78235.

Thallium 201 myocardial imaging has widespread use in evaluating patients with myocardial disease and myocardial infarction, including recent coronary artery by-pass surgery. Many of these patients receive serial cardiac scintigrams over a period of years.

The reproducibility of visual and computer quantification of repeated thallium imaging in the same patient is

vital in assessing the effectiveness of therapeutic programs and the detection of cardiac (myocardial perfusion) deterioration.

The USAF School of Aerospace Medicine is presently conducting a long term Thallium 201 myocardial reproducibility and quantification study with correlation of cardiac catheterization results.

From this study we have determined that several technical variables are paramount in thallium reproducibility studies. These technical variables are:

1. Exercise stress levels
2. Patient recovery time
3. Scanning time
4. Camera angles
5. Collimators
6. Crystal thickness
7. Camera calibration and window(s) characteristics
8. Computer software/hardware
9. Computer acquisition parameters

FACTORS AFFECTING IN VIVO LABELLING OF RED BLOOD CELLS:

S.J. Seawright, P.J. Maton, J. Greenall, S. Houle, P.R. McLaughlin, Toronto General Hospital, Toronto, Ont.

Drug history, sex and method of injection of stannous pyrosphosphate (SnPYP) were investigated as factors which could affect in vivo labelling of red blood cells (RBC).

One hundred and fifty-six patients (Pts), 45 women and 111 men, ranging in age from 18-69, were asked to complete a standard drug history form, prior to undergoing cardiac blood pool imaging. Prescription and non-prescription medications, general health care products and environmental factors were documented. In vivo RBC labelling was carried out by a standard injection of 2.5mg. SnPYP directly into a vein, followed 25-35 minutes later by 25mCi 99mTc pertechnetate. Two observers independently examined the blood pool images and visually scored the image quality.

An additional group of 30 Pts had SnPYP injected through a butterfly extension set or intravenous (IV) tubing. Their blood pool images were also examined and visually scored for image quality.

The uncontrollable factors of sex and drug history had no observable effect on the quality of the image. Pts receiving adriamycin, however, had poor quality images. Their ventricular edges were not well defined and background values were consistently high. A marked deterioration of image quality was also noted whenever SnPYP was injected through a butterfly or IV tubing.

Pt medication does not significantly affect image quality, however, method of administration of SnPYP plays an important role in producing high quality images. Technologists should ensure that SnPYP is introduced directly into the vein.

Author Index: Technologist Abstracts

Titles and Authors: Scientific Exhibits
30th Annual SNM Meeting—Technologist Section

Technologist Scientific Exhibits

Technologist Scientific Exhibits for the 30th Annual Meeting of the Society of Nuclear Medicine will be located in the Cervantes Convention Center in St. Louis. The abstracts for them may be found in the *Scientific and Commercial Exhibits Brochure*, which will be available on-site. Exhibit titles and authors are presented below; they are listed alphabetically by the last name of the first author.

"WHERE THERE'S A WILL, THERE'S A WAY" OR "DO-IT-YOURSELF FULL BODY SHIELD" E. Campbell, K. Bujnowski, W. O'Donnell. Zurbrugg Memorial Hospital, Riverside, NJ.

SEVEN PINHOLE PARTICULATE MYOCARDIAL PERFUSION IMAGING. W.R. Green, L.W. Poole, T.R. Davidson. Loma Linda University Medical Center, Loma Linda, CA.

SINGLE PHOTON EMISSION COMPUTED TOMOGRAPHY: THE THEORY AND THE REALITY. D. Hamilton, A. Misunas, D. Cassidy. Jackson Memorial Hospital, Nuclear Medicine Program. Miami, FL.

RADIOPHARMACEUTICAL KINETICS AND ORGAN CONCENTRATION IN NUCLEAR MEDICINE. J. Hughes and the NMT class of 1983. University of Cincinnati Medical Center, Cincinnati, OH.

FLOOD FIELD UNIFORMITY, RESOLUTION, SYSTEM LINEARITY BY DIFFERENTIAL ANALYSIS: A NEW APPROACH TO OBJECTIVE QUALITY CONTROL OF ANGER CAMERA SYSTEMS. T. D. Kay, D.V. Porter, G.M. McGranahan, D.L. Johnson, D. Romo, L.M. Holt, S.J. Riahi, and J.L. Hodge. USAF School of Aerospace Medicine, Brooks Air Force Base, TX.

METHOD OF CHOICE FOR IDENTIFYING THE PRESENCE OF RADIOCHEMICAL IMPURITIES IN Tc-99m LABELED RADIOPHARMACEUTICALS. W. Miller and W. Cloutet. Ochsner Medical Institutions, New Orleans, LA.

RADIONUCLIDE DETERMINATION OF CARDIAC VOLUMES AND OUTPUTS: TECHNICAL ASPECT. M.G. Moates, L.R. Stringfellow, R.L. Dubuisson and M.D. Harpen. University of South Alabama Medical Center, Mobile, AL.

THE TECHNICAL ASPECTS OF DIURETIC RENOGRAM IN CHILDREN. N.A. Pandya. Children's Hospital National Medical Center, Washington, DC.

LIVER UPTAKE OF BONE-SEEKING RADIOPHARMACEUTICALS. S. White, D. Cox, M. Eklem, E. Kingston, M. Mesgarzadeh, H. Smith, H. Sawyer, E. Westcott. VA Medical Center, Portland, OR.

DETERMINATION OF THYROID GLAND MASS (TGM) USING THE GAMMA CAMERA AND COMPUTER. S. White, M. Eklem, A. Jansen, V.R. Bobba, and G.T. Krishnamurthy. VA Medical Center and Oregon Health Sciences University, Portland, OR.