

34th Annual Meeting/Technologist Section

Proceedings of the 34th Annual Meeting of The Society of Nuclear Medicine June 2-5, 1987 • Toronto, Canada

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Floyd L. Potes, CNMT	1972-1973
Leonard Lopez, MHA	1973-1974
Vincent V. Cherico, CNMT	1974-1975
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Mark I. Muilenberg, CNMT	1976-1977
James K. Langan, NMT	1977-1978
Susan C. Weiss, CNMT	1978-1979
George W. Alexander, Jr., CNMT	1979-1980
Michael L. Cianci, CNMT	1980-1981
John J. Reilley, CNMT	1981-1982
Dorothy Duffy Price, CNMT	1982-1983
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Maria V. Nagel, CNMT	1984-1985
James J. Wirrell, CNMT	1985-1986

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TECHNOLOGIST SECTION MATRIX

MONDAY	ALL DAY SEMINAR/EDUCATORS WORKSHOP—Planning for Instructional Presentations	
<p>OUTLINE OF TOPICS: Conducting a pre-planning assessment • Writing Objectives • Researching and Organizing Content • Selecting Support Materials/Activities • Writing Lesson Plans Making Final Preparation • Performing Self-Evaluation and Revisions</p> <p>OBJECTIVE: Utilizing the information presented, the participants will be able to follow the steps of a systematic process for developing instructional plans and/or revising existing ones.</p>		
ROOM 101	8:30-12:00 and 1:00-3:30	This workshop is supported by funds from Mallinckrodt, Inc.
ICEBREAKER RECEPTION AT THE SHERATON CENTRE / GRAND BALLROOM ON CONCOURSE LEVEL: 5:30-7:30		

TUESDAY	EXHIBIT HALL OPEN 10:00-6:00 SCIENTIFIC POSTERS AND SCIENTIFIC EXHIBITS OPEN 10:00-7:00	
FORMAL OPENING AND PLENARY SESSION ROOMS: 105, 106, 107 8:45-10:00 Constitution Hall		
SCIENTIFIC PAPERS I: TRACK A / CARDIOVASCULAR ROOM 202B	10:30-12:00	SCIENTIFIC PAPERS II: TRACK A / INSTRUMENTATION ROOM 202D 10:30-12:00
LUNCH / 12:00-1:30 / Visit exhibits and lunch in the Exhibit Hall. Student Day: "Hot Tips on Resume Writing and Job Interviews": ROOM 201F		
SCIENTIFIC PAPERS I: TRACK B / CARDIOVASCULAR ROOM 202B	1:30-3:00	SCIENTIFIC PAPERS II: TRACK B / BONE / JOINT ROOM 202D 1:30-3:00
COMPUTERS FOR THE COMPUTER-SHY WORKSHOP Please pre-register on the registration form. A \$5.00 fee is required. The location will be announced. Buses will leave from the Convention Centre. (Sponsored by the SNM Computer Council)		
FILM READING PANEL: ROOM 105	6:00-8:00	
DON'T MISS THE SNM TECHNOLOGIST PARTY AT THE SCIENCE CENTRE. This year's party is sponsored by all exhibitors. 7:30-11:00		

WEDNESDAY	SCIENTIFIC POSTERS AND SCIENTIFIC EXHIBITS OPEN 7:00-7:00	
WHO, WHAT, WHERE, WHEN AND HOW OF MULTICOMPETENCY: PANEL DISCUSSION		
ROOM 101	9:00-12:00	Managers Day ROOM 203D 8:30-12:00
SCIENTIFIC PAPERS III: TRACK A / CARDIOVASCULAR ROOM 202B	10:30-12:00	SCIENTIFIC PAPERS IV: TRACK A / GASTROENTEROLOGY ROOM 202D 10:30-12:00
LUNCH / 12:00-1:30 / Visit exhibits and lunch in the Exhibit Hall. "Radiation Risk in Perspective: Chernobyl, Radon and Risks of Radiation in Medical Diagnosis": ROOM 106		
SCIENTIFIC PAPERS III: TRACK B / CLINICAL IMAGING I ROOM 202B	1:30-3:00	SCIENTIFIC PAPERS IV: TRACK B / NUCLEAR MEDICINE TECHNOLOGY ROOM 202D 1:30-3:00
		EDUCATORS FORUM ROOM 203D 3:00-4:30

THURSDAY	SPECT/CLINICAL IMAGING	
ROOM 101	9:30-4:00	NMTCB ITEM WRITERS WORKSHOP ROOM 202D 8:30-12:00
SCIENTIFIC PAPERS V: TRACK A / CARDIOVASCULAR ROOM 202B	10:30-12:00	SCIENTIFIC PAPERS VI: TRACK A / COMPUTER & DATA ANALYSIS ROOM 202D 10:30-12:00
SCIENTIFIC PAPERS V: TRACK B / NEUROLOGY ROOM 202B	1:30-3:00	
LUNCH / 12:00-1:30 A behind the scenes look at <i>The Journal of Nuclear Medicine</i> : ROOM 106		

Abstracts of Scientific Papers

A Note on the Scientific Papers

The Scientific and Teaching Sessions Committee of the Technologist Section, The Society of Nuclear Medicine, is pleased to present the abstracts of the scientific papers for the 34th SNM Annual Meeting. The scientific papers will be presented commencing on Tuesday, June 2, in simultaneous sessions beginning at 10:30 am.

TUESDAY, JUNE 2, 1987

SCIENTIFIC PAPERS I: TRACK A, Cardiovascular

10:30-12:00

Room 202B

*Moderator: Arthur J. Hall, CNMT
Comoderator: Martha W. Pickett, CNMT*

No. 1000

IMAGING TECHNIQUES FOR Tc-99m SQ 30,217 MYOCARDIAL PERFUSION STUDIES. K.F. Smith, J.S. Zielonka, L.L. Johnson, D.W. Seldin, J.P. Zodda, A. Nunn, P.J. Cannon, P.O. Alderson, W.C. Eckelman. Columbia-Presbyterian Med Ctr, NY, NY, V.A. Med Ctr, Milwaukee, WI, and Squibb Institute for Med Res, New Brunswick, NJ.

Because various myocardial perfusion (MP) agents have different pharmacokinetics, patient imaging techniques must be optimized for clinical studies. Reported here is the initial evaluation of such techniques developed as part of the Tc-99m SQ 30,217 [Bis[1,2-cyclohexanedione dioximato(1-)-O]-[1,2-cyclohexanedione-dioximato(2-)-O] methylborato(2-)-N,N',N'',N''',N''''',N'''''']-chlorotechnetium clinical trial.

Precise patient positioning prior to exercise and injection is crucial due to rapid myocardial washout; this can be optimized using a transmission source. For exercise and initial imaging, with an LPOV camera, the LAO view is more comfortable; with a small FOV camera, the anterior view is preferred. Following injection (at maximal exercise), exercise continues for 90-120 sec. The subject is reinjected 90-120 min after exercise to determine baseline MP; SQ 30,217 demonstrates no significant myocardial redistribution.

Image acquisition techniques included first-pass (for EF); single projection dynamic (for washout); and multiple projection (for localization). The rapid efflux of SQ 30,217 is ideal for high-throughput clinical imaging of MP.

No. 1001

TECHNETIUM-99m-LOW DENSITY LIPOPROTEIN: IMAGING STUDIES IN ANIMALS AND PATIENTS WITH HYPO AND HYPERCHOLESTEROLEMIA. H. Lipszyc, S. Vallabhajosula, C. Brown and S. J. Goldsmith. Mount Sinai Medical Center, New York, N.Y.

Low Density Lipoprotein (LDL) is the major cholesterol carrying protein in plasma. In normal rabbits, we previously showed that Tc-99m-LDL (Tc-LDL) is useful to study LDL biodistribution. In order to study LDL distribution non-invasively, we imaged Tc-LDL in 5 normal (NL), 5 hypercholesterolemic (HC) rabbits and 8 patients with hypo and hypercholesterolemia. LDL from NL rabbit and human subjects was labeled with Tc-99m using sodium dithionite as reducing agent. Prior to injection, Tc-LDL was purified by gel filtration (sephadex G-25) and filtered through millipore (0.2 μ). Gamma camera images were obtained at 0.5, 1, 4, and 24 hours.

In NL rabbits, Tc-LDL was predominantly taken up by adrenal glands, spleen, liver and kidney, while in HC rabbits, liver and spleen uptake was reduced and adrenals were not visualized. In HC rabbits, plasma clearance of Tc-LDL was slow compared to NL rabbits. The 24 hr urinary excretion of Tc-99m activity in NL and HC rabbits was 17%. In NL humans at 4 hrs, Tc-LDL uptake was seen predominantly in liver with clear visualization of all major blood vessels. In HC patients, the plasma clearance was slow but the distribution was similar to that observed in NL human subjects. In one HC patient, Tc-LDL uptake was clearly seen in the xanthomas. By contrast, increased Tc-LDL uptake was seen in spleen and bone marrow in addition to liver. In all patients, 5-15% of Tc-99m activity was excreted during 24 hours. Tc-LDL is useful to image LDL distribution in both animal models and patients with abnormal levels of plasma LDL.

No. 1002

IN VIVO QUALITY ASSURANCE FOR QUANTITATIVE BOLUS INJECTIONS. P. Hogendoorn, C.A. Wesolowski, R. Vandierendonck, A.A. Driedger. Department of Nuclear Medicine, Victoria Hospital Corporation and University of Western Ontario, London, Ontario.

Many quantitative time based radionuclide techniques, for example, renal scintigraphy with simultaneous G.F.R. determination, require prompt intravenous delivery of an accurately measured tracer bolus with minimal residual tracer retention at the injection site. The quality assurance aspects of two antecubital vein, quantitative injection techniques were investigated. A flush bolus technique using a tuberculin syringe piggybacked onto a 10 mL saline flush (modified from Crucitti et al) was compared to a single blood pressure cuff syringe injection technique (modified after Oldendorf). Scintillation camera data for each technique were compared for

bolus duration in the abdominal aorta and for residual activity at the injection site at 5 minutes. Bolus times were measured as the FWHM of the gamma variate fits to the abdominal aortic regional time activity curves. The mean FWHM was 8.3 +/- 2.2 seconds for the flush bolus (N=19), and 11.4 +/- 3.7 seconds for the Oldendorf technique (N=23) (mean +/- 1 S.D.). Relatively little focal activity was seen in the antecubital injection site following the flush bolus; marked residual activity was seen following the blood pressure cuff injections. The injection site/arm background ratios averaged 1.3 for the flush bolus and 30.1 for the Oldendorf technique. (N=20). Although both methods allowed accurate in vitro determination of administered radioactivity, only the tuberculin syringe flush bolus technique was acceptable for time based quantitation because of its superior in vivo characteristics.

No. 1003

MYOCARDIAL IMAGING WITH SPLIT DOSE TC-99m METHOXYBUTYL ISONITRILE (Tc-MIBI) TO DEMONSTRATE CORONARY OCCLUSION AND REPERFUSION. A.C. Lamb, L. Mills, Y. Allidina, M. Lewis, S. Houle, P. Liu. Toronto General Hospital, Toronto, Canada.

Tc-MIBI is a new myocardial perfusion agent that will demonstrate the distribution of coronary blood flow without significant clearance with time. To test the ability of this agent to detect coronary flow abnormalities at various times following occlusion, and subsequent changes on reperfusion, we investigated split-dose Tc-MIBI imaging in a canine model.

Twelve dogs underwent occlusion of the left anterior descending (LAD) artery for 1/2 hour. Prior to release, 7 mCi of Tc-MIBI was injected IV and a 2 minute static image (#1) was acquired immediately in the lateral view. Two hours after reperfusion, a delayed image of the initial injection was acquired (#2) to document persistence of the flow abnormality. To demonstrate reperfusion, additional 10mCi Tc-MIBI was injected and a third image was acquired (#3) in the same view.

To quantitate LAD flow changes, the myocardial Tc-MIBI activity was averaged over identical 4x4 pixel regions of interest in each image for both the LAD and circumflex (LCX, control) territories, and an LAD/LCX ratio calculated. To demonstrate reperfusion after the second dose of MIBI, the subtracted value between images #2 and #3 was used.

	Occlusion: Reperfusion: Reperfusion:		
	1st dose(#1)	1st dose(#2)	2nd dose(#3-#2)
LAD/LCX Ratio	0.52±0.16	0.62±0.20	0.83±0.15*
	(mean±SD, *p<0.01 compared to #2 and #1)		

We conclude that Tc-MIBI shows no significant redistribution during 2 hours of reperfusion. Normalization of flow after reperfusion can be demonstrated by a second dose of Tc-MIBI on a subtraction image. This demonstrates the potential of Tc-MIBI to detect coronary occlusion even after some delay, and the restored coronary flow after reperfusion.

No. 1004

NEW STRESS LIST MODE RADIONUCLIDE ANGIOGRAPHY FOR PATIENTS WITH ARRHYTHMIAS
Y. Allidina, S. Houle, P. Liu, K. Yip. Toronto General Hospital, Toronto, Canada.

Exercise radionuclide angiography acquired in the conventional frame mode is ideal for patients with steady R-R interval, but is inadequate for ejection fraction calculation in patients with significant arrhythmias. To improve the ability to acquire adequate studies for patients with arrhythmias during exercise, we have used a list mode acquisition in this group of patients where the serial nuclear data is acquired simultaneously with digitized ECG morphology.

Patients who have more than 20% ventricular premature beats, variable R-R interval during atrial fibrillation, ventricular tachycardia, intermittent pacing or patients with abnormal R-R histogram during conventional acquisition were included in the study. A rest study was first acquired in list mode for 3 minutes. The patient then performed exercise at 200 kilograms-metre/minute increments every 3 minutes. The exercise study was acquired continuously in the best septal

view. The rest and last 3 minute of exercise data were reconstructed using only the beats with normal R-R interval and morphology, by using a predefined window.

This technique was successful in obtaining analyzable gated images in all patients, with visually verifiable ejection fractions obtained using background subtraction and conventional region of interest analysis. Studies were possible even in patients who had only 1 out of 4 beats that was normal, or patients with intermittent pacing.

Given the fact that patients with significant arrhythmias often have the poorest prognosis where ventricular function assessment will be the most critical, combined list mode and ECG morphology acquisition during stress may allow uniquely adequate studies where conventional techniques have failed.

No. 1005

A COMPARISON OF DETECTION SYSTEMS FOR QUANTITATING THE RADIOCHEMICAL PURITY OF THE MYOCARDIAL IMAGING AGENT Tc-99m SQ 30,217. K.F. Smith, J.S. Zielonka, J.P. Zodda, T. Feld, A. Nunn, M.N. Eakins, L.L. Johnson, D.W. Seldin, P.J. Cannon, P.O. Alderson, W.C. Eckelman. Columbia-Presbyterian Med Ctr, NY, NY, V.A. Med Ctr, Milwaukee, WI and Squibb Institute for Med Res, New Brunswick, NJ.

Various detection system have been examined for quantitating paper chromatography (PC) strips for determining the radiochemical purity of Tc-99m SQ 30,217 [Bis [1,2-cyclohexanedione dioximato(1-)-O]-[1,2-cyclohexanedione-dioximato(2-)-O]methylborato(2-)-N,N',N'',N''',N''''-chlorotechnetium. Using a two strip PC method, two separate clinical centers evaluated the labeling efficiency of Tc-99m SQ 30,217. One center used a radiochromatographic scanner (RCS) while the other used a collimated gamma camera (CGC). Five kits were analyzed using the CGC and four kits using the RCS. The average labeling efficiency was 94.7±2.2% and 92.4±1.7%, for the CGC and RCS respectively.

A evaluation of the PC method using a dose calibrator and a well-counter revealed labeling efficiencies of 93.1±0.3 and 92.7±0.5, respectively.

Therefore, the data suggest that any of the four detection systems can be utilized to determine the labeling efficiency of Tc-99m SQ 30,217 with equivalent results.

**SCIENTIFIC PAPERS II:
TRACK A, Instrumentation**

10:30-12:00

Room 202D

*Moderator: Mark H. Crosthwaite, CNMT
Comoderator: Lynnette A. Fulk, CNMT*

No. 1006

THE USE OF LOW ENERGY COLLIMATORS FOR LOW COUNT SPECT IMAGING IN IN-111 LABELED MONOCLONAL ANTIBODY (MoAb) STUDIES. R. Phillips, L.M. Lamki, and A.L. Garza. The University of Texas M. D. Anderson Hospital, Houston, TX.

At our institution, we have been studying various In-111 labeled MoAb. In performing SPECT imaging of the chest, it takes at least 96-120 hours post infusion of the labeled antibody for the blood pool to clear. The count rate at this time is too low for proper SPECT imaging using a medium energy collimator. To alleviate this problem, a low energy all purpose collimator (LEAP) was used, and the results compared to the medium energy collimator.

Using a 64 stop, 20 seconds per view acquisition, the LEAP and medium energy collimators were evaluated on patients as well as phantoms with low count rates. Tomographic slices were reconstructed using a Butterworth prefilter, a Ramp

backprojection filter and the appropriate attenuation correction.

The count rate is sometimes too low for SPECT imaging using a medium energy collimator. Comparing the LEAP collimator to the medium energy collimator, the total study counts were 21%±6% higher with the LEAP collimator in patient and phantom studies. Although the increase in counts is due to some scatter from septal penetration, this noise can be filtered out during tomographic reconstruction. The counts per tomographic chest study were around one million total counts using a LEAP collimator. The 21% increase in counts using the LEAP collimator increases the overall image quality without significant degradation in resolution.

No. 1007

COMPLEX MOTION: A MEANS OF OBTAINING GOOD FLOODS FROM BAD SOURCES. S. Matthiesen, T. Simon, VAMC, University of Texas Health Science Center, Dallas, TX

Single photon emission computed tomography demands low flood field non-uniformity (about 1%). A 1% Cobalt-57 source is difficult to obtain. A refillable liquid phantom (RE) is labor intensive and subject to deformation, contamination and poor mixing.

We tested the effect of complex motion (CX) on the apparent uniformity of two Co-57 flood sources with 5% (C5) and 10% (C10) non-uniformity and compared these apparent non-uniformities to that of a Tc-99m filled RE. The RE was thoroughly mixed, allowed to equilibrate for 8 hours and again vigorously agitated. Flood acquisitions with 30,000,000 counts (requiring about 70 minutes) were obtained for each source. Co-57 sources were imaged both when stationary and when undergoing CX. The geometric relationship of the crystal, collimator and flood source was kept constant. The CX device repeated its path every 17 minutes. The non-uniformity of the central (75%) field of view was computed by commercial software. The respective differential and integral non-uniformities were (stationary) C5 3.7%, 6.3%; C10 7.9%, 10.0%; RE 3.7%, 6.1%; and (CX) C5 3.7%, 5.2%; C10 3.6%, 5.6%.

Thus complex motion lowers the apparent non-uniformity of even a very poor flood source to the range encountered with a well mixed RE without incurring the disadvantages of a liquid flood source.

No. 1008

AN IMAGE INDEPENDENT METHOD OF EVALUATING THE EFFICACY OF HEAD RESTRAINT DEVICES USED IN BRAIN IMAGING. K. Kempner, S. Stein and M. Green. National Institutes of Health, Bethesda, MD.

Objective comparison of methods for suppressing head motion during PET or conventional brain imaging requires numerical estimates of residual head motion with the restraint in place. We have tailored an electromagnetic spatial tracking device, consisting of a position transducer and reference source, to measure translation (X,Y,Z) and rotation (AZimuth, Elevation, Roll) of a coordinate system attached to the forehead. These angular motions correspond approximately to rotations about an axis perpendicular to the face, through the ears and about the body long axis, respectively. This system was used to assess the efficacy of a moldable thermoplastic face mask in suppressing head motion in 5 normal volunteers studied first without restraint (W) and then with the mask in place (M). The 6 coordinates were sampled every 2.5 seconds for 45 minutes in both the W and M states. The variation in each coordinate was summarized with frequency distributions, standard deviations and other measures. The population means of the maximum range of each coordinate are compared for W and M, below.

	centimeters			degrees		
	X	Y	Z	AZ	EL	RO
W	.65	.80	.19	1.51	2.44	2.62
M	.22	.10	.06	.99	2.02	.50

Compared to the W state, the mask appears to reduce significantly translation, AZ and RO motions but does not significantly reduce EL motions. Such measurements should permit the strengths and weaknesses of any restraint system to be identified and competing methods to be compared objectively.

No. 1009

A NEW METHOD FOR DISPOSAL OF LIQUID RADIOACTIVE WASTE USING ACTIVATED CARBON FILTER. M. DeSantis, G.W. Bennett, and J.J. Pescatore; Long Island Jewish Medical Center, New Hyde Park, New York and Brookhaven National Laboratory, Upton, New York.

The current method for disposal of liquid radioactive waste from radioassay procedures compromises laboratory storage space due to a maximum sanitary sewage disposal of 10uCi per day and retention of long physical half life assay tubes. A new approach to radionuclide sanitary disposal is to extract the radioactive component of the liquid and allow the element to decay in-house.

We have constructed a prototype waste system utilizing a commercially available granular activated carbon (GAC) water filter. GAC has been effective in adsorbing a wide range of organic chemicals and is commonly used in radio xenon gas traps. Typically, the diluted assay tubes are decanted into a funnel entering the affluent side of the of the shielded filter. The effluent exits through a small bore plastic tube affixed to a sanitary drain.

Measurements with Sodium I123, I125, Thallous Chloride 201 and 99m Sodium pertechnetate test sources indicate the GAC filter reduces effluent radioactivity by a minimum of 90%.

In conclusion, the GAC waste line system decreases the radioactivity disposed into sanitary sewage and offers reduced volume of radionuclide to be physically handled and stored.

**SCIENTIFIC PAPERS I:
TRACK B, Cardiovascular**

1:30-3:00

Room 202B

Moderator: Allen E. Beranek, CNMT
Comoderator: John J. Reilley, CNMT

No. 1010

LEFT ANTERIOR OBLIQUE (LAO) FIRST PASS LIST MODE RADIOANGIOCARDIOGRAPHY EJECTION FRACTION; COMPARISON TO EQUILIBRIUM FRAME MODE GATING. M. DeSantis, G.W. Bennett, J.H. Koss, A.M. Grunwald and M.M. Bodenheimer. Long Island Jewish Medical Center, New Hyde Park, New York and Brookhaven National Laboratory, Upton, New York.

Measurements of left ventricular ejection fraction (LVEF) in 25 patients were obtained by a combined technique of list mode radioangiocardiology and frame mode gating acquired in the LAO projection. Images were acquired using a mobile scintillation camera interfaced with a list mode capable computer after rapid injection of technetium 99m human serum albumin (HSA). List mode and physiological data were processed to form a dynamic series at a frame rate at 0.1 seconds.

The dynamic study was reviewed to determine the time the bolus appeared in the superior vena cava (SVC), T₀, and the time when the bolus cleared the left heart, T₁. The time interval T₁ - T₀ was utilized to reformat the original list mode data and finally processed using the average R-R interval to provide a 14 frame gated

study from which the LVEF was determined. The equilibrium frame mode gated study was then processed with the same algorithm to obtain the LVEF. This was compared to LVEF obtained by standard equilibrium frame mode gating.

Regression analysis produced a correlation coefficient of 0.97 with a standard error of Y estimate of 4.65.

In conclusion, calculation of LVEF by list mode radioangiocardiology is equivalent to standard equilibrium frame mode gating, despite reduced counting statistics. Using this new method, there is reduced back-ground contribution which increased image contrast.

No. 1011

IMPROVEMENT IN THE ACCURACY OF BULLSEYE ANALYSIS IN FEMALES BY ACCOUNTING FOR VARIABLE BREAST ATTENUATION.
A Gober, KG Cloninger, W Carlson, J Jones, S Moriarty, D Dunn, RL Eisner, RE Patterson, Carlyle Fraser Heart Ctr/Crawford Long Hosp of Emory U; Dpts of Medicine (Cardiology) & Radiology, EUSM, Atlanta, GA

Accuracy of reconstructed images obtained from 180° SPECT Tl-201 acquisition is directly related to the effects of attenuation in the acquired planar views. Thus, Bullseye displays (BD) derived from a series of reconstructed short axis slices exhibit distortions caused by attenuation, and BD normal (nl) files for males and females are different. The standard deviation (SD) BD reflects the physiological and anatomical variations in the nl population so that abnormality is determined when counts on a patient's BD differ by a predetermined number of SDs from the gender-matched nl BD. Due to the large variation in counts from breast attenuation in females we found that it was not possible to obtain good sensitivity (SENS) and specificity (SPEC) for Tl-201 SPECT using a fixed SD level and our standard female nl file. Thus we tested whether: 1) BD from low probability of disease (LPD) subjects correlate with various descriptors of body habitus. If so, the nl file could then be subdivided with respect to the appropriate descriptor. 2) Better SPEC could be obtained with a Breast Tissue Attenuation (BTA) scoring system which was based upon a semiquantitative examination of the planar view images. SD criteria for abnormality were adjusted based on the BTA score (0=none to 4=severe) and location when compared with our standard 50 female nl file. The results show 1) The following descriptors of body habitus did not correlate with wall ratios in the BD: % ideal body weight, chest circumference or bra cup size so that nl BD file could not be further subdivided. 2) Accounting for breast attenuation in women improves the SPEC (0.58 to 0.83, p<0.05) of Tl-201 without reducing SENS (0.95 to 0.90). In conclusion, SPECT Tl-201 in women requires a special procedure to account for variable breast attenuation of the cardiac image.

No. 1012

ROTATING SLANT-HOLE COLLIMATOR FOR 3-VIEW RADIONUCLIDE VENTRICULOGRAMS (RVGs). A. Azami, H.A. Ziesman, F.H. Fahey. Georgetown University Hospital, Washington, DC.

Overlap of the atrium and ventricle on RVGs may result in inaccurate quantitation. Caudal tilt with the parallel-hole collimator can minimize this problem, but with decreased resolution. An alternate method is to use a slant-hole collimator (SHC). Since changing collimators during the study is inconvenient and adds time to the study, we tried to use our fixed 20° parallel SHC for all 3 routine views: LAO, ant., and left lateral (LL). The orientation of the collimator could be rotated from 0-360°. An angle of 180° was used for the LAO and ant. views to emulate caudal tilt, 270° for RAO, and 90° for the LL to emulate what was felt to be an LPD view. This worked well for the LAO, ant., and RAO views, but inf. wall motion was not interpretable on the LL view. Therefore we studied the best orientation to use for imaging in the LL projection. A phantom study was performed by placing line sources 2 cm. apart on the ant. and posterior walls of a model of the left ventricle. The model was positioned so as to replicate the anatomical position during imaging. It was felt that the best angle for visualizing inf. wall motion

would be when the two line sources overlapped, therefore the inf. wall was parallel to the direction of the collimator holes. By this method 135° was determined to be best for seeing both the ant. and inf. wall in the LL projection. The subjective evaluation of patient studies acquired at various angles confirmed the phantom study. In conclusion, the rotating SHC can be used for all RVG views. A simple phantom study can determine the proper angle to position the collimator for each view.

No. 1013

EFFECT OF TREADMILL EXERCISE ON PERFORMANCE OF EJECTION FRACTION IN PATIENTS WITH DILATED CARDIOMYOPATHY.

G. White, K. Lloyd, D. Przybylski, K. McCarthy, R. Bonow, S. Larson. NIH, Bethesda, MD.

We studied 11 patients (9 Males, 2 Females) with DCM ranging in age from 27 to 66 years (mean 48) to evaluate the relationship between radionuclide angiographic (RNA) left ventricular ejection fraction (LVEF) before, one hour, and two hours after treadmill testing. Alterations in heart rate, blood pressure, circulating catecholamines, and afterload which result after exercise testing can affect the calculated LVEF. The patients were then exercised according to a preset treadmill protocol. No significant differences were found between baseline, one hour, two hour LVEF, heart rate, or blood pressure. Patients with the lowest LVEF's (< 20%, N=7) demonstrated LVEF's elevated from baseline at both the one hour and the two hour acquisition. The table below presents the ejection fraction values computed in these patients by three independent observers.

	BASELINE	1 HOUR	2 HOUR
Observer 1	12.9%	15.0%	14.4%
Observer 2	12.4%	14.0%	14.1%
Observer 3	12.9%	15.1%	15.3%

We conclude that treadmill exercise even after recovery may have effects on calculated LVEF's in patients with more severe resting cardiac dysfunction and result in an elevation of the LVEF. In order to keep the LVEF as accurate as possible, it is important for technologists to schedule DCM patients for RNA's prior to treadmill exercise.

No. 1014

REPRODUCIBILITY OF FIRST-PASS RNA STUDIES OF RIGHT AND LEFT VENTRICULAR FUNCTION USING THE BAIRD SCINTICOR.

L.R. Lambe, C. Bigelow, S.R. Collins and R.H.Jones. Duke University Medical Center, Durham, NC.

With the development of the portable multicrystal Baird Scinticor system, it is now feasible to perform multiple first-pass radionuclide angiocardiology (RNA) studies in the operative and acute care settings. While this technology is well established for the study of left ventricular function, the reproducibility of right ventricular function determinations is unknown. Twenty technically adequate first-pass RNA studies were analyzed to determine intra- and inter-observer reproducibility. All studies were worked up twice by two observers in random order. Statistical significance was assessed using analysis of variance techniques. The inter-observer differences and the average estimated intra-observer errors in measurement (SEM) and reliability coefficients (R) are reported for 3 parameters - right and left ventricular ejection fraction (RVEF, LVEF) and end-diastolic volume (EDV):

	RVEF	LVEF	EDV
Inter-observer difference	ns	ns	.0001
Intra-observer: SEM	2.2	1.7	13
R	.97	.98	.88

Our reproducibility coefficients for parameters of left ventricular function agree well with those obtained for the Baird System 77. With the Scinticor system, we are now able to precisely estimate right and left ventricular function in a variety of clinical settings.

**SCIENTIFIC PAPERS II:
TRACK B, Bone/Joint**

1:30-3:00

Room 202D

*Moderator: Robert J. English, CNMT
Comoderator: Jacqueline A. Bridges, CNMT*

No. 1015

QUALITY CONTROL TECHNIQUES AND ARTIFACTS IN DUAL-PHOTON ABSORPTIOMETRY. M. Costanza, Wheeling (Jesuit) College, Wheeling, WV; K. Patel and E. Turbiner, Mercy Hospital, Pittsburgh, PA.

Three factors which can affect the final diagnostic quality of dual-photon densitometry images have been examined. They are: 1.) the effects of attenuating materials found on or within the patient; 2.) the consequences of marginal quality control parameters on subsequent data; 3.) the value of accurate history taking.

An x-ray phantom with various artifact-producing devices was imaged by a Lunar DP3 Dual-Photon Densitometer with IBM PC-AT computer.

The study provided an understanding of how numerous artifacts can be produced by the three factors. We were able to generate, reproduce and catalog a series of artifact images which serve as a useful reference.

No. 1016

SPECT TECHNIQUES IN THE EVALUATION OF SPINE AND SHOULDER ABNORMALITIES. J. Botti, R. Ackermann, R.L. Wahl. University of Michigan Medical Center, Ann Arbor, MI.

SPECT imaging of the musculoskeletal system has proven useful in the pelvis and temporal mandibular joint. Planar imaging of the spine and shoulder is not always sufficient for localizing bone pathology. We evaluated SPECT imaging of these bony structures.

Forty-two patients had routine bone scintigraphy for a variety of reasons using 15 mCi of Tc-MDP. SPECT imaging of either the spine or shoulders was performed after planar views. SPECT of the shoulder girdle was performed on 23 patients. Acquisition parameters were as follows: 360° axial rotation, 64 stops, 20 seconds per stop. Acquisition parameters were similar for the 19 spine patients: 180° axial rotation posteriorly, 64 stops, 20 seconds per stop. Total acquisition time was 21 minutes for both studies. All acquisitions were done with a circular orbit. Transverse reconstruction was done with a .20 to .30 Butterworth Order 5 filter. Filter cutoff selection was relative to counts acquired per projection. A weighted slice averaging in the Y direction was also used. Slices were then generated in the sagittal and coronal planes for evaluation. In 9 of the 23 shoulder girdle and upper thorax patients SPECT images were a useful adjunct in defining bone pathology. Similarly, 8 of 19 spinal SPECT studies provided additional useful information.

SPECT imaging of the spine and shoulder is technically feasible in the adult patient. Excellent quality reconstructions can be obtained which offer a distinct advantage over planar imaging in selected instances.

No. 1017

Sm-153-EDTMP: A PROMISING RADIOPHARMACEUTICAL FOR THE TREATMENT OF METASTATIC BONE CANCER. L.M. Stringham, A. Williams, A.R. Ketring, L.A. Corwin, W.A. Volkert, and R.A. Holmes. University of Missouri and Harry S. Truman Memorial Veterans Hospital, Columbia, MO.

Sm-153-ethylenediaminetetramethylenephosphonate (Sm-153-EDTMP) has been proposed as a palliative treatment for metastatic bone cancer. The biolocalization properties of the complex (rapid blood clearance, low soft tissue uptake, high lesion affinity) and the physical decay and production parameters of the isotope (medium-energy beta particles, 46.3 hour half-life, imageable 103 KeV gamma photon, high neutron cross-section) are desirable for a therapeutic agent. Biokinetics of Sm-153-EDTMP were evaluated at subtherapeutic dose levels in five patients with metastatic bone cancer. The agent clears rapidly from blood by urinary excretion (2.1 +/- 0.5% remaining at 4 hours p.i.), with an estimated 44 +/- 10% localizing in bone. Planar images were obtained and lesion-to-normal bone (L/NB) ratios were calculated using regions of interest (ROI). The L/NB ratios for all patients equalled those obtained with Tc-99m-HDP. Sm-153-EDTMP has been used for three years to treat dogs with spontaneous bone cancer. Several cases have responded dramatically to the therapy. Since the biolocalization of Sm-153-EDTMP in humans is consistent with the animal data, we anticipate similar positive responses in human therapeutic trials.

No. 1018

ASYMMETRY OF PROXIMAL FEMUR BONE MINERAL DENSITY MEASUREMENTS. M. DaCosta, M. DeLaney and S. J. Goldsmith. Mount Sinai Medical Center, New York, N.Y.

Fracture of the proximal femur is the most serious fracture site in osteoporosis. Bone Mineral Density (BMD) measurements using Dual Photon Absorptiometry (DPA) have been used to assess bone loss. Direct measurements of the femur have been suggested to identify fracture risk of this area. In general, unilateral measurement of this site have been made, presuming correlation between left and right femoral BMD. This study evaluates that premise and determines the clinical significance of BMD differences in the proximal femurs.

27 patients, (19 suspected osteoporotics and 8 normals) had DPA BMD determinations of both proximal femurs. The left and right femoral neck BMDs are highly correlated, $r=0.975$. The values lack agreement, however, with absolute differences in BMD results of up to 11%. The mean difference was 3.99% (4.19 for suspected osteoporotics, 3.52 for normals). 2 standard deviations of the mean difference was 0.084 gm/cm². Over the range of BMD values sampled (0.6 - 1.2 gm/cm²) this represents a 6.6 to 13.3% difference.

These results suggest that measurements of both femurs are necessary to accurately assess fracture risk. BMD differences of this magnitude can alter the clinical interpretation and effect patient management decisions.

No. 1019

RAPID URINE DILUTION: A SIMPLE PROTOCOL TO IMPROVE PELVIC IMAGING IN BONE SCANNING. B.E. Bolser, J.M. Mountz, R.S. Steventon, P.A. Suto, L.E. Lemon, K. Miller, M.D. Gross. University of Michigan Medical Center, Ann Arbor, MI.

In the elderly male population pelvic bone scan images are often obscured by residual urine activity in the bladder. Techniques used to obviate this problem include catheterization, angulated views or delayed images. We have performed a 3 month prospective study at the Veterans Administration Hospital, Ann Arbor, to determine how well pelvic bone scan images improve as a result of rapid urine dilution by voluntary ingestion of water. Of 116 consecutive patients receiving bone scans, 34 had retention of urine activity obscuring the pelvic image. By random selection, (patients assigned to one of 3 Anger gamma cameras), 11 patients entered the study. After tracer injection patients were instructed to drink 4-6 glasses of water and void prior to their 3 hour post-injection scan session (standard protocol). At imaging an anterior pelvic view was obtained first, and if exces-

sive counts were retained in the bladder, the patient was given 16-32 oz of water p.o. while imaging of the body continued. At scan completion the patient voided and a second anterior pelvic image was obtained. On initial scanning, the bladder contributed an average of 29%, (range 12-40%) of the counts in the anterior pelvic view. The second pelvic image (after additional water ingestion and voiding) showed only 7.5% of the total pelvic counts arising from the bladder. The average bladder counts after rapid dilution were 26% of the original counts (range 7.7 to 61%). This simple, rapid dilution technique improved image quality in each case without increasing scanning time or resulting in apparent patient complication.

WEDNESDAY, JUNE 3, 1987

**SCIENTIFIC PAPERS III:
TRACK A, Cardiovascular**

10:30-12:00

Room 202B

*Moderator: Allen E. Beranek, CNMT
Comoderator: Louis H. Emond, CNMT*

No. 1020

IMPROVEMENT IN THE ACCURACY OF BULLSEYE ANALYSIS BY CORRECTING FOR PATIENT MOTION. D Dunn, T Noever, D Nowak, AL Churchwell, J Oates, RE Patterson, RL Eisner. Carlyle Fraser Heart Ctr/Cranford Long Hsp of Emory U; Dpts of Medicine (Cardiology) & Radiology, EDSM, Atlanta, GA; GE Medical Sys. Grp., Milwaukee, WI.

Patient motion of less than 1 pixel (6.2mm) in the vertical (axial) direction can cause artifacts in SPECT Tl-201 myocardial imaging. We have developed computer programs that 1) quantitate motion between consecutive frames of the study, 2) use the measured pixel shift values to motion-correct the acquired projection data. The method uses frame-to-frame cross correlation functions of the summed profiles in the vertical and horizontal directions of the planar images. Quantitative output is derived from examination of the variation of the change in the pixel value, corresponding to the maximum of the cross-correlation function at each view. Purpose: 1) determine the accuracy of the correction algorithm, and 2) evaluate the effect of motion correction on diagnostic interpretation. In 10 normals (nls), vertical motion was computer-simulated. This was accomplished by arbitrarily translating the planar images, in frames 16 to 32 by a known distance in the vertical direction. The results show 1) vertical motion can be corrected to a precision of better than 0.1 pixel. 2) Of the 10 nls, 4 showed artifactual defects following simulated motion between ± 0.5 and ± 1.0 pixel. Three were subsequently interpreted as nl, and 1 was equivocal, after correction. In conclusion, 1) the cross-correlation technique is a useful tool to detect and quantitate sudden patient motion during a SPECT study. 2) As a general QC procedure we suggest that data with vertical patient motion of >0.5 pixel be motion corrected.

No. 1021

THE EVALUATION OF GATED Tc-99m-ISONITRILE (RP-30) MYOCARDIAL PERFUSION IMAGES FOR REGIONAL WALL MOTION. M.A. Saari, J.A. Mattered, D.J. Errico. Yale-New Haven Hospital, New Haven, CT.

Tc-99m Labeled-Isonitrile (RP-30) is currently being evaluated as a promising new tracer for myocardial perfusion imaging. Because of the increased myocardial uptake, retention and count density of RP-30 gated images are possible. Clinical evaluation into the feasibility

and accuracy to which this new myocardial perfusion imaging tracer can be used in the assessment of regional wall motion (RWM) abnormalities as compared to conventional Tc-99m-RBC's gated blood pool images (G-BPI) is being sought.

Patients (N=10) having known stable myocardial infarction had conventional G-BPI and G-RP-30 images (1-2 day interval). Imaging was performed in 3 projections, (45° LAO, ANT, 70° LAO), collected in a 64 x 64 matrix, 16 frame format with 125 KCTS/frame using a gamma camera with a GAP collimator and a digital computer. All images were acquired 1 hr. post I.V. administration of 20mCi (740 MBq) Tc-99m-RP-30.

The G-BPI and G-RP-30 images were blindly evaluated by 3 physicians for RWM. RWM was scored on a 5 point scale in 11 segments per study. Of 110 segments compared there was 83% agreement.

Besides the obvious use of RP-30 as a myocardial perfusion imaging agent in the detection of ischemic heart disease, G-RP-30 images allow for the assessment of RWM abnormalities in the presence of perfusion defects which correlated well with RWM on G-BPI. G-RP-30 is a promising new method for acquiring information that may be useful in the evaluation of anatomic and functional myocardium in relationship to MI.

No. 1022

IMPROVEMENT IN Tl-201 CARDIAC IMAGING USING ENERGY WEIGHTED ACQUISITION. L.E. Friend, J.R. Halama, R.E. Henkin, and G.L. Dillehay, Loyola University Medical Center, Maywood, IL; and P.W. Kasulis, Siemens Gammasonics, Inc., Desplaines, IL.

A common problem with Tl-201 myocardial imaging has been finding an efficient way to deal with scatter. Energy weighted acquisition (EWA) is a method of reducing the contribution of scatter and improving image contrast in planar and SPECT imaging.

To evaluate the differences between EWA and normal window acquisition, patient and phantom images were acquired in planar and SPECT modes. For phantom studies, a heart shaped phantom submerged in water was imaged over 360 degrees. Patient data was acquired using 180 degrees. In both cases attenuation correction and flood correction were not used in reconstruction. By visually comparing patient and phantom studies in planar and SPECT modes, EWA clearly showed less background and improved image contrast over normal window studies. By using image profile to compare the ratios of ventricular wall to chamber activity, EWA showed a 40% increase in contrast over normal window images.

EWA holds tremendous possibilities for improving planar and SPECT imaging especially when using isotopes with low target to non-target ratios. With further development and refinement, weighted acquisition could lead to significant improvements in lesion detection due to the increased contrast.

No. 1023

DIASTOLIC AND SYSTOLIC FUNCTION AFTER AORTIC VALVE REPLACEMENT - OBSERVATIONS AND A POTENTIAL PITFALL. L. Wu, S.L. Warber, J. Santinga, J.E. Juni. University of Michigan Medical Center, Ann Arbor, MI

A number of scintigraphic studies of left ventricular function after aortic valve replacement have yielded conflicting results. We performed gated radionuclide ventriculography (RVG) on 8 pts, age 24-70 (mean 51 yrs). Four pts had aortic stenosis (AS), 3 had insufficiency (AI) and 1 had both AS and AI. Each pt underwent resting RVG within 6 months before and after elective aortic valve replacement. The decision to operate was made on standard clinical criteria of symptoms and hypertrophy. Left ventricular time-activity curves were generated using a variable region-of-interest. Filling and ejec-

tion rates were determined from a 3-harmonic fit to the original time-activity curve.

Ejection fraction was only minimally altered with valve replacement; 63% pre-op (range 39-81) to 68% post-op (range 37-95) ($p=.29$, NS by paired t-test) and times to end-systole was similar; 169 vs 211 msec ($p=.21$). Peak diastolic filling rate (PFR) appeared to be significantly altered by valve replacement, going from 2.61 EDV/sec (range 1.55-3.87) to 3.27 EDV/sec (range 2.49-4.55), $p=0.030$. However, although resting heart rate as a group did not change significantly with surgery (mean 78.6 vs 85.8, $p=0.11$ by paired t-test), PFR normalized for cycle length was essentially unchanged: 2.00 vs 2.30 EDV/cycle-length, $p=0.164$.

Thus, in this group, ejection fraction, TES, and heart-rate corrected PFR were unchanged by valve replacement. More importantly, the necessity of correction of filling rate measurements for cycle length is highlighted.

No. 1024

COMPARISON OF ELLIPTICAL THALLIUM-201 SPECT TO CIRCULAR SPECT EMPLOYING CIRCULAR NORMAL LIMITS. W. L. Robbins, J. R. Galt, J. L. Klein, P. L. Hartley, E. V. Garcia, Emory University Hospital, Atlanta, GA.

Quantitative assessment of Tl-201 SPECT myocardial perfusion has been previously reported employing normal limits developed using circular scanning paths. We undertook a study to determine if the same normal limits could be used with elliptically acquired Tl-201 SPECT data. Phantom studies were performed using a commercially available SPECT phantom with a mounted cardiac insert simulating the left ventricular myocardium and in-house developed lungs and spine. The phantom chambers were filled with Tl-201 concentrations in proportion to those determined from patient studies. Studies were performed elliptically and circularly employing identical parameters for acquisition, reconstruction and quantitation. Acquisitions were done with a cold defect positioned in the inferior wall of the myocardium measuring 2.0 cm. long by 45 degrees. Using the same parameters as the phantom studies, ten patients were acquired circularly and then elliptically both post stress and approximately 4 hrs later (delayed). Results showed a 6.6% increase in contrast resolution of the perfusion defect on the elliptically acquired phantom studies which was visually appreciated in the patient studies. Nevertheless, the interpretation of 8/10 elliptical patient studies agreed with the circular. Thus, elliptically acquired Tl-201 SPECT studies may be analyzed using circular normal limits without a significant loss in the accuracy of detecting CAD. It is still to be determined whether using elliptical normal limits would significantly increase the overall accuracy of the method.

**SCIENTIFIC PAPERS III:
TRACK B, Clinical Imaging I**

1:30-3:00

Room 202B

*Moderator: Vincent V. Chericco, CNMT
Comoderator: Lynnette A. Fulk, CNMT*

No. 1025

INCREASED OCULAR UPTAKE OF GALLIUM CITRATE IN PATIENTS WITH SARCOIDOSIS. P. Turner, R. Pratt, D. Walker, G. Leach, A. Levine, N. Andrews. Detroit Osteopathic Hospital, Highland Park, MI.

The use of gallium scanning as an adjunct to the diag-

nosis of sarcoid has been focused on the lung area and the evaluation of the activity of pulmonary sarcoid changes, however, it would seem that not enough attention has been focused on the eyes of these patients. Gallium scans of the chest are more sensitive than routine chest roentgenograms for showing pulmonary involvement in sarcoidosis. In addition, increased gallium citrate uptake by the lacrimal glands may be useful in diagnosing sarcoidosis.

Fifty-three patients were studied with gallium citrate for varying diagnostic evaluations. These patients were divided into two groups. Group I consisted of 28 patients with suspected or diagnosed sarcoidosis and Group II had 25 patients without sarcoid. Sarcoidosis was diagnosed in patients with a typical clinical pattern including bilateral hilar adenopathy. In these patients, the diagnosis was either confirmed or further substantiated by biopsy and/or by increased serum angiotensin-converting enzyme activity.

Eight of the 28 patients with known or suspected sarcoidosis had intense uptake of gallium in the eyes suggesting ocular involvement of the disease.

Although gallium citrate is normally taken up by the lacrimal glands, we conclude that more attention should be concentrated on the degree of the intensity of this uptake since it is well documented that at least 25% of sarcoidosis patients have conjunctival sarcoid changes.

No. 1026

QUANTITATIVE LUNG IMAGING TECHNIQUE FOR EVALUATION OF PULMONARY FUNCTION IN RADIOTHERAPY PATIENTS. M. Wintjen, P. Fogel, P. Moldofsky. Fox Chase Cancer Center and Jeanes Hospital, Philadelphia, PA.

We evaluated the effectiveness of quantitative lung imaging in determining post-radiotherapy pulmonary function, as well as proportional function loss post-therapy. 19 patients with lung carcinoma were evaluated. Patients were administered 3-4 mCi Tc-99m macroaggregated albumin intravenously. 500k count perfusion images were obtained in multiple projections utilizing a 400 mm field of view gamma camera and a low energy parallel collimator. Data was simultaneously acquired on computer in a 128 x 128 byte matrix. Subsequent to review of the patient's radiotherapy portal chest radiograph and quantitative perfusion images, an area inclusive of the therapy field was determined by the radiologist. This region of interest was applied to the appropriate computer image by the technologist and the proportion of count within the therapy field relative to the total lung field was calculated. Based on the pre-radiotherapy forced expiratory volume at 1 minute (FEV₁) and the quantitative lung scan, post-therapy FEV₁ values were predicted to range from 0.74 to 2.16 liter. Actual values were from 0.79 to 2.53 liter. In only two cases the post-therapy FEV₁ values fell below predicted function level, by 2% and 5%. Comparison of measured post-therapy FEV₁ values with predicted post-therapy FEV₁ calculated by this method indicated an ability to conservatively and accurately predict post-therapy pulmonary function.

This technique is currently employed by our lab on a routine basis to assist the radiotherapy physician in designing radiotherapy fields to preserve critical levels of pulmonary function.

No. 1027

TECHNICAL ASPECTS OF THE NEUROFIBROMATOSIS SCAN. C.A. Sharkey, H.T. Harcke, G.A. Mandell, L.A. Cooley. A.I. duPont Institute, Wilmington, DE.

Technetium (Tc) DTPA, used for renal scintigraphy, has been observed to localize in neurofibromas. Scintigraphy can identify occult lesions and map the distribution of known tumors. A population of 65 patients, with and without neurofibromatosis, ranging in age from 1.5 to 50 years has been studied and an optimal scanning technique has been determined. Patients are intravenously injected with 200 uCi/kg of Tc DTPA and

positioned supine for 20 minutes for renal imaging. Total body planar images are started 30 minutes after injection. Extremities must be positioned symmetrically and are imaged for 200,000 counts. Four views of the cranium (anterior, posterior, and both laterals) are obtained, each for 200,000 counts in order to best visualize optic gliomas or cerebral neurofibromas. The thorax, abdomen, and pelvis are imaged for 500,000 counts obtaining, 6 planar views (anterior, posterior, both obliques, and both laterals) of each area. After planar imaging, SPPECT is performed to help demonstrate both suspected and unsuspected internal lesions. The detector rotates at 30 second intervals for 32 minutes with a 64x64 word matrix and no attenuation correction. Pre-filtering of the raw tomo using an 11.4 coefficient Butterworth filter alleviates noise that could otherwise mask a suspected lesion. Transaxial, sagittal, and coronal reconstructions are viewed in color rather than black and white, as this enables one to better enhance small lesions. In summary, scintigraphy with Tc DTPA can effectively localize neurofibromas with a combined technique of planar and SPPECT imaging and a knowledgeable technologist.

No. 1028

SPORTS MEDICINE SCINTIGRAPHY: IMAGING PROTOCOL FOR THE DETECTION OF SHIN SPLINTS AND STRESS FRACTURES IN CHILDREN. S. L. Carichner and C. E. Nagle. William Beaumont Hospital. Troy, Michigan.

Bone scans of pediatric athletes performed between January, 1984 and June 15, 1986 in the Nuclear Medicine Department of a 200 bed community hospital were reviewed to determine a technical protocol which would maximize the detection of occult osseous injuries and minimize imaging time. Of 2192 whole body bone scans performed during this period approximately 31 (1%) were done to evaluate for musculoskeletal injury as a result of the patient's participation in a regular exercise program or sport.

Positioning techniques, e.g. obtaining oblique views of the spine in patients suspected of stress fractures of the pars interarticularis, or obtaining simultaneous lateral views of both lower legs on one large field of view image in patients suspected of posterior tibial stress fracture or shin splint, are reviewed to acquaint the technologist with the special views necessary to detect specific types of osseous, sports injuries.

The importance of performing whole body scans versus limited scans is revealed by the detection of secondary abnormalities in 42% of the pediatric athletes scanned.

Bone scintigraphy has been recognized as a useful diagnostic tool in detecting the presence of occult osseous injury in athletes. With increasing awareness of shin splints and stress fractures by both athletes and physicians more bone scans may be performed for the evaluation of these injuries in the future.

No. 1029

THE SIGNIFICANCE OF ¹³¹I-6β-IODOMETHYLNORCHOLESTEROL (NP-59) UPTAKE IN THE NON-HYPERFUNCTIONING ADRENAL MASS. L. Meyers, J.A. Bouffard, B. Shapiro, G. Glazer, J. Ellis, and M.D. Gross. The University of Michigan and the Veterans Administration Medical Centers, Ann Arbor, MI.

The presence of ¹³¹I-6β-iodomethylnorcholesterol (NP-59) has served to not only localize, but can be shown to characterize the function of the adrenal glands in numerous states of adrenal hyperfunction. NP-59 uptake is related to urinary cortisol in Cushing's Syndrome, urinary aldosterone in aldosteronism and urinary androgens in adrenal hyperandrogenism. In non-hyperfunctioning adrenal masses the presence of discernable accumulation of NP-59 has predicted the functional status of the adrenals and allows space-occupying lesions to be distinguished from functioning, but not hyperfunctioning adrenal cortical masses. To assess the relationship of NP-59 uptake to the status of the adrenals in the non-hyperfunctional adrenal mass (incidentaloma) 49 patients identified with an adrenal mass on computed tomography were studied with NP-59

scintigraphy. In all patients adrenal function was normal; this based upon tests of plasma cortisol suppressibility and 24 hr. measurements of urinary hormone excretion. Each patient received stable iodide (2 drops BID x 10 days) and 1mCi of NP-59 i.v. and posterior, lateral and anterior abdominal images (50,000 counts/image) were obtained 5 to 7 days later using a gamma camera interfaced to a digital minicomputer. Adrenal uptake was estimated with a depth and decay corrected semi-operator-independent computer algorithm and was compared to the final diagnosis in each patient. In non-hyperfunctioning masses (30) adrenal uptake was 0.19 ± 0.05 % administered dose/gland (mean \pm SEM) while in space-occupying lesions (19) (12 metastasis, 3 carcinoma, 2 lymphoma, 2 cysts) uptake was 0.05 ± 0.01 % administered dose/gland ($p < 0.01$). Thus, the level of individual adrenal gland NP-59 uptake may be useful to distinguish benign, non-hyperfunctioning masses from space-occupying lesions in patients with incidentalomas.

SCIENTIFIC PAPERS IV: TRACK A, Gastroenterology

10:30-12:00

Room 202D

Moderator: Jeffrey S. Carey, CNMT
Comoderator: Kathryn N. Wilkins, RT(N)

No. 1030

DETECTING BILE LEAKS: TIPS FOR TECHNOLOGISTS ON HEPATOBILIARY IMAGING. S. L. Carichner and C. E. Nagle. William Beaumont Hospital, Troy, MI.

The occurrence of iatrogenic leaks in the biliary tree following hepatic or biliary surgery is well documented in the literature. In addition, abdominal trauma is sometimes responsible for bile leaks. Patients with a bile leak may complain of pain, tenderness, swelling, nausea, or low-grade fever. The non-specificity of these symptoms makes a bile leak very difficult to diagnose solely on a clinical basis. The Tc-99m IDA scan has been shown to be of value in detecting bile leaks, especially post surgery, where distortion of anatomical landmarks can interfere with evaluation via ultrasound or computed tomography.

The authors present an imaging protocol for hepatobiliary scintigraphy for patients suspected of having a bile leak. Case examples are used in discussing how the technologist can improve the biliary scan information. Special attention is given to the patient history and clinical setting, acquisition of special images to enhance the detection of aberrant radiotracer, and ways to assist the nuclear physician in the performance of further supplemental scan procedures, i.e. paracentesis.

Although bile leaks are relatively uncommon, the frequency with which cholecystectomies are performed dictates that Nuclear Medicine personnel become familiar with the clinical signs of these leaks and special imaging procedures that aid in making the diagnosis.

No. 1031

BILIARY KINETIC STUDY IN CHRONIC PANCREATITIS USING CHOLESCINTIGRAPHY. H. Itoh, R. Shimono, K. Murase, M. Kataoka, H. Mogami, Y. Yasuhara, M. Kawamura, and K. Hamamoto. Ehime University Hospital, Ehime, Japan.

Significance of cholescintigraphy in evaluating chronic pancreatitis (CP) was studied in 12 normal cases and 22 patients of CP by using Tc-99m N-pyridoxyl-5-methyltryptophan (PMT). These patients were divided into three groups on the basis of ERCP findings; 10 cases of minimal CP (MIP), 7 cases of moderate CP (MOP), and 5 cases of advanced CP (ADP). After intravenous injection of 5mCi of PMT, digital images were obtained and the time-activity curves of the ROIs (liver, hepatic duct, gallbladder, and duodenum) were generated.

There were no significant differences in the gall-

bladder kinetics assessed by the flow rate and the ejection rate of the gallbladder between CP and normal. Eleven of 22 cases of CP(50%) and two of 12 normal cases (16.7%) showed no duodenal radioactivities in 60 min. As the delayed excretion to the duodenum was observed in both dysfunctional and normal cases, the transit time was thought to be not so useful in this study. The reflux to the hepatic duct after intramuscular injection of caerulein, which was determined by the elevation of radioactivities in the ROI of the hepatic duct, was found in five of 14 cases(36%) of CP and more frequent in ADP(all of two examined cases), whereas there was no reflux in MIP and normal cases.

We conclude that the dysfunction of the common bile duct in CP is well demonstrated as the reflux to the hepatic duct and this finding is helpful in evaluating pathophysiology of the biliary kinetics in CP.

No. 1032

TECHNICAL ASPECTS OF CCK CHOLESCINTIGRAPHY (CCK-C) IN ACALCULOUS BILIARY DISEASE (ABD). D. Heitner, L. Swayne, C. Dize. Morristown Memorial Hospital, Morristown, NJ.

The studies from 154 patients and 11 controls were retrospectively examined in an attempt to identify the technical factors which could potentially lead to variability in gallbladder ejection fractions (GBEF). After an overnight fast, each subject was administered 5 mCi of technetium-99m Hepatolite. At maximal gallbladder filling (60-90 min.), 0.2ug/kg CCK was then infused through an intravenous line over 5 min. followed by a 40 minute computer acquisition. Background subtracted time activity curves were generated and a latent period, ejection rate, and GBEF were calculated. A GBEF \leq 35% is considered abnormal, indicative of ABD.

48 patients with GBEF \leq 35% underwent cholecystectomy; all had pathologic evidence of ABD and all were clinically improved post-operatively. Only two of the 11 controls (mean GBEF = 55.2%) had a GBEF less than 35%.

Three important potential pitfalls exist for CCK-C studies, the most critical of which involves a steady uniform intravenous infusion of CCK over a 5 min. interval. Although we employ a careful hand injection technique, a Harvard infusion pump is recommended. Significant patient movement occurred during only 7(4.3%) examinations, and all had an abnormal GBEF. Motion artifacts may be minimized with the utilization of a parallel hole collimator (vs. a pinhole collimator). 3(1.8%) exhibited overlap of the gallbladder with underlying bowel; following careful initial positioning, each was subsequently restudied without difficulty. Awareness of potential pitfalls will maximize the reliability of the clinical results.

No. 1033

THE SUPERSCAN: A SINGLE SCINTIGRAPHIC TEST FOR EVALUATION OF COMBINED GASTROINTESTINAL MOTOR DYSFUNCTION. J.L. Perri, A.H. Maurer, R.S. Fisher, J.L. Urbain, J.A. Siegel, B. Krevsky, L.C. Knight, R.A. Vitti, K.M. Brooks, L.S. Malmud. Temple University Hospital, Philadelphia, PA.

Patients with gastrointestinal (GI) motor dysfunction may have multiple disorders involving GI tract motility. The purpose of this study was to facilitate evaluation of such patients by combining several scintigraphic studies into a single procedure. The study consisted of an initial IV administration of 2.5 mCi Tc-99m-DISIDA. Gallbladder (GB) activity was monitored continuously until a plateau was attained or until 60 min. when the subjects then received an In-111-Oxine egg labeled meal developed for this study. Following ingestion of the meal whole abdomen Tc (140 keV) and In (273 keV) data were acquired for up to eight hours using a 53.5 cm large field-of-view camera to analyze: GB emptying, presence of bile reflux, gastric emptying, small bowel transit derived from the leading edge of cecal arrival or the difference curve derived from G.E. and colonic filling. In 5 normal controls mean GB T 1/2 emptying time was 50+/-29 min., GE T 1/2 103+/-55 min., and cecal arrival was 308+/-31min. A

mean small bowel transit could not be reliably determined from GE and colonic filling primarily due to small bowel overlap and difficulty identifying the cecum. Fifty percent (4/8) of symptomatic patients with diverse GI complaints showed at least two abnormalities in GI motor function. These results indicate that it is possible to derive quantitative data on multiple aspects of GI motor dysfunction in a single test and that symptomatic patients commonly have multiple GI motility disturbances.

No. 1034

PORTAL VENOUS SCINTIGRAPHY. P. Soon, L. Hanelin, M. Lee

A technique for evaluating catheters surgically placed in the portal vein (PV) is described.

Following colon cancer resection, these catheters provide direct access to the liver (L) for chemotherapy in patients without L metastases as demonstrated by surgery or CT. 85 procedures were done on 44 patients within five days of surgery. 40 patients had two procedures done on the first and fifth day after surgery. The portal venous scintigraphy (PVS) was performed with a LFOV gamma camera positioned in the anterior projection to include the PV, L, and right atrium (RA). 2 mc of Tc-99m DTPA was bolused directly through the catheter with a 20 cc saline push. Both analog and computer images were collected in a 64 x 64 matrix at 1 second per frame for 45 seconds. Time activity curves were generated with ROI's placed over the PV, RA, and right lobe of the L. From these curves, a mean transit time (MTT) through the L were obtained. The MTT on day 1 was compared to day 5. Images were evaluated for PV, L, and RA perfusion and any evidence of extravasation.

SCIENTIFIC PAPERS IV:

TRACK B, Nuclear Medicine Technology

1:30-3:00

Room 202D

*Moderator: Louis M. Izzo, CNMT
Comoderator: Jeffrey S. Carey, CNMT*

No. 1035

AN IMPROVED METHOD FOR IN VITRO LABELLING OF RED BLOOD CELLS WITH TECHNETIUM-99m. B Gerson, JR Ballinger, and KY Gulenchyn, Ottawa Civic Hospital, Ottawa, Canada.

We have modified the Brookhaven method for in vitro labelling of red blood cells (RBCs) by adding an initial centrifugation step and performing the labelling on packed RBCs.

A 3-5 ml sample of blood is obtained in an evacuated heparinized tube which is then centrifuged upside down for 5 min at 2000 RPM. A 1.0-1.5 ml sample of packed RBCs is added to a stannous citrate kit (50 ug tin) and incubated for 5 min, followed by addition of 0.6 ml 0.1% sodium hypochlorite and 1 ml 4.4% EDTA. 800 MBq Tc-99m pertechnetate is added to the kit and allowed to incubate 15 min before reinjection.

With this technique the labelling efficiency is 99.3 + 0.4% (N = 50). The standard method using 2-4 ml whole blood requires 25-30 min incubation to reach 98% labelling efficiency.

The use of packed RBCs results in: a) a reproducible labelling efficiency of >98%, b) a higher concentration of labelled RBCs (smaller bolus for injection), and c) less radiation exposure to the technologist because of better shielding. The shorter incubation time more than offsets the centrifugation time. This technique has proved useful for radionuclide angiography, venography, gastrointestinal bleeding studies, and red cell mass determination. It is particularly advantageous for RBC labelling in patients receiving chemotherapy.

No. 1036

COMPARISON OF IN-111-MERC LEUKOCYTES PREPARATION WITH THAT OF IN-111-OXINE LEUKOCYTES FOR ABSCESS DETECTION. J.I. Patel, C.M. Intenzo, M.L. Thakur, K. Tatum and C.H. Park. Thomas Jefferson University Hospital, Philadelphia, PA.

Most of the abscess studies at our institution are done using Indium-111-oxine (oxine) labeled leukocytes and with a relatively newer Indium-111-2-Mercaptopyridine-N-oxide (Merc) labeled leukocytes.

We found that Merc preparation is a better method because of (1) ease of labeling, (2) time involved in labeling (3) availability of In-111-Chloride for labeling and (4) the possible availability of Merc in a kit form.

Both methods (i.e. Merc and oxine) were used in more than 150 patients. Whole body images were obtained 24 hours later. Interpretation of the scans was done without the knowledge of the leukocyte labeling method. The diagnosis was confirmed in each case by using other modalities.

The results indicated that there was no appreciable difference between Merc and oxine labeled leukocytes for abscess detection. Sensitivity, specificity and accuracy of the diagnosis were comparable with both the methods. We prefer Merc over oxine because of the reasons mentioned above.

No. 1037

QUANTITATION OF ABSORBED DOSE TO NEUROBLASTOMA FROM I-131-MIBG THERAPY. J. Johnson, J.C. Sisson, K. Koral, B. Shulkin. University of Michigan, Ann Arbor, MI.

I-131 MIBG is used to treat neuroblastoma. For dosimetry, a tracer dose is given prior to therapy to quantitate tumor activity. We developed a new method using conjugate views and a mock source of known activity placed on the patient. The mock source gives an artificial tumor of known activity and thereby enables correction of attenuation, Compton scatter, and septal penetration which vary with patient size and site of tumor. Assuming the uptake of I-131-MIBG is linear from tracer to therapy, we calculated the absorbed dose imparted to a tumor from the ratio of tumor to mock activities, summing the cumulated radioactivity in the tumor and converting to rads, and then using the ratio of tracer to therapy doses. The tumor absorbed dose in two recently treated patients was:

Results	Dose mCi	Tumor Dose (rads)
Patient 1	203	Tumor #1 7890; #2 34000
Patient 2	132.1	Tumor #1 7680

A method to check that tracer kinetics are predictive is to obtain therapy conjugate tumor counts and then to apply the previously determined factor from the mock to give activity in the tumor and compare the results with those of the tracer study at the same interval after the dose. These calculations were performed on patient 1 at 47 and 72 h and on patient 2 at 43 h. The ratio of activity calculated to tracer scaled activity was .996 (range: .92 to 1.05).

Conclusion: 1) the use of radioactive mock provides reasonable estimates of tumor absorbed dose, 2) tumor uptake appears linear from tracer to therapy.

No. 1038

COMPARISON OF PRETINNING METHODS TO LABEL LEUKOCYTES WITH TECHNETIUM-99m. B Gerson, JR Ballinger, RH Reid, and KY Gulenchyn, Ottawa Civic Hospital, Ottawa, Canada.

Because of the expense, inconvenience of supply, and dosimetry of indium-111 oxine for leukocyte labelling, there is interest in alternative Tc-99m methods. We compared 3 pretinning methods: pyrophosphate (PPI), glucoheptonate (GH), and gentisic acid (GA).

Mixed WBCs were isolated from 40 ml blood, followed by hypotonic lysis of residual RBCs. With PPI and GH, WBCs were incubated with the pretinning agent, washed, then incubated with pertechnetate and washed again. With GA, WBCs were incubated with pertechnetate and GA together, then washed once. 4-10 mCi labelled WBCs were reinjected into volunteers and the clearance of the cells through the lungs was determined.

	PPI	GH	GA
preparation time (hr)	2.5	2.5	2.0
labelling efficiency (%)	22 + 11	48 + 13	40 + 10
lung half-time (min)	47-108	57-61	20-24

The labelling efficiency with PPI increased at lower pH but cell viability was impaired as indicated by loss of dye exclusion capability.

pH of Sn:PPI	6.8	6.5	6.0	5.1	2.5
labelling efficiency (%)	22	30	61	70	88

WBCs labelled with GA showed the best lung clearance (approaching the 7-21 min of In-111 oxine), along with moderate labelling efficiency, shortest preparation time, and greatest in vivo stability. Activity was seen in liver, spleen, and bone marrow, as well as colon at later times.

No. 1039

PHARMOKINETICS OF HIGH ACTIVITY I-131 T-101 MONOCLONAL ANTIBODY. J.M. Kazikiewicz, A.M. Zimmer, D. Robinson, R.E. Goldman-Leiken, S.T. Rosen, and S.M. Spies. Department of Nuclear Medicine, Department of Medicine and the Cancer Center, Northwestern University Medical Center and Veterans Administration Hospital Lakeside, Chicago, Illinois.

Currently, our laboratory has treated 7 patients and retreated 3 patients with cutaneous T-cell lymphoma using 100-200mCi I-131 T-101. Plasma clearance studies and radioactive component analysis of plasma and urine samples were performed. Blood samples were collected up to 7 days following antibody infusion. Urine was collected daily up to 6 days post infusion. Aliquots of plasma and urine were counted for radioactivity in a multichannel analyzer. Clearance and excretion curves were generated and T1/2 calculated. Plasma samples were analyzed using size exclusion high pressure liquid chromatography (HPLC), while urine samples were analyzed using HPLC, gel exclusion and anion exchange chromatography. Diagnostic plasma activity for 5 of 6 patients showed biexponential clearances with an initial T1/2 from 0.9 to 1.5 hours and a prolonged T1/2 from 14.8 to 25.0 hours. Therapeutic plasma activity for 5 of 6 patients showed monoexponential clearances with a T1/2 from 11.6 to 24.6 hours. Urinary excretion T1/2 was 2.3 + 0.9 days. Analysis of plasma showed predominant activity associated with intact I-131 T-101 (greater than 80% up to 40 hours post infusion). Urine activity was associated with uncomplexed "free" I-131.

No. 1040

QUANTITATION OF RELATIVE HEPATIC TUMOR PERFUSION AND EPINEPHRINE INDUCED ALTERATIONS. S.L. Warber, J.E. Juni, S. Walker-Andrews, J. Andrews, W. Ensminger. University of Michigan Medical Center, Ann Arbor, MI

Hepatic artery perfusion studies (HAPS) performed with Tc-MAA can demonstrate the relative tumor/non-tumor perfusion (T/NT) advantage of intra-arterial (IA) infusion of therapeutic agents. Angiographic experience suggests that epinephrine's (EPI) selective vasoconstrictive effects could increase T/NT. To test this theory we performed serial tomographic HAPS with concurrent infusion of escalating doses of EPI (0-10 mg/min) on 13 pts with liver metastases. The sequential studies were done at least 48 hrs apart. Transverse, sagittal, and coronal slices which intersected within the selected tumor area were chosen. ROI's were selected and T/NT ratios were calculated for each slice and then averaged to find the

reported T/NT ratio. Lung shunts were calculated and planar films assessed for extra-hepatic perfusion.

All pts had a baseline T/NT perfusion advantage (range 1.7-18.7, ave 4.8). Six pts had significantly improved T/NT perfusion with EPI at 9 lesions (T/NT: 1.8-30x baseline, avg 12x, p=0.018). 3/6 pts had extra-hepatic perfusion to stomach, spleen or small bowel and 2/6 had increased lung shunts. The remaining 7 pts had no improvement of T/NT with the doses of EPI used.

Our study corroborates those which show a local T/NT advantage with IA infusion to the liver. Additionally we have shown that the beneficial local effects of EPI infusion vary greatly between individuals and that shifting extrahepatic perfusion patterns may be a limiting factor. Quantitative EPI-HAPS can help identify those pts who may benefit therapeutically from dramatically increased T/NT ratios.

THURSDAY, JUNE 4, 1987

**SCIENTIFIC PAPERS V:
TRACK A, Cardiovascular**

10:30-12:00

Room 202B

*Moderator: Vincent V. Chericco, CNMT
Comoderator: Becky M. Cacciato, CNMT*

No. 1041

TECHNICAL ASPECTS OF EJECTION FRACTION QUANTITATION USING GATED SINGLE PHOTON EMISSION COMPUTED TOMOGRAPHY. K.L. Rowell, J.W. Scott, A. Peretz*. VETERANS ADMINISTRATIVE MEDICAL CENTER, BIRMINGHAM, ALABAMA. *ELSCINT INC., BREA, CALIFORNIA.

Gated Single Photon Emission Computed Tomography, (GSPECT) is a new tool used to evaluate cardiac function. GSPECT acquisitions accumulate large data volumes that require long time periods for processing. We have developed a technique which requires minimal processing time and calculates both the left and right global ventricular ejection fractions.

Our GSPECT acquisitions were performed as follows: a 180 degree rotation of 6 degree increments with 16 frames per cardiac cycle. The data was normalized, time corrected and reconstructed into thick, long axis horizontal slices. The slices containing ventricular activity were combined to form a group of ventricular slices which represent the cardiac cycle. From this group, global ejection fractions were quantitated using a second derivative technique.

We tested our procedure with data attained from 10 patients who underwent a radionuclide ventriculogram, GSPECT, and when possible a first pass study. The results showed good correlation:

(L)GSPECT vs (L)Planar -- $y = 0.95x + 0.78$, $r = 0.97$;
(R)GSPECT vs (R)Planar -- $y = 0.69x + 11.3$, $r = 0.88$;
(R)GSPECT vs (R)F.P. -- $y = 0.94x + (-4.3)$, $r = 0.82$.

We conclude that GSPECT can be used to accurately quantitate left and right ventricular ejection fractions in a reasonable clinical time period.

No. 1042

STRESS/REST MYOCARDIAL PERFUSION IMAGING WITH Tc-99m-ISONITRILE (RP-30) FOR DIAGNOSIS OF ISCHEMIC HEART DISEASE. J.A. Mattera, M.A. Saari, D.J. Errico, E. Levine, L. Pytlik. Yale-New Haven Hospital, New Haven, CT.

To evaluate Tc-99m-RP-30 for the detection of ischemic

heart disease, 8 patients underwent stress and rest myocardial imaging with Tc-99m Isonitrite (RP-30) within 2 weeks of a stress Tl-201 study. All patients were exercised to the same level (HR and BP) with no change in condition or therapy between the tests. RP-30 imaging was done 60 min. post injection of a 20 mCi dose injected at peak exercise. LAO, LAT, and ANT static images were obtained for 5 min. each. The lack of redistribution of RP-30 into ischemic zones over time requires a repeat study be done at a rest the following day. Tl-201 imaging was done using the same camera, a 2.5 mCi dose, and 8 min. images.

Because of the higher count density and more favorable energy of Tc-99m, the quality of the RP-30 images was superior. RP-30 studies had 300-400K total cardiac counts per 5 min. Post exercise RP-30 studies average heart/lung and heart/liver ratios were 2.6 and 1.7 respectively. Post exercise Tl-201 images heart/lung and heart/liver ratios were 2.2 and 1.8 respectively. Interpretation of the RP-30 images was similar to Tl-201 demonstrating infarction and ischemic tissue. Because of the high heart retention of RP-30 over time, scheduling is more flexible (1-3 hrs. post injection) and alleviates the need for a treadmill nearby. This also allows for multiple types of imaging i.e. planar, tomographic and gated. One disadvantage is that stress and rest studies must be done by separate injections.

No. 1043

COMPARISON OF SUPINE AND UPRIGHT THALLIUM-201 IMAGES. W.A. Marshall, D. Jansons, A.F. Jacobson, J.A. Parker, H.D. Royal, G.M. Kolodny. Beth Israel Hospital, Boston, Mass.

Because of the low energy of Thallium-201 (80 KeV), the distribution of activity is easily affected by positional artifacts such as breast tissue, the diaphragm or overlying arms. These artifacts often cause difficulty in assessing the distribution of activity of the inferior wall in the anterior view. The purpose of the present study was to determine if an upright anterior would help to differentiate artifacts from defects which were seen in the supine anterior view. Four images were taken in the following order: 40 LAO, the 70 LAO, and the upright anterior. This format was followed for 30 consecutive patients and the images divided into two sets of pictures for each patient. The first set contained the 40 LAO, the 70 LAO and the supine anterior. The second set contained the 40 LAO, the 70 LAO and the upright anterior. Each set was given a random number and all were read independantly by three physicians.

The results indicate that all three readers reported less defects in the inferior wall when the upright anterior view was read. Seventy-five percent of the inferior wall defects read as possibly abnormal on the supine view were read as normal on the upright view. Use of the upright position for anterior views of the heart in Tl-201 imaging reduces the reporting of inferior wall defects.

No. 1044

TECHNOLOGIST INVOLVEMENT IN OBTAINING ACCURATE AND REPRODUCIBLE ATTENUATION-CORRECTED RADIONUCLIDE LEFT VENTRICULAR VOLUMES. S.A. Squicciarini and M.R. Starling, Department of Internal Medicine, University of Michigan and VA Medical Center, Ann Arbor, Michigan.

Accurate radionuclide angiographic (RNA) left ventricular (LV) volumes are necessary to evaluate LV contractility. A trained technologist can play an important role in obtaining LV volumes through the use of a simple geometric method to correct for attenuation. To determine the accuracy and reproducibility of this method, we studied 8 patients using LV biplane contrast cineangiography (CINE) and RNA on two separate occasions, one si-

multaneous with (Day 1) and one within 48 hours of (Day 2) CINE. To obtain an attenuation correction factor (A) for RNA LV volumes, the distance from the gamma scintillation camera to the LV center of mass (d') was determined by the technologist using anatomic landmarks in the LAO and anterior projections on Day 1 and Day 2. LV end-diastolic (ED) and end-systolic (ES) volumes were calculated using hand-drawn, background subtracted regions-of-interest, plasma blood sample counts, and A. The d' values on Day 1 and Day 2 correlated ($r=0.96$) as did the values for A ($r=0.95$). The mean CINE LVED volume was 327 ± 214 ml, while the average RNA LVED volumes were 280 ± 250 ml on Day 1 and 275 ± 230 ml on Day 2 ($p=NS$). The mean CINE LVES volume was 184 ± 212 ml, while the average RNA LVES volumes were 152 ± 193 ml on Day 1 and 154 ± 167 ml on Day 2 ($p=NS$). We conclude that a trained technologist can reproducibly obtain distances to the LV center of mass for attenuation correction using anatomic landmarks that yield RNA LV volumes which do not differ significantly from those obtained by biplane CINE.

No. 1045

"CHEMICAL STRESS TESTING": USE OF DIPYRIDAMOLE INSTEAD OF EXERCISE FOR Tl-201 MYOCARDIAL IMAGING. J Jones, D Dunn, W Carlson, S Moriarty, D Shonkoff, HA Liberman, AL Churchwell, RE Patterson, Carlyle Fraser Heart Ctr/Crawford Long Hosp of Emory U; Dpt of Medicine (Cardiology), EUSM, Atlanta, GA

IV dipyridamole is being used to increase coronary blood flow for Tl-201 imaging in patients (pts) who are unable to be stressed adequately on a treadmill. Indications for dipyridamole instead of exercise imaging include 1) pt inability to exercise due to physical problems such as arthritis or peripheral vascular disease, 2) pts with severe lung disease, and 3) pts who fail to achieve 85% maximum predicted heart rate during exercise due to lack of motivation, beta blockers or other factors. Still investigational when infused IV, dipyridamole is a coronary vasodilator which increases flow near maximally in myocardium supplied by normal coronary arteries. Stenotic arteries cannot dilate as much as normal arteries, creating a lower blood flow and decreased Tl-201 uptake. This "chemical stress test" mimics the effect of strenuous exercise on coronary blood flow. The pt is positioned supine on the imaging table. Using a special infusion pump, the dipyridamole is infused at a rate of 0.142 mg/kg/min for 5 min (total dose = 0.710 mg/kg). A physician monitors a 12 lead ECG during the infusion, and blood pressures (BP) and heart rates (HR) are recorded every minute for at least 7 min. At 6 min into the test, the pt sits up to decrease blood flow and Tl-201 uptake by abdominal viscera. After the infusion is stopped the Tl-201 is injected following the 7 min HR and BP check. Images are obtained 5 min and 3-4 hours after Tl-201 injection. Possible side effects of dipyridamole may include headache, nausea and/or dizziness, severe hypotension or angina. Aminophylline, which can antagonize the effects of dipyridamole, is available for use IV to relieve angina or hypotension. In conclusion, dipyridamole provides an alternative to exercise for noninvasive assessment of myocardial perfusion by Tl-201 imaging.

**SCIENTIFIC PAPERS VI:
TRACK A, Computers & Data Analysis**

10:30-12:00

Room 202D

*Moderator: Paul D. Cole, CNMT
Comoderator: Mark H. Crosthwaite, CNMT*

No. 1046

USING A GENERAL-PURPOSE IMAGE PROCESSING WORKSTATION IN NUCLEAR CARDIOLOGY. MJ Tamas, J Oates, RL Eisner, RE Patterson, Carlyle Fraser Heart Ctr/Crawford Long Hosp of Emory U; Dpts of Medicine (Cardiology) & Radiology, EUSM, Atlanta, GA; Digital Design, Inc., Norcross, GA.

The Digital Design Crystal is a general-purpose image

processing workstation operating under the UNIX operating system. Its central processor is a Motorola 68000 running at 12.5MHz. Six terminals are attached to the system, permitting concurrent image acquisition, algorithm development, image processing, and numerical modeling. This versatility is not often found in nuclear medicine workstations.

Multiple data storage devices are used, including hard disk, floppy disk, tape, and optical disk drives. Images, data, and programs from other imaging or computer systems can be transferred on compatible media to the Crystal for processing. Data transfer can also be accomplished through DMA, Ethernet, or modem. Technical support for the system is available via modem.

There are 16 MB of RAM installed on the system, divided into 2 MB for UNIX and programs, 3 MB for display buffers, 8 MB for images, and 3 MB for registers and tables. UNIX occupies about 200 KB. Image memory is conveniently reconfigurable from 64×64 to 512×512 . Operator defined 3×3 convolutions on a 512×512 image take 0.033 sec. Image memory is mapped so that it is addressable by languages such as C, FORTRAN, and Pascal.

Each 16-bit pixel consists of 12 data bits and 4 graphics bits. Graphics can be configured as 4 independent planes, or as one plane in 16 colors. Up to 16 regions of interest can be simultaneously displayed and used with quantitation programs.

The Crystal permits multimodality processing and display of cardiac imaging studies. The size and addressability of the image memory facilitates rapid image processing.

No. 1047

COMBINED SCINTIGRAPHIC MEASUREMENT OF TOTAL HEPATIC BLOOD FLOW, PORTAL VEIN FLOW AND HEPATOCYTE FUNCTION - CLINICAL APPLICATION IN LIVER TRANSPLANTATION. S. Pitt, J.E. Juni, R. Reichle, S.L. Warber, R. Merion, D. Campbell. University of Michigan Medical Center, Ann Arbor, MI.

Total hepatic blood flow (THBF), portal vein blood flow (PVBF), and hepatocyte function (HFX) are all known to be altered in liver disease. We have developed a technique which permits assessment of these parameters in a single 50 min imaging procedure and have tested this procedure in 7 liver transplant pts studied serially for a total of 27 studies. THBF is measured by obtaining 15 sequential 1-min images of the heart and liver with injection of 1 mCi Tc-sulfur-collloid (TcSC). The rate of clearance from the blood represents the fraction of total blood volume passing through the liver/min. As this measurement also reflects liver uptake of collloid, the TcSC extraction efficiency (XE) for each pt is calculated by deconvolutional analysis (DCA) with commercially available software. This is followed by 2 mins of 1 sec images of the chest and liver using 10 mCi of Tc-DTPA. DCA of these images has been demonstrated by our group to accurately reflect PVBF as a % of THBF. Finally, a 32 min 15 mCi Tc-Disofenin scan with 1 min dynamic images is acquired to measure hepatocyte XE as previously validated by our group. Images are also inspected visually. All studies can be successfully completed in a single session. Liver rejection is accompanied by a reduction in THBF and PVBF acutely, followed by a fall in HFX. Serial changes in HFX reflect, and appear to precede, changes in bilirubin, bile volume, and clinical status.

This combined study permits quantitation of multiple parameters of liver function and is practical in the clinical setting.

No. 1048

COMPUTER SUBTRACTION OF VENTILATION/PERFUSION LUNG SCANNING WITH TECHNETIUM-99m DTPA AEROSOLS. J.A. Ward, N.S. Newlin, M.S. Gross and S.A. Updike. Herrick Memorial Hospital, Tecumseh, MI.

A problem associated with Ventilation/Perfusion scanning with Tc-99m DTPA aerosols has been the inability to do dual isotope subtraction. Some institutions ventilate with a very small amount of DTPA followed by a perfusion with 4 mci of MAA. Our institution has developed a way

to perfuse first and then use computer subtraction to show true ventilation.

After intravenous injection with 2 mCi MAA, six static scans are acquired using a GE maxi 400AT camera with a Star computer. A physician reviews these images to check for perfusion defects. If no defects are seen the exam is terminated. If defects are present, the patient is securely taped to the camera in the position showing these areas best. A two minute scan is taken immediately. The patient then inhales the aerosol until the count rate is doubled. Another two minute scan is taken immediately post inhalation. Subtraction of the perfusion from the ventilation/perfusion scan shows true ventilation. The perfusion scan is then subtracted from the true ventilation. The remaining areas are those which ventilated but did not perfuse. Care must be taken in interpretation of these scans to assure that there was no movement during acquisition. Advantages are the ability to perfuse first and a better estimation of the amount of DTPA inhaled. Five additional views are obtained for further aid in scan interpretation.

We have used this method for over one year. Several outside nuclear physicians agree that it is of value in determining the presence of pulmonary embolism obviating the use of Xenon.

No. 1049

IMPROVED CR-51 RBC LABELED SPLEEN SEQUESTRATION ANALYSIS. F.P. Dawry, S.P. Rothenberg, L. Biermann, M.L. Maayan. V.A. Medical Center, Brooklyn, N.Y. 11209.

In the evaluation of hemolytic anemia (HA), it is helpful to determine whether the spleen(S) is the primary site for the destruction of the red blood cells (RBC). The traditional method of measuring splenic sequestration of RBCs is subject to a number of inaccuracies. Chromium-51 (CR), used to label the RBCs has a low gamma emission, counting probe placement is subject to much variation and only a fraction of the S and liver (L) is evaluated.

These problems are circumvented through use of a LFOV gamma camera and a dedicated computer to store the images of S and L following the injection of 0.5 mCi, Tc-99m sulfur colloid (SC). Without patient repositioning, a second acquisition is made of the CR-51 at its 320 Kev setting. This sequence is repeated over the study period with reinjection of Tc-99m SC only as often as necessary to obtain a computer image reflecting the correct positioning of S and L.

Normalized S/L ratios were determined by the CR-51 counts on the regions delineated by the Tc-99m images corrected for daily variation in patient positioning. The S/L ratio obtained by the described computer assisted analysis has the advantage over the previously used methodology of being more accurate in localizing the organ of interest, and hence in evaluating the true RBC sequestering potential.

Fourteen patients suspected of HA of which four underwent splenectomy, have been studied by this method. Controls had a final S/L ratio of <2.5 while subjects with HA had >2.5. The accuracy of this method recommends it for evaluation of S activity in HA suspected cases.

No. 1050

"STATISTICAL SUBTRACTION": AN ALTERNATIVE APPROACH TO DUAL-ISOTOPE IMAGE SUBTRACTION. S. Spaulding, G. Brown, J.E. Juni. University of Michigan Medical Center, Ann Arbor, MI.

The sensitivity and specificity of many scintigraphic procedures is enhanced by the use of dual-isotope image subtraction. By subtracting the non-specific distribution of one radiotracer from that of another "specific" tracer, the regions of target tissue uptake unique to the tracer of interest are enhanced. In this manner, non-specific distribution may be removed or reduced prior to image interpretation. As an alternative to the stan-

dard subtraction approach, we have developed a processing protocol based on the statistical differences between two images rather than simply the absolute difference in counts.

Allowing for the known Poisson distribution of counting noise, a pixel by pixel examination of a dual-isotope image pair is performed to determine the statistical probability that the images are actually different at any given point. The relative count distribution in a reference region in each image is used to determine the expected ratio between the images in the absence of noise. The resulting image, rather than being a simple subtraction, represents the likelihood of a significant difference in content in the images under consideration, allowing for changes in both absolute count density and regional changes across the images.

We have found that image processing by this "statistical subtraction" technique consistently have greater consistency and provide a more impressive assessment of the differences between specific and non-specific uptake in neighboring organs. We expect this technique to prove useful in the performance of dual-isotope imaging.

**SCIENTIFIC PAPERS V:
TRACK B, Neurology**

1:30-3:00

Room 202B

*Moderator: Paul D. Cole, CNMT
Comoderator: Kathryn N. Wilkins, RT(N)*

No. 1051

RESPONSE OF THE VISUAL CORTEX WITH I-123 HIPDM: EYES OPEN VS EYES CLOSED AT TIME OF INJECTION. J.D. Krephaw, C.R. Appledorn, H.N. Wellman, B.M. Mock, R. Tangerman. Indiana University Medical Center, Indianapolis, IN.

To determine the effect of environmental stimuli upon the uptake of I-123 HIPDM within the brain, we examined regional cerebral uptake levels depending upon eyes open (EO)/eyes closed (EC) at the time of tracer injection. Five clinically normal subjects, providing informed consent, were examined twice (EO and EC). For the EC study, the subjects were blindfolded five minutes prior to injection and remained so throughout the SPECT acquisition. The EO study was performed in an identical manner, without the blindfold. Fourteen days separated the two studies in each subject.

Injected doses were similar (5.2 - 5.4 mCi). Data acquisition was performed 25 minutes post-injection using a dual detector SPECT system. Data were collected at 15 sec/image, 120 images/360 degrees, times two detectors. Approximately 5.5 million counts/study were collected. Twelve mm transaxial slices (6 mm overlap) were reconstructed parallel to the O.M. line and study slices (EO and EC) were registered. Circumferential profiles at the level of the visual cortex were generated and EO and EC curves were compared for five regions: L & R frontal, L & R parietal, and occipital.

We observed a dramatic increase in relative activity in the occipital region for EO compared to EC. This increase was not observed in the other regions. The best homogeneous distribution of the tracer was obtained for EC. We conclude that environmental (visual) stimuli do influence HIPDM tracer uptake and efforts should be made to control them.

No. 1052

BRAIN STRUCTURE LOCALIZATION: A COMPARISON OF PET, MRI AND THE STEREOTACTIC METHOD. K. Stafford-Schuck, R. Koeppel, J.M. Mountz. University of Michigan Medical

Center, Ann Arbor, MI.

Positron emission tomography (PET) depicts functional images of the brain. These images have no definite structural definition and presently require anatomic correlation by other localization methods. Currently used structural localization methods include identification directly from the PET image, magnetic resonance imaging (MRI) correlation, and the stereotactic method. Comparison between these methods was performed by localizing visually identifiable structures on PET images and comparing pixel coordinates to those obtained from MRI and stereotactic methods. We identified 65 separate regions in 5 patients consisting of 13 identical regions per patient. The regions include brain stem, bilateral head of caudate nuclei, brain edges at level of caudate nuclei, thalami, brain edges at level of thalami, genua of internal capsule and carotid arteries. The center of each structure was localized on PET images by two independent observers and agreement was within ± 2 pixels in each case. MRI localization was performed by the two independent observers blind to the PET image. Stereotactic coordinates were chosen from a standard atlas (Talairach). When comparing MRI localization to PET structure location, X, Y, and Z values ranged from 2 ± 1 pixel. Similar accuracy was found in X and Z coordinates by comparing the stereotactic method of localization with PET, however, a wide variation in Y coordinate values was observed. In conclusion, with careful slice and head alignment, the MRI method of structure localization agrees with PET better than the stereotactic method.

No. 1053

MEASUREMENT OF ANXIETY IN STUDIES WITH POSITRON EMISSION TOMOGRAPHY. A. Betley, J. Rothley, R. Parks, S. Berent, R.D. Hichwa. University of Michigan Medical Center, Ann Arbor, MI.

Numerous studies have shown that anxiety is a variable condition that can have profound effects on measures of human physiology. With regard to positron emission tomography (PET) specifically, some of these effects have already been demonstrated. It seems clear that anxiety represents an important individual difference variable, and that the effects of this variable need to be understood in the interpretation of PET.

To further our understanding in this area, we sought to operationally define anxiety through the use of a standardized psychometric examination, and Spielberger's self-report approach to the measurement of anxiety. Measures of state and trait anxiety were obtained from subjects undergoing PET studies. These measures were

taken in the morning of the day of the scan and at the end of the day following completion of all procedures. A third measurement was obtained four days after the PET, scans and was completed by the subject at home.

In addition to the Spielberger scales, subjects received interventions that were designed to minimize their apprehensiveness in the PET situation. Some of the subjects heard a standard verbal explanation of what to expect during the day. A second group was given the same verbal explanation and pamphlet written by the PET Facility staff. Finally, a third group received the pamphlet, verbal explanation, and viewed a prepared video tape.

This presentation contrasts the findings from the Spielberger measures for the various treatment groups. The study suggests that anxiety is minimized through patient education.

No. 1054

HEAD-HOLDING SYSTEM FOR REPRODUCIBLE POSITION ALIGNMENT IN POSITRON EMISSION TOMOGRAPHY STUDIES (P.E.T.). A. Betley, P. Mukhi, J. Rothley, R.D. Hichwa. University of Michigan Medical Center, Ann Arbor, MI.

For temporal studies that involve PET, it is essential to obtain identical tomographic slice data. To accomplish this, a head-holding system was developed with the following characteristics: maximization of patient comfort, accurate positioning of patient's head, replication for temporal studies, accommodation for different imaging modalities, and minimization of attenuation.

The system included a lucite head-holder and a heat activated moldable mask. A 60°C water bath was used to heat the mask for 2 minutes. After the patient was accurately aligned, the heated mask was placed and formed on the patient's face within 6 minutes. The materials of the head-holder allowed for its compatibility with other imaging modalities, such as the MRI or CT. It has been found that a perforated mask, having holes of 3 mm and separation of 1 cm allows for quick hardening (within 4 minutes) and reduces the amount of heat to the patient's face than a non-perforated mask. To adjust the position of the patient's head and neck from the base of the skull to the third vertebrae, gauged knobs are used to allow for 3 degrees of freedom, each having a movement of $\pm 1^\circ$. These knob settings are recorded for the purpose of reproducibility at a later time. To insure a perfect patient head alignment, the head-holding system contains alignment pins for the reusable mask. In addition, the face of the patient as well as the perforated mask are marked and aligned to the canthomeatal line with a multi-dimensional laser system. These techniques produce accurate repositioning coordinates for the realignment of the patient.

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Continuing Education

MONDAY

EDUCATOR'S WORKSHOP PLANNING FOR INSTRUCTIONAL PRESENTATIONS

8:30-3:30 VOICE .7 Room 101

Goal:

Using the information presented, the participants will be able to follow the steps of a systematic process for developing instructional plans and/or revising existing ones.

Outline:

1. Conducting a preplanning assessment.
2. Writing objectives.
3. Researching and organizing content.
4. Selecting support materials/activities.
5. Writing lesson plans.
6. Making final preparation.
7. Performing self-evaluation and revisions.

Moderator:

Elaine Markon, M.S., CNMT, Program Director, Nuclear Medicine Technology Program, Findlay College, Findlay, OH

Faculty:

James B. Lockwood, M.A., CNMT; Charlene F. Rencher, M.S., CNMT

TUESDAY

RADIOPHARMACY/RADIATION SAFETY

10:30-5:00 VOICE .6 Room 203D

Goal:

To provide the nuclear medicine technologist updates on the currently accepted practices of radiation safety in the laboratory, and new applications of diagnostic radiopharmaceuticals.

Outline:

1. ALARA standards applied in the research laboratory.
2. Discussion on current concepts and practices when dealing with the pregnant radiation worker.
3. A review of the practice of radiopharmacy and the use of radiopharmaceuticals.
4. Introduction to new uses of radiopharmaceuticals.

Moderators:

Raymond E. Exten, CNMT, Abington Hospital, Abington, PA
Louis H. Emond, CNMT, NE Deaconess Hospital, Boston, MA

Faculty:

Louis M. Izzo, CNMT; Anthony R. Benedetto, Ph.D.; Clare Jennings, CNMT; Michael Cianci, CNMT; Patrick W. Gallagher, Ph.D.; Michael Noska, Ph.D.

STUDENT DAY

HOT TIPS ON RESUME WRITING AND JOB INTERVIEWS

12:00-1:30 VOICE .2 Room 201F

Goal:

Information presented will assist the student in choosing the appropriate format for selling him- or herself to prospective employers through the written resume and personal interviews.

Session Leader:

Elpida S. Curtis, M.S., CNMT, Program Director, Nuclear Medicine Technology, Veterans Administration Medical Center, Buffalo, NY

WEDNESDAY

MANAGER'S DAY

8:30-12:00 VOICE .4 Room 203D

Goal:

To enhance the knowledge and competence of those who are currently department managers, and to establish the ground work for those who aspire to become department managers.

Outline:

1. Justification of FTEs and analysis of productivity.
2. Important things to remember when preparing a department operating and capital budget.
3. What to expect from JCAH reviewers in 1987.
4. Discussion of revisions of 10CFR35.

Moderators:

Jacqueline A. Bridges, CNMT, Baptist Memorial Hospital, Memphis, TN
Shelley D. Hartnett, CNMT, Swedish Hospital Medical Center, Seattle, WA

Faculty:

Dorothy Duffy Price, CNMT; Susan C. Weiss, CNMT; George Alexander, CNMT; Norman McElroy

WHO, WHAT, WHERE, WHEN, AND HOW OF MULTICOMPETENCY: PANEL DISCUSSION

9:00-12:00 VOICE .3 Room 101

Goal:

There is a movement toward the utilization of the multiskilled health worker. The panel participants will describe their perceptions of the multiskilled training programs, share their personal experiences, and predict the future of the multiskilled health worker.

Moderators:

James J. Wirrell, M.S., CNMT, Methodist Hospital, Indianapolis, IN
 Bradley K. Pounds, CNMT, St. Luke's Episcopal Hospital, Houston, TX

Faculty:

Loretta L. Hanwell, RT(R); Robert E. O'Mara, M.D.; Diana Schatz, Ph.D.; Donna L. Thaler, RT(R); James J. Wirrell, M.S., CNMT

**EDUCATOR'S FORUM
 STUDENT RECRUITMENT—WHAT
 WORKS AND WHAT DOESN'T**

3:00-4:30 **VOICE .2** **Room 203D**

Goal:

The forum is organized to allow an exchange of information, brainstorming, and participant interaction toward developing a broad range of ideas that can be used in student recruitment.

Moderators:

Charlene F. Rencher, M.S., CNMT, Department of Nuclear Medicine, St. John Hospital, Detroit, MI
 Elaine Markon, M.S., CNMT, Program Director, Nuclear Medicine Technology Program, Findlay College, Findlay, OH
 Elpida S. Curtis, M.S., CNMT, Nuclear Medicine Department, Veterans Administration Medical Center, Buffalo, NY

THURSDAY

**NMTCB: ITEM WRITER'S WORKSHOP
 AND OPEN FORUM**

8:30-12:00 **VOICE .3** **Room 202D**

Goal:

This workshop is designed to teach the principles and conventions of multiple-choice item writing and to train persons wishing to

participate in the NMTCB exam process to become proficient in item writing. This workshop should be of general interest since it will provide insight into NMTCB examination development, methodology, and philosophy.

Moderators:

Ann M. Steves, M.S., CNMT, Chairman, NMTCB Exam Committee, Emory University, Atlanta, GA
 Marcia R. Boyd, M.S., CNMT, Co-Chairman, NMTCB Exam Committee, Baptist Memorial Hospital, Memphis, TN
 Helen H. Drew, CNMT, Chairman, NMTCB Task Analysis Committee, Johns Hopkins Hospital, Baltimore, MD

SPECT/CLINICAL IMAGING

8:30-4:00 **VOICE .6** **Room 101**

Goal:

To provide technologists with inside information and share the previous experiences of others to help establish SPECT as a clinical imaging service. Introduction to new state-of-the-art specialty imaging procedures.

Outline:

1. How, when, and what to expect with quality control of SPECT systems.
2. Explanation of filter functions and what works best for specific scan types.
3. Review of what procedures are accepted for routine SPECT imaging and how this will impact the way your department operates.
4. Introduction to specialty imaging procedures.

Moderators:

John J. Reilley, CNMT, West Park Hospital, Philadelphia, PA
 Robert J. English, CNMT, Brigham and Women's Hospital, Boston, MA

Faculty:

Robert E. Zimmerman, CNMT; Robert J. English, CNMT; Charles E. McCarthy, CNMT; Allen E. Beranek, CNMT; Michael W. Plankey, CNMT; John F. Rockett, M.D.

Scientific Exhibits

All Scientific Exhibits to be presented are listed on the following pages in alphabetical order by category and first author. The number above each title refers to the exhibit location.

Scientific Exhibit Hours

Tuesday	10:00 am- 7:00 pm
Wednesday	7:00 am- 7:00 pm
Thursday	7:00 am-12:30 pm

BONE/JOINT

Posterboard No. 987

COMPARISON OF CT AND SPECT IN ASSESSING LUMBAR PAIN.
K.A. Beck. St. Luke's Hospital, Milwaukee, WI.

A retrospective study was done to compare the findings of Computerized Tomography and Tc-99m MDP bone scan with SPECT imaging of the lumbar spine. The thirty-nine cases used were patients who came in complaining of low back pain and who had also undergone both a Single Photon Emission Computed Tomography and a CT scan, without contrast, of the same area. Of these, 64% of the cases correlated. Of those that correlated 52% were positives, with abnormalities found in both modalities, and 12% negative. Thirty-two percent of the patients were found to have tested positive by use of CT only and 4% by SPECT only. In this case, the results show that CT is more sensitive than SPECT in the evaluation of low back pain.

CARDIOVASCULAR

Posterboard No. 988

ARTIFACTUAL DEFECTS IN THALLIUM POLAR COORDINATE PLOTS. E.J. Ladwig, W.H. Moore, B.K. Pounds, M.J. Blust, R.D. Dhekne, S.E. Long. St. Luke's Episcopal Hospital and Baylor College of Medicine, Houston.

Polar coordinate mapping of stress and redistribution SPECT thallium images at our institution has provided increased sensitivity and specificity for the identification of ischemic coronary disease compared to planar imaging. However, due to the highly processed nature of the resultant images the identification of artifactually produced defects can be difficult. Errors in data processing can be observer induced (such as improper short axis slice determination) or related to the performance of the imaging system used for acquisitions (incorrect center of rotation value, field of view non-uniformities). A third consideration is the anatomical variation of the patients imaged. Even with the use of a sex matched normal file, artifacts can be seen due to mastectomies, obesity, or thallium concentration outside the myocardium. We will

display several examples of documented artifactual abnormalities and the corresponding effects on the thallium "Bullseye" plot.

Posterboard No. 989

COMPARISON OF ELLIPTICAL VS. CIRCULAR ACQUISITION IN CARDIAC THALLIUM-201 IMAGING. P. Pederson. St. Luke's Hospital, Milwaukee, WI

In an attempt to determine the mode of acquisition that best displays tomographic slices of the heart, elliptical and circular acquisitions were accessed. Cardiac phantom (Model 7070) was used to simulate the left ventricle of the heart. Approximately 150 uCi of Thallium-201 was inserted into the phantom chamber. The chamber was then mounted within the Data Spectrum's SPECT Phantom Cylinder. Water was used to fill the cylinder in order to represent chest attenuation. Eight different defect arrangements were then setup and acquired on the GE 400 AC Camera. Circular acquisitions were immediately followed by elliptical acquisitions of the same defect. Acquired files were smoothed and filtered, reconstructed, obliqued and photographed. Two radiologists specializing in Nuclear Medicine viewed the photographs basing their evaluations on the clarity of the implanted defect. Although elliptical acquisitions generally yield more accurate representations of the myocardium, the results indicated no preference for them. In fact, the views acquired by circular means were preferred in four of the eight cases. It was also found that the elliptical acquisition required an additional 10 minutes for the setup of the Gamma Camera. Since the optimal time for the acquisition is recognized as 15 minutes after peak stress, the extra time required is a disadvantage to the study. The findings indicated that circular acquisition is the preferred mode for cardiac Thallium-201 imaging.

COMPUTERS AND DATA ANALYSIS

Posterboard No. 990

USE OF FOREGROUND/BACKGROUND FOR CARDIAC GATED STUDIES IN A CLINICAL ENVIRONMENT. C.M. Bauman. St. Luke's Hospital, Milwaukee, WI.

Infield company testing of a new software program designed by Computer Design & Applications, Inc. assures that simultaneous use of acquisition and

processing protocols for cardiac gated studies can be achieved. The software was tested on Siemens Microdelta Plus at various heart rates, which ranged from 53 bpm - 144 bpm using the Amersham - Vanderbilt Cardiac Phantom AP 201, for its possible use in clinical exercise testing as well as during rest studies. The data from the images acquired on a GE 400 AC Maxi Camera then allowed for the calculation of the ejection fractions, end systolic frames, end diastolic frames, number of accepted frames per study, and the heart rates. The results from this testing prove that acquiring at one heart rate in the background and processing at another heart rate in the foreground, or vice versa, can be attained. This software is a Beta test evaluation for clinical validity.

Posterboard No. 991

AUTOMATION OF ESOPHAGEAL SCINTIGRAPHY. Feldkamp MJ, Preston DF, Robinson RG, Allen MA, Rhodes JB. University of Kansas Medical Center, Kansas City, Kansas

Our purpose is to demonstrate a semi-automated method of esophageal scintigraphy which superimposes the esophageal clearance data from the patient and the abnormal and normal patient groups established by Malmud and Fisher (Seminars in Nuclear Medicine XII, 104-115, 1982).

Following overnight fast, the patient is placed supine under a standard field of view GE mobile Model 300a gamma camera equipped with Starcam Computer using a low energy diverging collimator. Tc-99m-sulfur colloid (300 uCi) diluted in 15 ml of water is ingested through a straw in a single swallow. Initial data is acquired at 1-second/frame for the first 15 seconds (single swallow) followed by 15-seconds/frame for the next 9 minutes and 45 seconds (multi-swallow). The patient dry swallows every 15 seconds for the entire 10 minutes. All 40 frames are summated and a region of interest is drawn around the esophagus activity. Time activity curves are generated from both the single swallow study and the multi-swallow study. The maximum count (E-Max) is found from each curve. The esophageal clearance formula $Ct = (E-Max - Et)/E-Max \times 100$ is used. Ct is % esophageal transit at time t. Et is esophageal count rate at time t. The Ct curves for single and multi-swallow studies are displayed with the curves generated by data of Malmud and Fisher which define 6 categories: normal, achalasia, diffuse spasm, scleroderma, esophagitis with normal motility and esophagitis with motor disorder. Computer processing takes approximately 10-minutes. This procedure has been accepted by both nuclear medicine physicians and referring gastroenterologists.

Posterboard No. 992

COMPARING CEDARS-SINAI QUANTITATIVE TOMOGRAPHIC THALLIUM-201 ANALYSIS TO SPECT ACQUISITION RESULTS USING MULTIPLE FILTERS. M.G. Morateck. St. Luke's Hospital, Milwaukee, WI.

A comparison was made between Cedars-Sinai Quantitative Tomographic Thallium-201 analysis (CTQ) and SPECT imaging on stress and redistribution myocardial perfusion studies using Siemens Microdelta computer analysis. The CTQ program was tested using the raw SPECT acquisition data from a group of 25 thallium stress test patients. Two sets of data were obtained: first, utilizing CTQ's .2(5) Butterworth filter and second, utilizing a heavy smooth and a high pass filter with a matrix size of nine (HS9). The two data sets were then compared to the physician's reports from the original SPECT acquisition data. The CTQ

protocol using the .2(5) Butterworth correlated 84% with the physician's findings and the CTQ protocol using the HS9 correlated 72%. This software is a Beta test evaluation for clinical validity.

Posterboard No. 993

DEFECT SENSITIVITY OF CEDARS - SINAI COMPUTERIZED THALLIUM QUANTIFICATION. W.A. Nelson. St. Luke's Hospital, Milwaukee, WI.

A quantitative tomographic Thallium-201 program would be an ideal method for the evaluation of patients with suspected or known coronary artery disease. Using the Model 7070 heart phantom and the GE 400 - AC camera, the Cedars - Sinai computerized thallium quantification program was tested. Eight stress and redistribution studies were acquired and incorporated into a 64 x 64 word matrix with 64 views at 15 seconds per view, for 180 degrees. One hundred fifty microcuries of Thallium-201 was injected into the phantom and was uniformly mixed. Of the eight studies, four had small defects located high on the anterior, septal, lateral, and inferior walls. The other four had two defects per study, one medium and one small located opposite each other on the same walls. The data was run through the quantitative program and the results showed the program to pick up three out of four (75%) of the medium size defects and five out of eight (63%) of the small size defects.

This software is Beta test evaluation for clinical validity.

Posterboard No. 994

EVALUATION OF EJECTION FRACTION OF THE LEFT VENTRICLE BY CARDIAC GATED BLOODPOOL SCANNING USING SIEMENS CDA 6.0 VERSION SOFTWARE AND A² MDS PROCESSING PROTOCOLS. B. Petri. St. Luke's Hospital, Milwaukee, WI.

The left ventricle ejection fraction of 10 patients were compared by using the Cardiac Gated Bloodpool processing protocols developed by A² MDS and Siemens 6.0 version software. Nine of these patients were normal with ejection fractions ranging from 43% to 76% and one patient was cardiomyopic with an EF of 11%. The acquired studies were processed with a double smooth and high pass filter on the A² MDS software and a spatial and temporal smoothing on the CDA. An ROI was drawn over the left ventricle of the ES and ED frames and ejection fractions computed by A² MDS and automated Siemens CDA 6.0 softwares. The computed ejection fractions of the Siemens 6.0 software were significantly lower than those of the A² MDS.

Viewbox No. 995

SPECT FILTER SELECTION AND ITS INFLUENCE ON LESION DEMONSTRATION. MC Wright, EL Kramer, JJ Sanger. NYU Medical Center/Bellevue Hospital, New York, NY and GE Medical Systems, Milwaukee, WI

The purpose of this study was to demonstrate the effect of filtering on single photon emission tomographic reconstruction data. The Hanning and Butterworth filters were examined by varying the critical frequency from 0.4-1.2 cm⁻¹ and 0.3-0.8

cm^{-1} , respectively. The Butterworth power factor was manipulated from 10-20.

A Jaszczak phantom containing 25 mCi of Tc-99m pertechnetate was scanned with a GE 400ACT Starcam fitted with a high-resolution collimator. 64 projections were acquired into a 64 x 64 pixel matrix over 360° for 25 sec/view. Various filters were applied prior to reconstruction in conjunction with a ramp back-projection filter. Reconstructed slice width was 1 pixel (~6 mm). Selected filters were then applied to albumin colloid and tagged red blood cell studies of the liver. The effect of filters on both "hot" and "cold" lesions was evaluated.

Detectability of photopenic defects was more sensitive to filter parameter selection than detectability of "hot" spots on these studies. Detectability of small foci was especially vulnerable. Filter design can dramatically influence lesion detectability on SPECT studies.

INSTRUMENTATION

Posterboard No. 996

EVALUATION OF ASYMMETRIC ENERGY WINDOWS FOR SPECT IMAGING USING A JASZCZAK PHANTOM. J. Kantor, and L. McIntyre. Toronto Institute of Medical Technology, Toronto, Ontario, Canada.

This work evaluates the effect of asymmetrically shifted energy windows to reduce the scatter contribution in the window and therefore improve lesion contrast.

Three studies were performed using a 15% symmetrical window (129.5 - 150.5 keV) and 15% asymmetrical windows shifted 2.5% (133 - 154 keV) and 5% (136.5 - 157.5 keV). All other parameters were typical of those used in routine liver SPECT imaging. For each study, the Jaszczak phantom contained cold spheres ranging in size from 12.7 mm to 35 mm in diameter and was filled with 5 mCi of Tc-99m sodium pertechnetate. 128 ten-second views were acquired using a 64x64 image matrix. The raw data were corrected for nonuniformities with a 45M count flood acquired on the same window settings. Reconstruction into two-profile-thick slices was performed using a 0.15/cm attenuation correction and a Hanning 32 filter. The slice best demonstrating the 35 mm sphere in each study was selected and 4x4 pixel regions were placed over the sphere and adjacent background. The contrast (sphere/background) was then calculated for each window position.

Compared to the symmetrical window, a 7.9% improvement in contrast was obtained when the window was shifted 2.5%. Count rate loss was 1%. A 5% shifted window yielded an additional 4.1% improvement in contrast, but with a total 9% loss in count rate. Previous investigators (Sanders et al.) have found that a 2.5% window shift is optimal for planar imaging. Our results show that it is also useful in SPECT imaging for improved lesion detectability.

Posterboard No. 997

THE CLINICAL UTILITY OF SPECT IN THE COMMUNITY HOSPITAL. T.P. Meehan and J.A. Rick, Highland Park Hospital, Highland Park, IL.

The clinical utility of SPECT imaging has been demonstrated by numerous authors. Cases where SPECT played a decisive role in differential diagnosis were often limited to availability of equipment at major medical centers.

We would like to present examples of the usefulness of this diagnostic tool in the community hospital setting. By using commercially available software and hardware, we have been able to provide the same quality of testing and useful diagnoses previously found only at larger medical institutions.

SPECT imaging is provided at the discretion of our Nuclear Medicine physician after the clinical findings and planar scans have been reviewed. As the validity of SPECT is recognized, the utilization has increased, as shown:

YFAR	TOTAL PROCEDURES	SPECT PROCEDURES	% SPECT
1985	2004	114	6%
1986	2720	223	8%

The 8% increase in test volume due to SPECT in 1986 justifies its existence at our hospital. We have been able to enhance sensitivity of testing, increase physician satisfaction, and add additional revenue through the optimal use of a large field of view ECT unit which is used for both planar and tomographic imaging.

We hope our success will encourage other hospitals to explore the use of SPECT in their Nuclear Medicine departments.

Posterboard No. 998

SPECT IMAGING OF THE BRAIN WITH Tc-99m-HM-PAO. K.G. Royston, W.H. Olive, K.W. Logan, R.A. Holmes. University of Missouri, and Harry S Truman Memorial Veterans Hospital, Columbia, MO.

The diagnostic content of SPECT images can vary significantly depending on data acquisition, image reconstruction techniques, and image display format. The technical factors selected depend on the instrumentation, radiopharmaceutical, and the organ imaged. The clinical application of Tc-99m-HM-PAO in our laboratory has included SPECT imaging of the brain using a single rotating camera, and a standard nuclear medicine imaging computer system. Even with the Tc-99m radiolabel, optimal data acquisition is balanced between the type of collimation, the number of acquisition angles, the image pixel size, and the collecting time per angle. Clinical studies and phantom images were used to select the final protocol for data acquisition, image reconstruction, and image display. Our protocol collects 360 degree data in 64 stops using an off peak 15% window (positive shift 4%). Collected images contain 3mm pixels (128 X 128 or 64 X 64 zoomed 2.0). Several reconstruction filtering protocols were evaluated to optimize image quality and reduce reconstruction time. Attenuation correction factors were selected on the basis of the best visual correction of the phantom studies. We conclude that clinically optimum SPECT images of Tc-99m-HM-PAO in the brain can be produced using a single rotating camera and standard nuclear medicine computer system. Our protocol requires 25 minutes data acquisition and 30 minutes of processing time to produce on film 16 slices each of the transaxial, sagittal, and coronal views.

NEUROLOGY

Posterboard No. 999

DIRECT COMPARISON OF Tc-99m d,l HMPAO FOR IMAGING REGIONAL SPECT BRAIN PERFUSION WITH CT AND MRI. H. Dickson, K. Cooper, B. Engelstad, K. Laxer. University of California, San Francisco, CA.

Tc-99m d,l HMPAO is potentially of use in patients with suspected cerebrovascular disease, seizure

disorders, cerebral neoplasms, dementia and white matter disease. Tc-99m d,l HMPAO undergoes sustained distribution in brain in proportion to regional blood flow. We make slice by slice comparisons of NM, CT and MRI with each study. This exhibit is a detailed multiplanar anatomic correlation between these complementary imaging modalities showing normal vs abnormal. We utilize a Siemens Orbiter with low energy slant hole collimator; Bayesian deblurred preprocessing; 120 images are acquired with "step and shoot" through

360 degrees; frame rate varies from 8-20 sec/frame; imaging begins 1-4 hours post IV administration of 15-20 mCi Tc-99m d,l HMPAO; meticulous care is taken for immobilization and positioning. ECT reconstructions are in axial, coronal and sagittal orientation. Twelve patients (13 exams) have been performed to date with no adverse effects. Nine out of thirteen exams were of seizure patients. Tc-99m d,l HMPAO exhibited positive results in four patients not seen on the other modalities.