Abstracts for the Technologist Section Scientific Papers:
SNM 28th Annual Meeting Program—Las Vegas, Nevada, 1981

A Note on the Scientific Papers

The Scientific Program Committee of the Technologist Section of the Society of Nuclear Medicine is pleased to present the abstracts of the scientific papers for the 28th Annual SNM Meeting. The papers will be presented in two sessions to run simultaneously beginning Wednesday, June 17th at 8:30 am. Fifteen minutes are allotted for each paper and they will follow in the order presented below.

We have grouped the papers according to topics to enable you to schedule your time according to your area of interest. I urge all technologists to attend these sessions to support your fellow technologists and to share the knowledge of these excellent papers.

—Janice Brewster

Las Vegas Convention Center
Wednesday, June 17
Room R-1 8:30-10:00 am

COMPARATIVE RESULTS OF EQUILIBRIUM RADIONUCLIDE VENTRICULOGRAPHY (RVG) DATA ACQUIRED ONTO 64x64 (H-GROUP) AND 32x32 (S-GROUP) COMPUTER MATRICIES. R.R. Lew, J.A. Mattera. The Medical Center Hospital of Vermont and University of Vermont College of Medicine, Burlington, VT.

Twenty non-randomized and sequential patients scheduled for routine RVGs were used to determine if computer matrix size, on which the digitalized data is stored, would affect results of the RVG analysis.

A Ohio Nuclear Sigma 420 mobile camera system with a VIP 560 on board computer were used to acquire and temporarily store the RVG data. Imaging is done in a modified LAO projection with a E.D.C. 30 degree slant hole collimator oriented for caudal tilt. A routine RVG was acquired utilizing sixteen 64x64 matricies for data storage between the occurance of R-waves. A user controlled region of interest (ROI) was positioned over the area of the left ventricle. Termination of acquisition occurs when gamma counts achieve a saturation of 250 counts per pixel in the ROI. A second RVG was acquired without repositioning the patient, with the new data now stored in sixteen 32x32 matricies. All data is written in word mode and transfered to a Digital PDP 11·34 computer system for smoothing and analysis.

A high degree of correlation resulted in the comparative analysis:

1. LVEF (r=0.94; s y=0.04)
2. RVEF (r=0.93; s y=0.03)
3. MARF (r=0.94; s y=0.02)
4. C.O. (r=0.92; s y=0.03)

We conclude that, although resolution is degraded, quantitive analysis between the H-GROUP and S-GROUP data have a high degree of correlation with advantages to the insitutions with small systems and limited memory capacity.

USE OF PHASE IMAGES IN THE DISPLAY OF CONDUCTION AND CONTRACTION ABNORMALITIES. J. Clare, W. Chan, V. Kalff, and J.H. Thrall, University of Michigan Medical Center, Ann Arbor, MI 48109

The cinematic display of the radionuclide ventriculogram (RNV) is widely used to assess patterns of ventricular empytying. In the presence of conduction (CD) and contraction (CT) abnormalities, however, the normal pattern is often difficult to characterize visually. Phase imaging using Fourier analysis is helpful here. As the cardiac cycle is periodic, it can be separated into temporal frequency attributes such as phase and amplitude.

Gated RNV is acquired in the 45-60° LAO projection with 30° caudal tilt to achieve best interventricular and atrioventricular separation. A hardware zoom is used to expand the central field of view 1.48 times in a 64 x 64 byte mode matrix. Sixty four frames, each containing about 300K counts are collected. Fourier transformation is performed using a commercially available software (A2, MDS). The phase data are displayed, using a 360° rainbow spectrum color scale, as a phase histogram and a static color-coded phase image.

Normal hearts show a narrow ventricular phase histogram and a narrow color band encoding all ventricular pixels. The atria are 180° out of phase in the histogram display and are painted an opposite color in the scale.

In bundle branch blocks, the ventricles are clearly asynchronous and the ventricular phase histograms show a wide base and double peaks.

These phase images are, therefore, unequivocal in characterizing altered patterns of ventricular empyting, during CD and CT abnormalities, which are otherwise difficult to determine visually with conventional techniques.

CARDIAC ANALYSIS SOFTWARE: A COMPARATIVE EVALUATION. D. Jansons, H.D. Royal, J.A. Parker, G.M. Kolodny. Division of Nuclear Medicine, Beth Israel Hospital, Boston, MA.

The results of the ejection fraction calculation were compared in twenty patients using three cardiac analysis programs on two Nuclear Medicine computer systems. The cardiac analysis software included DEC's radionuclide ventriculogram (RVG) program and Technicare's QMICA and GMICA programs. The DEC software uses an operator selected fixed ventricular region of interest (VROI) and computer selected background regions of interest (BROI) whereas Technicare's QMICA and GMICA use operator selected BROI and computer derived variable VROI. The QMICA program uses operator selected isocontours to derive its VROI while GMICA uses a second derivative based algorithm to determine the left ventricular edge.

The correlation coefficients, slopes and intercepts for the calculation of ejection fraction are presented below.

	CORRELATION	SLOPE	INTERCEPT
DEC vs. QMICA	.89	.66	9.9
GMICA vs. QMICA	.91	.74	6.0
DEC vs. GMICA	.93	.84	8.0

Despite the obvious nonphysiologic fluctuations in the volume versus time curve derived from the GMICA program, the GMICA program and DEC's program correlated well. When compared to GMICA and DEC, QMICA underestimates ejection fractions, especially with higher ejection fractions.

Since cardiac catheterization was not performed in these twenty patients, it is not known which of these programs would correlate best with catheterized data. Users should be aware that there may be a considerable systematic difference in ejection fraction due to the algorithms applied by each vendor.

THE EFFECT OF CAUDAL ANGULATION ON THE MEASUREMENT OF EJECTION FRACTION (EF) AND STROKE VOLUME RATIO (SVR). D. Jansons, H.D. Royal, J.A. Parker, G.M. Kolodny. Division of Nuclear Medicine, Beth Israel Hopsital, Boston, MA.

Gated radionuclide ventriculograms were acquired on twenty consecutive patients in the modified left anterior oblique (MLAO) (30° caudal angulation) and left anterior oblique (LAO) (no caudal angulation) views to determine if there was any systematic effect on the measurement of EF and/or SVR. These studies were subsequently analyzed using three different cardiac analysis programs on two different Nuclear Medicine computer systems. DEC's cardiac analysis software uses a fixed operator defined left ventricular region of interest (LVROI) with computer selected background regions of interest (BROI). The two Technicare cardiac analysis programs (QMICA and GMICA) use operator selected BROI and computer derived variable LVROI. QMICA uses operator selected isocontours to determine the left ventricular edge in each quadrant of the LVROI whereas GMICA uses the second derivative to determine ventricular edge. The correlation coefficients, slopes and intercepts for the EF (MLAO vs. LAO) are presented in a table below:

SOFTWARE	CORRELATION	SLOPE	INTERCEPT
DEC	.95	.93	2.5
QMICA	.89	.84	4.8
GMICA	.94	1.02	1.06

Using the DEC software, the SVRs were also calculated in the MLAO and LAO view. The correlation coefficient, slope and intercept of a linear regression of the MLAO view vs. the LAO view were .87, .84 and .28, respectively. In sixteen of twenty patients, the SVR determined in the LAO view was higher than in the MLAO view by an average of 0.1.

QUALITY ASSURANCE OF MULTIPLE GATED BLOOD POOL SCINTIGRAPHY BY PROPER R WAVE GATING. D. Ford, E. Garcia, A. Anderson, D. Berman, J. Maddahi. Cedars-Sinai Medical Center, Los Angeles, CA.

The main requirement of multiple gated equilibrium blood pool scintigraphy is the accurate recognition of the R wave by an electronic gate which synchronizes in time all subsequent counts which are used to reconstruct images throughout the cardiac cycle. Improper gating results in an artifactual reconstruction of scintigrams thus leading to invalid volume-time curves, ejection fraction measurements and wall motion assessments. It is essential that the technologist be able to recognize if the gate is properly triggering on the R wave, what to do about improper gating and under what conditions improper gating cannot be corrected. Gating is considered proper when the gate marker persistantly coincides with the R wave of the QRS complex. Low R wave amplitude is a common reason for improper gating. This in most cases can be corrected by altering the electrode placement or the lead that is being monitored. Other reasons for improper gating, which can be corrected, include; artifacts from defective lead wires and electrodes, patient tremor, 60 cycle interference, and pacemakers. Improper gating cannot be avoided in patients with irregular heart rates such as atrial fibrillation or excessive premature beats. This results in a damped volume time curve and lowering of the ejection fraction. Studies can be evaluated as to whether or not they are suitable for diagnosis by examining the frequency of irregular heart beats using R-to-R wave histograms where the time between R waves is plotted vs the number of heart beats. Awareness of potential gating problems and their correction will assure a valid assessment of biventricular function.

FACILITATED HANDLING OF GATED BLOOD POOL SCINTIGRAPHY USING A MICROPROCESSOR WITH BASIC PROGRAMMABILITY. K. Miceli, M. DaCosta, S. Horowitz, M. Goldman, S.J. Goldsmith and J. Weber. Mt. Sinai Medical Center, New York, New York.

Gated blood pool scintigraphy (GBPS) has become a viable diagnostic modality. At Mt. Sinai Medical Center more than 1500 GBPS were performed last year including multi intervention procedures requiring 10 or more data acquisitions such as rest, handgrip, rest, cold pressor, rest, bicycle, rest, nitroglycerin, etc. The increasing utilization of multi intervention GBPS has resulted in a flood of raw data that requires new and rapid methods of storage, processing and data display. We have utilized the programmability option of our microprocessor system to assist in the development of an integrated system designed to acquire, store and process this data more efficiently.

Multiple programs have been written to coordinate 1) rapid sequential multi intervention acquisition and data storage; 2) data retrieval; 3) display and labeling of end diastolic and systolic images; 4) labelling and cine display of sequential acquisitions; 5) additional analysis of data derived from time activity curves; 6) central directory of patient data.

In conclusion, the development of new scintigraphic techniques requires development of more advanced data handling techniques for efficient utilization of resources.

Room R-1 — 10:30-12 noon

TECHNICAL CONSIDERATIONS IN THE ASSESSMENT OF SUPINE AND UPRIGHT GATED CARDIAC IMAGING AT REST AND DURING EXERCISE. P.D. Purves, W.J. Kostuk, D.E. Manyari, A.J. Nolewajka, University Hospital, London, Ontario.

For technical reasons (ease of patient positioning, reduced chest motion) exercise (Ex) gated cardiac imaging is most often performed in the supine position, however, this is nonphysiologic. Accordingly, we evaluated the influence of posture on left ventricular (LV) function and volume in 20 normal subjects utilizing ECG-gated blood pool imaging. Studies were performed at rest (R) and during graded ergometer Ex (workload increased every 3 minutes until exhaustion) in both the supine (Sp) and upright (Up) positions. The order of Ex was randomized with 45 minute rest intervals between each Ex. Changes in ventricular end-diastolic and end-systolic volumes (EDV and ESV) were estimated by counting techniques. Results (mean±SD) (Volumes are given as a percent change from value at R; Rate Pressure Product = RPP; Ejection Fraction = EF; heart rate = HR: * = P < .005):

	Rest		Exercise	
	Sp	Up	Sp	Up
LV-EF	64±8	64±10	76±8	77±13
HR	74±12	96±12*	145±22	159±19*
RPPx10^{-2}	89±16	116±20*	269±64	290±57*
LV-EDV			+1±19	+24±31*
LV-ESV			-25±41	-17±44*

Absolute changes of all parameters from R to Ex and Ex duration were similar in the 2 positions. Changes in right ventricular EF and volumes were also similar. Thus, in spite of significant differences in blood pressure, HR and ventricular volumes at R and Ex, the ejection fraction response is similar in both the Sp and Up positions.

EVALUATION OF THE MOTION ARTIFACT IN REST/EXERCISE VENTRICULOGRAMS. M. Lerner and M. Cianci. George Washington University Medical Center, Washington, D.C.

The resolution of exercise radionuclide ventriculogram images may be degraded by patient motion. Significant variations in the position of the chest wall has the potential to alter the heart image from the resting view. The intent of our study was to measure the degradation of resolution attributable to chest wall motion.

This was accomplished by obtaining two-minute static images of a line source positioned on a subject's chest in the LAO 45° projection. Multiple images were acquired with the subject at rest, exercising, and exercising while restrained. A mobile scintillation camera equipped with a 1/4" NaI crystal, 37 pm tubes, and a General All Purpose collimator was used for the collection of data. FWHM was then calculated for each image utilizing the software of a commercially available computer. Our analysis suggests: (1) the resolution of the resting image (10 mm) did not dramatically decrease because of exercise;

(2) this decrease was only minimally reduced through use of a restraint; (3) changing the acquisition matrix from a 256 x 256 byte to a 64 x 64 byte masked any apparent degradation of resolution from the resting to the exercise view.

PARALLEL HOLE VS. SLANT HOLE COLLIMATORS: A COMPARISON OF RIGHT HEART IMAGES. J. Wing, C. Neveu, W. Hooper. Veterans Administration Medical Center, University of California San Diego, School of Medicine, La Jolla, CA.

As the demand for left and right ventricular ejection fractions increases, the nuclear medicine technologist is faced with the question of which collimator and what view is best suited for any given evaluation. An ongoing clinical study comparing views taken with a high sensitivity parallel hole collimator and a 30° high sensitivity slant hole collimator has been undertaken in our laboratory.

Each patient receives 20 millicuries of technetium-99m. A resting gated study is recorded on a portable G.E. Data Camera equipped with onboard Modumed computer, first with the parallel hole collimator and then with the slant hole collimator. Striving for optimal separation of the ventricles, the patients are positioned as follows: 30-45° LAO with 15-30° caudal tilt when using the parallel hole collimator, and 30° LAO with no caudal tilt but with the slanting directed diagonally from left shoulder to right hip, when using the slant hole collimator. The data are recorded for 5 minutes using a 32 x 32 word mode acquisition in 28 frames for each evaluation.

We have found that the parallel hole collimator, positioned as described previously, produces images of the left heart chambers which are readily identifiable; however, the right heart structures are not as easily distinguished. The slant hole collimator produces images which more clearly separate the right atrium from the right ventricle, while preserving the interventricular septum, and only slightly compromising the separation between the left heart chambers.

AN EVALUATION AND COMPARISON OF FOUR COMMONLY FOUND APPARATI USED IN BOLUS INJECTIONS FOR ACTIVITY COMPACTNESS AND COST EFFECTIVENESS. J. W. Fain, J. Carmody, I. Mena. LAC Harbor-UCLA Medical Center, Torrance, CA.

The purpose of this experiment was to evaluate four different manufacturer's apparatus used in bolus injections for quality of bolus and unit cost.

The unit cost ranged from a high of $2.65 to a low of $1.20 excluding additional costs of syringes and venipuncture materials. Each apparatus is in current use and is advertised for use in bolus injection primarily for first pass left ventriculography (FPLV).

Four randomly selected populations (N=25 each) were subjected to one of the four examined injection apparati with the same operator administering all injections. During FPLV quality control was accomplished by placing a region of interest over the superior vena cava (SVC) and plotting the representative time/activity curve. Compiled data of bolus SVC mean transit times (MTT) were examined by one-way analysis of variance (Anova) methods designed to determine if there is significant difference between various population means.

Anova testing yielded an F score of 1.80 (first degrees of freedom=3 and second degrees of freedom=96) showing that there is greater than a 15% probability that the four populations and therefore, the four apparati are not significantly different in administering a high quality compact bolus regardless of cost.

As a point of discussion we did find variance in the ease of use and time needed for installation of radionuclide prior to injection. Since shielding is not provided as part of any of these apparati, time and radiation exposure to technical personnel must be considered.

AN OSMIUM-191-IRIDIUM-191m GENERATOR FOR FIRST-PASS RADIONUCLIDE ANGIOCARDIOGRAPHY. A.Samuel Sawan, C.Cheng and S. Treves. The Children's Hospital Medical Center, Boston, MA.

An osmium-191-iridium-191m generator for first-pass angiocardiography has been developed in our laboratory. Ir-191m has a half-life of 4.9 seconds and emits 65 and 129 keV photons suitable for imaging with currently available gamma cameras.

25-80 mCi of Ir-191m are eluted directly into the patient in 0.6-1.0 ml of 0.9% NaCl at pH 1. A sodium phosphate buffer solution is used to neutralize the Ir-191m eluate to pH 3.5 just prior to injection. The patient is imaged supine with a gamma camera fitted with a low energy collimator positioned over the chest. The study is recorded on a computer at 20 frames/sec. for 25 seconds on a 64 x 64 matrix. With the high photon flux of Ir-191m cardiac images recorded at this rapid frequency are of higher information density than those with Tc-99m.

Because of its short half-life, Ir-191m delivers a significantly lower radiation dose per study than other presently available radionuclides. A 25 mCi injection of Ir-191m with approximately 7 uCi of Os-191 breakthrough to a 1 yr. old is responsible for a whole body dose of 27.4 mr. In addition, multiple studies can be obtained a few seconds apart in different projections or to evaluate changes in cardiac function without residual background interference. In cases of a prolonged or fragmented bolus injection the study can be repeated immediately.

The use of Ir-191m improves the diagnostic capabilities of first-pass radionuclide angiocardiography. Its 4.9 sec. half-life, gamma photopeaks and high photon flux make it an ideal agent for imaging while delivering a low radiation dose to patients.

THALLIUM 201 TRANSAXIAL IMAGING USING A ROTATING CAMERA K.C. Worthington, B.A. Harkness, N.H. Clinthorne, J.W. Keyes, Jr., and J.H. Thrall. University of Michigan Medical Center, Ann Arbor, MI

A technique has been developed for transaxial tomographic (TT) imaging of thallium 201 distribution in myocardium utilizing an MDS A2 computer interfaced to a GE 400T rotating camera. One hundred patients have been imaged using this technique in our research unit. The patients were stressed and injected with 2.0 mCi Tl-201 IV 1 min. before completion of exercise. Imaging took place 5 min. post injection data collection was completed within 30 minutes of injection. Thirty-two evenly spaced images were acquired in a 180° arc. The arc position started at 315° (RAO) and terminated at 135° (LPO). This arc position provides optimal visualization of the heart by minimizing collimator to object distance through soft tissue. It is often erroneously assumed that 360° arc is needed for (TT) reconstruction but, in fact, the resolution is degraded by adding in attenuated data and the imaging time is doubled. The frames are acquired for 30 sec. each with a total imaging time of 22 minutes. Reconstruction takes place using an algorithm (filtered back projection) that can produce images of data acquired in either 180° or 360°. These serial (TT) images can be viewed directly in standard CT format or reorganized into tomographic planes in other orientations. The quality images produced provide our physicians with a three dimensional representation of thallium uptake by normal myocardium. Transaxial, as compared to planar images, more clearly define lesion size and anatomy. This method of myocardial imaging has provided more information as well as excellent images of normal and abnormal hearts.

Room R-1 1:30-3:00 pm

EXERCISE THALLIUM SCINTIGRAPHY AS A FOLLOW UP TO CORONARY ANGIOPLASTY. S. Johnson, Presbyterian-Univ. of Pa. Medical Center, Philadelphia, Pa. 19104

The technique of percutaneous transluminal angioplasty (PTCA) has been used to widen atherosclerotic vessels. With some modifications, this technique has been performed in coronary obstructive disease, usually single vessel avoiding the need for bypass surgery.

During PTCA, a dilatation catheter is passed through the narrowing in the artery and is inflated, compressing the atherosclerotic material against the wall of the vessel. Since this is an angiographic study, the results are known immediately. However, due to the invasive nature of catherization, and its risk to the patient, it is not suitable for follow-up studies. Therefore, Thallium exercise testing,

because of its non-invasive nature and ease of repeatability is the method we use to monitor the success of PTCA.

Prior to PTCA, a baseline exercise Tl-201 test is performed under a strict protocol governing resistance and time. The patient is encouraged to exercise to at least 85% of maximal heart rate. The test is stopped early if ECG changes occur or if the patient experiences chest pain or serious arrhythmias. This procedure is repeated early (1-3 weeks) and again 6 months after angioplasty.

In those patients in whom PTCA has been successful, that is, a substantial increase in vessel diameter occurred, repeat Tl-201 study also has shown an improvement in perfusion. Areas which showed a perfusion defect before PTCA, show an improvement in perfusion after angioplasty. In addition, these patients usually did better on their exercise test.

Since myocardial perfusion imaging correlates very well with angiographic findings, sequential Tl-201 scintigraphy provides a valid method for evaluating PTCA's success.

A NEW QUANTITATIVE APPROACH FOR ASSESSING MYOCARDIAL PERFUSION. G.I. Petroff, R.P. Waterfield, D.D. Watson, G.A. Beller, and C.D. Teates. University of Virginia Medical Center, Charlottesville, VA.

Sequential post exercise thallium-201 myocardial imaging is commonly used for the detection of abnormal myocardial perfusion. A new method is available for the quantification of results. Thallium chloride is injected intravenously through an indwelling cannula at peak symptom-limited exercise. Imaging begins 10 min. post-exercise with uniform 10 min. images in the following sequence: ANT, 45-LAO, 70-LAO, ANT, and 45-LAO. Delayed images are repeated 2-3 hours post injection in the ANT and 45-LAO. Computer processing is performed as follows: An interpolative method is used to subtract the background from each individual image; images in the delayed sequence are computer aligned to overlap the initial image; and multiple count profiles are generated by the computer in the background subtracted images. Myocardial counts above background are determined from peak profile counts and segmental myocardial uptake as a function of time is determined from each sampled myocardial segment in the image sequence. Numerical criteria are used to establish the presence of a focal defect, delayed redistribution, and/or abnormal segmental thallium washout. In a group of 140 patients having coronary angiography the sensitivity and specificity for this technique were 91% and 90% respectively. The predictive accuracy for this patient population was 97%. This quantitative approach has provided an accurate and objective means of assessing myocardial perfusion from sequential thallium studies.

TECHNICAL ASPECTS OF QUANTITATIVE THALLIUM-201 MYOCARDIAL SCINTIGRAPHY. K. Van Train, E. Garcia, J. Maddahi, D. Brown, S. Hulse, A. Waxman, and D. Berman. Cedars-Sinai Medical Center, Los Angeles, California.

To overcome problems associated with subjective interpretation of stress-redistribution TI-201 scintigrams, we previously developed and validated a method for quantitation of TI-201 myocardial distribution (D) and washout (W/O). The method uses maximum counts circumferential profiles (CP) for the stress and 4 hr anterior, 45° and 70° LAO images following interpolative background subtraction and 9 point smoothing. W/O CPs were calculated as % W/O from stress after apex alignment. Abnormality was defined by comparing profiles to previously established normal limits. This study describes the technical aspects of acquisition and processing using a new improved computer program and validates it by comparing it to our previously established method. Each study was evaluated independently by an expert and a non-expert investigator. Subjectivity was reduced by facilitation of apex alignment through simultaneous display of all profiles and by processing images with the intensified selected apex. Output was optimized by displaying both images as well as a simulated heart ellipse indicating the location and extent of the abnormalities. Processing time was reduced from 26 to 10 minutes by this program. In 15 patients there were 270 analyzable segments. There was intra-observer agreement between the previous and the new method in 259/270 segments (96%) and interobserver agreement in 267/270 segments (99%). Interobservations using the new method between an expert and non-expert agreed in 262/270 segments (97%). Thus, this improved program for quantitation of Tl-201 scintigrams has increased objectivity while reducing operator interaction and processing time.

CALIBRATION OF A HIGH QUALITY VIDEO IMAGER FOR USE WITH A COMPUTER. K.C. Worthington, B.A. Harkness, W.L. Rogers, and J.W. Keyes, Jr. University of Michigan Medical Center, Ann Arbor, MI.

Computers have proven essential in the modern clinical and research Nuclear Medicine Unit. To provide hard copy images of data stored in a computer system, video imagers have been successfully utilized. To consistently produce quality images with a specific photographic gray scale, a calibration of the computer-video imager system is necessary.

Our system is comprised of an MDS A2 computer and a Matrix 1000 Video Image Formatter (VIF) (512 x 512, matrix, 256 gray scale levels). To calibrate this system, a positive linear translation table was generated via the computer. A translation table converts the numerical value of a pixel into a visual intensity (256 levels). Synthetic images with known total counts were created and photographed using the VIF and the positive linear table. The film response curve was then plotted as film density versus counts. Using this information, the system may be calibrated to produce any desired film response. The four variables that are manipulated to produce a specific photographic exposure are translation table values, VIF's display brightness and contrast setting, and exposure time. Restoration of the original calibration curve at regular intervals insures the user of consistent operation and complete system calibration. It should be noted that for different film types the film response will change necessitating calibration alterations.

This calibration procedure, though involved, has proven useful and provides a baseline for reliable quality control of the imaging system.

MINIMIZING CLINICAL NON-UNIFORMITY ARTIFACTS IN UNIFORMITY CORRECTED GALLIUM IMAGES. M.L. DeLaney, J.K. Weber, S.J. Goldsmith. Mount Sinai Medical Center, New York,N.Y.

Artifacts of non-uniformity were observed on clinical Ga-67 images obtained on a gamma camera with a uniformity correction computer. These non-uniformities were not observable on the Tc-99m or Ga-67 flood field images. It was postulated that these artifacts were caused by photon scatter in the patients body tissues. A method was investigated to minimize these clinical non-uniformity artifacts.

Uniformity computer correction factors were accumulated using an extrinsic Tc-99m flood phantom centered on the collimator surface as per the manufacturers recommendation. Tc-99m and Ga-67 flood field images were obtained with and without lucite scattering media. Computer analysis of field uniformity was performed. For these images the range of points beyond 10% of the mean pixel value was 14.4 to 17%. The uniformity computer correction factors were then reaccumulated using an extrinsic Ga-67 flood phantom with three inches of scattering media interposed between the source and the detector to simulate the clinical situation. A second series of flood field images was obtained and uniformity analysis performed. For these images the range of points beyond 10% of the mean pixel value was reduced to 8.2 to 14.5%. This new method of accumulating uniformity correction factors was instituted and clinical non-uniformity artifacts have not been observed.

XENON-133 VENTILATION STUDIES ON VENTILATOR PATIENTS. F.D'Ercole, J.P. Capuzzi, and H.P. Rothenberg. Crozer-Chester Medical Center, Chester, PA.

The inability to adequately perform the ventilation segment of the radionuclide ventilation-perfusion lung scan in ventilator-assisted patients has made the diagnosis of pulmonary embolism much more difficult. We have developed a non-complex technique for performing the

Xenon-133 ventilation studies on these patients. Only minor modifications to our Xenon-133 system were required.

The patient is placed supine on the imaging table with the detector beneath the table. Two one-way valves incorporated into a four port Y adapter regulate the direction of all air flow. One port is connected by flexible tubing to the endotracheal tube. The next port is connected directly to the Xenon system by another piece of flexible tubing. The third port, containing a one-way valve, is attached directly to the Xenon dispensing gun. The last port, containing a one-way valve, is secured to an Ambu bag.

The oxygen to the dispensing gun is set at 4 liters. The tubing to the Xenon system is clamped shut. The oxygen control button is depressed delivering the bolus of Xenon into the lungs. The Ambu is then deflated and held in the deflated position until the inspiration image is acquired, about 15 seconds. While breathing is maintained by the Ambu bag, a 30 second pseudo-equilibrium image is acquired. The oxygen is increased to 10 liters. The clamp is released as the Ambu inflates. Subsequently, prior to each deflation of the Ambu bag, the clamp is closed and prior to each inflation, the clamp is opened. This process continues throughout the washout.

In over 30 ventilator-assisted patients, we have successfully performed the Xenon-133 ventilation study by utilizing this technique.

Room R-1 3:30-4:30 pm

REFORMATTING TRANSAXIAL TOMOGRAMS FOR IMPROVED ORGAN VISUALIZATION. B.A. Harkness, K.C. Worthington, J.A. Borrello, N.H. Clinthorne, and J.W. Keyes, Jr. University of Michigan Medical Center, Ann Arbor, MI

Current transaxial reconstruction algorithms present images in standard CT format. It is often advantageous when performing transaxial reconstructions to reformat the data into other viewing planes for ease of interpretation and quantitative analysis.

The reconstructed transaxial images determine a volume where the x-axis is the width, the y-axis the depth, and the z-axis is the height of the patient. Slices perpendicular to these axes form the sagittal, coronal, and transaxial images respectively. It is quite simple to reformat the data from a series of transaxial tomograms into new tomograms in the sagittal and coronal planes and also into tomograms that are oblique to the three major planes. Viewing organs in many planes and varying angles increases the ability to determine lesion depth and size. Oblique angle tomograms are particularly advantageous when performing TL-201 myocardial scans. Oblique angle reformatting allows the formation of images that are perpendicular and/or parallel to the long axis of the left ventricle. By using this format, lesions are easily detected due to the presence of clearly visualized, and reliably oriented surrounding viable myocardium. Images parallel to the long axis of the heart are useful for viewing the apex of the left ventricle. Images perpendicular to the long axis may also be analyzed in a manner similar to the circle algorithm used for seven pinhole images.

The reformatting of transaxial images provides improved accuracy and greater flexibility in the use of tomographic imaging.

WHAT'S IN A NAME? THAT WHICH WE CALL A COLLIMATOR BY ANY OTHER NAME WOULD RESOLVE THE SAME. M.R. Boyd, R.J. Wilson and P.L. Brady. University of Tennessee Center for the Health Sciences, Memphis, TN.

Various terms are used for gamma camera collimators by manufacturers, e.g. high resolution, general purpose, high sensitivity. Since currently no standards exist for properly naming collimators, a better characterization is sensitivity and resolution with depth measurements.

Analog measurements using phantoms were made for all available collimators on gamma cameras by four different manufacturers. A flood source smaller than the field of view was used for sensitivity measurements. Resolution measurements were made with a "pie" phantom having continuous variation of lead/interspace from 1mm. to 9mm. Resolution was determined at contact and 5 and 10 cm from the face of the collimator. Radiographs of the collimators were taken to compare hole sizes, hole shapes, and septal thicknesses.

The information obtained from the radiographs correlated with the sensitivity and resolution measurements. The sensitivity and resolution with depth have been helpful in choosing the best collimator to be used for various imaging studies. From the studies, it was recognized that manufacturers' names for collimators are meaningless as to their sensitivity and resolving capabilities. To call a collimator "rose" could describe it as well.

CALIBRATION OF THE ROTATING GAMMA CAMERA FOR TRANSAXIAL TOMOGRAPHY. B.A. Harkness, K.C. Worthington, W.L. Rogers, N.H. Clinthorne and J.W. Keyes, Jr. University of Michigan Medical Center, Ann Arbor, MI

The advent of commercially available rotating gamma camera tomographs has presented the need for new calibration procedures to insure high quality tomograms. Although some of these calibrations are performed on standard gamma cameras, they take on greater significance and require increased precision when doing transaxial tomography. These calibrations include field uniformity, center of rotation, pixel size, and camera alignment. Field uniformity is one case where nonuniformities have a greater effect on the final reconstructed image than on the planar images. Very small nonuniformities produce concentric ring artifacts on the reconstructed image. This problem is more apparent near the center of rotation. The center of rotation is the point in the x axis which corresponds to the rotational axis as seen by the computer. Inaccuracies in the center of rotation determination will result in structured artifacts and decreased resolution in the tomograms. Determination of pixel size is necessary for sizing, reformatting uniformity, and attenuation correction. The pixel size should be equal for both the x and y axis. This will prevent astigmatism in the reformatted images. Finally, for each imaging procedure the camera should be level and properly aligned with the imaging table. Failure to do so will result in inconsistent images and decreased resolution. Detailed protocols and programs to accomplish these calibrations have been developed and the results of errors in the calibration procedures documented. These will be discussed in detail. Performing each of these quality control measures insures high quality, consistent and reproductible tomograms.

USER SOLVABLE AND DETECTABLE PROBLEMS: IMAGE APPEARANCE AND QUALITY CONTROL. G. W. Enos and W. J. Carroll. Picker Corporation, Northford, CT.

Performance of routine and special quality control procedures can provide the end user of scintillation camera equipment with the ability to monitor performance and identify problems needing service attention. With microprocessor controlled correction of various parameters in today's scintillation camera market, the need to recognize problems which may be "covered up" by these correction devices is essential.

In addition to identifying routine and specialized quality control procedures, this paper will deal with identification of common and rare problems which can be identified clinically. Scintigraphic results will be shown to demonstrate the problem and the mechanism by which these problems can be identified.

Room R-2 8:30-10:00 am

THE EFFECT OF BACTERIOSTATIC SALINE ON Tc-99m LABELED RADIOPHARMACEUTICALS. K.T. Study, H.W. Schultz, and D.L. Laven. University of New Mexico, Albuquerque, NM.

The effect of bacteriostatic saline on various Tc-99m labeled radiopharmaceutical preparations was investigated. After reconstituting radiopharmaceutical kits with bacteriostatic saline (containing benzyl alcohol), the following parameters were measured: 1). radiochemical purity, 2). stannous ion content, 3). radiolytic destruction of bacteriostatic properties, 4). dissolved oxygen content,

and 5). altered biodistribution. As a control, studies using kits reconstituted with preservative-free saline were conducted in parallel.

The radiochemical purity of several radiopharmaceuticals was markedly decreased, as indicated by TLC, when bacteriostatic saline was used as the diluent. Dissolved oxygen was measured with a silver/lead galvanic cell. Bacteriostatic saline contained the same amount of dissolved oxygen as the preservative-free saline, approximately 9 ppm.

Biodistribution studies were performed in Swiss-Webster mice. Two groups of mice were injected with Tc-99m-MDP. The % injected dose/organ/gram of femur was 19.63% in the control group and 7.84% in the experimental group. The % injected dose/organ/gram in non-target organs such as blood, muscle, and liver was 2-3 times higher in the experimental group.

The exact mechanism of benzyl alcohol's interfering properties is not known, but it does degrade the biodistribution and radiochemical purity of Tc-99m-MDP.

COMPARISON OF Tc-99m HMDP and Tc-99m MDP, USING FOUR METHODS OF COMPARISON. S.L. Bass, M.R. Boyd, R.J. Wilson, and M.W. McDonald. University of Tennessee Center for the Health Sciences, Memphis, TN.

In a double-blind study designed to compare the image quality and blood clearance of Tc-99m Hydroxymethane Diphosphonate (HMDP) and Tc-99m Methylenediphosphonate (MDP), patients with suspected altered osteogenesis were imaged with each agent at 2 to 5 day intervals.

Each patient was imaged at two hours post injection. Bone images were taken using a wide field of view gamma camera. An image of the patient's right thigh was acquired on a computer system for determination of bone-to-soft tissue ratios for each agent.

Blood samples were drawn from each patient. Blood clearance times for each of the bone agents were determined by calculating a percent of the administered dose for each specimen. Plasma clearances for each agent were also determined by plotting counts versus time.

Comparison of the whole blood clearance for Tc-99m HMDP and Tc-99m MDP showed that the two agents were similar in clearance. The quantitative ratios of bone-to-soft tissue from images acquired on the computer were consistently higher for Tc-99m HMDP. Visual interpretation of the images showed no appreciable difference between the two agents. Plotting of the plasma clearances showed that the Tc-99m HMDP was a two component curve with the second component beginning at 30-60 minutes post injection. The Tc-99m MDP was a three component curve with the last curve beginning at 120 minutes.

RADIOCHEMICAL EVALUATION OF COMMERCIAL HEPATOBILIARY IDA RADIOPHARMACEUTICALS. W. Majewski, A.M. Zimmer, S.M. Spies, J. Hingeveld. Northwestern Memorial Hospital, Chicago, IL.

The purpose of this investigation was to evaluate the radiochemical purity of four commercially available hepatobiliary IDA agents. Tc-99m pertechnetate was obtained from a new generator which had not been eluted for at least 48 hours and added to vials of the agent to be tested at activity levels of 50, 100, and 150 mCi. Radiochemical evaluation was performed at 1.3,5,8 and 24 hours after formulation using miniaturized chromatography. Levels of free pertechnetate and hydrolyzed reduced Tc-99m were determined using Gelman ITLC-SA/20% NaCl and Gelman ITLC/SG distilled water, respectively, which have been previously shown to give reliable results. Results of the study indicated that free pertechnetate levels in three IDA agents (2,6-dimethyl IDA, p-butyl IDA, 2,6-diisopropyl IDA) were less than 5% up to 8 hours after preparation, and of the three, only 2,6-diisopropyl IDA showed levels of pertechnetate in excess of 5% at 24 hours (6.9% $\pm$ 0.7% and 12.6% $\pm$ 0.9% for 100 mCi and 150 mCi, respectively). The p-isopropyl IDA preparation was relatively unstable. Pertechnetate levels in excess of 5% were observed for some preparations at 5 hours after formulation (5.6% $\pm$ 1.7% and 5.7% $\pm$ 0.4% for 100 mCi and 150 mCi preparations). Further, radiopharmaceutical degradation was observed at 8 and 24 hours after formulation. The hydrolyzed reduced Tc-99m levels remained less than 5% for all IDA agents throughout the study.

STANNOUS-TIN LEVELS IN COMMERCIAL STANNOUS PYROPHOSPHATE: EFFECT OF ALTERING PREPARATION METHODS. W. Majewski, A.M. Zimmer, S.M. Spies. Northwestern Memorial Hospital, Chicago, IL.

The purpose of this study was to determine the stannous-tin levels in commercial stannous pyrophosphate preparations and to evaluate the effects of varying preparation conditions. Initially, the stannous-tin levels were determined by reconstituting Sn-PYP vials (Mallinckrodt Nuclear) with normal saline and determining the stannous levels one hour after reconstitution using a rapid stannous spot test described previously. The effects of altering the preparation methods on the stannous-tin levels were tested by maintaining one reconstituted Sn-PYP preparation at room temperature, another preparation was refrigerated, and air was introducted into the third preparation after reconstitution. Another Sn-PYP preparation was reconstituted using nitrogen-purged normal saline. Stannous levels of all preparations were determined from 0.5 to 48 hours after formulation. Results of the study showed that the initial stannous-tin levels of all Sn-PYP preparations tested were within 10% of the manufacturers stated levels and that no significant reduction in the stannous-tin levels occured within 8 hours after reconstitution. Neither refrigeration nor nitrogen-purged normal saline significantly altered the stannous-tin levels in Sn-PYP preparations within 8 hours after formulation. However, a significant reduction of stannous-tin occured within 2 hours after Sn-PYP formulation (36% reduction) when air was introduced into the vial and further decreases were observed with increasing time. These results confirm that careful technique must be utilized in the preparation and dispensing of Sn-PYP so that high stannous-tin levels are maintained.

THE USE OF BINDING ASSAYS IN THE DESIGN AND SYNTHESIS OF RADIOTRACERS TO INTERACT WITH THE DOPANERGIC NEUROTRANSMISSION SYSTEM. B. J. Dranbauer, J. M. Waud, S. Pogun, H. D. Burns, T. Duelfer, E. Corley and H. N. Wagner, Jr. The Johns Hopkins Medical Institutions, Baltimore, MD.

Binding assays have been used empolying 3H-spiperone in competition with compounds that have been designed to interact with the dopamine neurotransmission system. Binding inhibition plots to obtain IC50 values were performed. These compounds were analogues either of spiperone or benperidol and were of analytical purity. The particular compounds studies were chosen because they can be readily labeled with F-18, Br-77, or I-123. The receptors were isolated from corpus striatum of male Sprague-Dawley rats according to the procedure of Creese. The receptor precipi tate was resuspended in TRIS-HCl buffer. Varying concentrations of cold analogues of the radiotracers designed to interact with the dopaminergic system were incubated for 45 min with specific amounts of 3H-spiperone, and dopamine receptors. The radiolabelled ligands were then separated by suction filtration. The filters were rinsed x3 with ice cold buffer (total wash time <20 sec) and then placed in vials with 10 ml NEN 947 scintillation cocktail to be counted in a Beta-scintillation counter with counting efficiency of approximately 50%. The counts obtained were corrected for room background and non-specific binding. These corrected counts were then plotted as % maximal 3H-spiperone binding vs. the log concentration and an IC 50 was determined. We have found the binding assays to be an important part of an overall program aimed at the design and synthesis of compounds which interact with the dopaminergic receports. These compounds will be used to further study dopaminergic neurotrasmission system.

IN VITRO COMPARISON OF SOLID FOOD RADIOTRACERS FOR GASTRIC EMPTYING STUDIES. PE Christian, JG Moore and FL Datz. University of Utah Medical Center, Salt Lake City, UT

This study was performed to evaluate the labeling stability of Tc-99m Sulfur Colloid (SC) solid phase tracers. In vivo labeled chicken liver was compared to surface labeled chicken liver, labeled egg and canned liver patè. Canned liver patè was mixed with Tc-99m SC, then stirred while frying to form 2-5 mm pieces of pate. All food components were diced then sieved to remove particles less than 1 mm and washed with saline. One gram samples were

incubated at 37°C with 25 ml 1N HCl and also with 25 ml gastric juice (GJ)(pH=2.48). At one hour intervals samples were counted, filtered through a 1 mm sieve and recounted to determine the percent label to solid food.

Time	% of Solid Food Label			
	Intracellular Liver HCl/GJ	Liver Paté HCl/GJ	Egg HCl/GJ	Surface Liver HCl/GJ
1 Hr	99/99	96/96	98/71	94/93
2 Hr	99/99	94/94	96/63	94/86
3 Hr	99/98	92/92	96/56	93/85
4 Hr	99/97	92/90	96/48	92/83

In all solid food labels there is a deterioration of the label in the presence of gastric juice as compared to 1N HCl. Intracellular labeled liver or labeled liver paté maintain their radiotracer through an adequate time interval for clinical utilization. Liver paté fried with Tc-99m SC is easier to prepare than in vivo labeled chicken liver and is a sufficiently stable solid food marker for use in gastric emptying studies.

Room R-2 10:30-12:00 noon

ANOTHER BONE IMAGING ARTIFACT RELATED TO TECHNIQUE
S. Weiss and J.J. Conway, M.D.
The Children's Memorial Hospital
Chicago, IL

Artifacts on nuclear medicine images can simulate pathological lesions and cause problems in interpretation. Technologists must be cognizant of the appearance and possible causes of artifacts in order to alert the physician that the abnormality is an artifact and/or to prevent recurrence of the artifact.

An artifact occasionally found on bone images of the extremities is described. The artifact appears as increased localization of the radiopharmaceutical in the distal extremity simulating reactive hyperemia or reflex sympathetic dystrophy. The artifact was thought to be due to immobilization pressure applied to the upper arm during intravenous injection. This was proved during a bone imaging study for avascular necrosis of the femoral head. The radiopharmaceutical was injected into a vein on the dorsum of the hand while the tourniquet pressure remained applied during the injection. A typical increased localization is demonstrated in bones of the left forearm. It is postulated that the increased localization is due to high concentration of the bone agent being forced into the bones while the tourniquet is in place. This artifact is related to technique and an awareness will prevent misinterpretation of the images.

QUANTITATIVE ANALYSIS OF TECHNETIUM-99m METHYLENE DIPHOSPHONATE BONE IMAGING OF THE KNEE. W.B.Wolf III, M.L. Cianci, R.C.Reba, R. Lewis. George Washington University Medical Center, Washington, D.C.

Bone imaging has shown to be a useful tool in the analysis of symptomatic knees which have equivocal radiological findings. Scans of knees affected by spontaneous osteonecrosis (SON) or the various arthritides are amenable to qualitative analysis, providing valuable information in the diagnosis and treatment of various conditions. Ahlback et al suggested the use of certain ratios obtainable from bone scans to quantitate diseases affecting the knee, but the limitations of strontium-85 bone scanning lessen the usefulness of this procedure.

A technique was developed of quantitative analysis of scans of knees. This paper presents: (1) the technique of standardized acquisition and quantitative analysis of technetium-99m MDP scans of symptomatic and asymptomatic knees; and (2) the results of these analyses.

The data supported the hypothesis that scans of knees affected by SON differ quantitatively from scans of normal knees. Ratios were obtained reflective of process occurring: (1) across the joint line compared to a bony diaphyseal point; (2) at any location within the joint compared to the average activity of the whole joint; and (3) on one side of the joint line compared to the other side. The ratios obtained from knees affected by SON differed consistently from those of normal knees.

QUANTITATIVE BONE IMAGING IN PROSTATIC CARCINOMA. A.M. Gober, D.A. Espinola, E.E. Camargo, J. Tyler, H.N. Wagner Jr. The Johns Hopkins Medical Institutions, Baltimore, MD.

We have developed a method of consistently reproducing serial bone images in patients (pts) with metastatic disease for visual and quantitative interpretation. The essence of the method is the sue of a flood source as a standard for: 1) to match the precise intensity in a 35mm high contrast film for each pts study; 2) to obtain bone/flood source counts ratios. Pts were given 20 mCi of Tc-99mmethylene diphosphonate with a pre and post syringe assay to determine the injected dose. A flat, liquid flood source was injected with 3 mCi of Tc-99m pertechnetate. Imaging was begun 2-4 hours post injection with a 140 keV high resolution parallel hole collimator on a LFOV scintillation camera interfaced to a computer. Information densities (ID) of 1200 counts/cm^2 over a normal thoracic vertebra and 600 counts/cm^2 over the tibia were used as time references for the axial and apendicular skeleton, respectively. The flood source was imaged for the same IDs. Immediately after voiding, 14 views, obtained in a constant sequence, were acquired. Anatomical landmarks were chosen for each view to insure reproducibility of pt positioning. After correction for decay, dilution and time, the counts/pixel of the flood source were used as 100% activity. The total counts of each lesion were calculated as a ratio to the flood source activity. A 3-month follow up study comparing visual and quantitative data was begun in 30 pts. At the present time, 10 pts had at least one follow up with this method. Our results have indicated that although the visual method may suffice to detect worsening of the lesions, both standardization of quantification have improved the objective assessment of the response to therapy.

PEDIATRIC RADIONUCLIDE ANGIOGRAPHY. N.A. Spangler. Milwaukee Children's Hospital, Milwaukee, WI.

Pediatric radionuclide angiography is a useful diagnostic technique which is both sensitive and specific. It is non-invasive, easy to perform, free of undesirable side-effects, as well as being physiologic. High quality examinations have contributed to its clinical acceptance.

The regions of application include most organ systems. Its use in pediatric cardiology has undergone rapid growth in evaluating congenital and acquired heart diseases. The examination may be qualitative or quantitative.

Representative examples including brain, renal, hepatic, cardiac, and musculoskeletal systems will be illustrated.

DOSE CALIBRATOR ACTIVITY LINEARITY EVALUATIONS PERFORMED WITH EXPOSURES ALARA. W. Miller, F. Bloe, N. Began, D. Close, V. Gargaro, D. Davis, P. Early, C. Giomuso, J. Ferrell. Nuclear Medicine Associates, Cleveland, Ohio.

The procedure for demonstrating dose calibrator activity linearity currently requires that a series of readings must be acquired throughout the range of activities to be assayed by the instrument. The NRC licensing guide suggests that this be accomplished by assaying the first elution from a generator over a period of several days. Displayed readings should be within a specified degree of accuracy. To reduce unnecessary exposure and the cost in time and materials, an alternative method is available.

The elution vial is placed in the dose calibrator and surrounded by lead tubes. The tubes are calibrated to provide readings that are equivalent to various amounts of activity. This enables readings to be obtained from the maximum activity contained in the elution vial down to relatively low activity levels. The displayed readings are then compared against calculated readings to confirm the accuracy of the instrument.

The benefits of this technique are as follows: The vial does not have to be removed from the dose calibrator; the evaluation can be performed in a few minutes; and the entire elution can subsequently be used for kit preparation or patient dose administration.

IN-111 LEUKOCYTE IMAGING FOR THE DETECTION OF SEPSIS. S. Chavez, S. Mohler, W. Al-Sheikh, A.V. Heal, and G.N. Sfakianakis. University of Miami, Miami, FL

A dual isotope approach was used to diagnose hepatic abscess and differentiate it from trauma or tumors. An In-111 leukocyte study was used to detect abnormal accumulations indicating sites of infections in 37 patients. Following standard labelling techniques the patient received between 200 to 600 uCi of In-111 white blood cells. At 24 hours post injection, a total body study was performed. In 16 patients a lesion within or around the liver was suspected and a Tc-99m sulfur colloid liver study was simultaneously performed using the useful peaks of the two radionuclides. The following technique rendered satisfactory results.

Patients were imaged in the supine position 24 hours post injection of the labelled leukocytes on a LFOV camera with a medium energy collimator. Images were recorded on both 3-F stop polaroid and on radiographic film. An anterior image of the liver for a preset count of 500k was obtained using the two peaks of the In-111 (173 and 240 Kev). The rest of the body was scanned applying the same exposure time with an increase in the intensity. If a dual isotope study was needed, Tc-99m sulfur colloid was injected and an anterior image of the liver was obtained using the high peak of the In-111 followed by an image in the same position, using the 140 Kev peak of Tc-99m. This was repeated in the posterior and right lateral positions.

The images obtained were technically satisfactory and clinically useful; the 3-F polaroid were particularly useful. Three liver abscesses, 1 tumor, 6 traumas and 6 normal studies were correctly identified.

Room R-2 1:30-3:00 pm

The Visual System- A Study Using Positron Computed Tomography J. Miller, F. Aguilar, R. Sumida, UCLA School of Medicine, Los Angeles, California.

Positron Computed Tomography (PCT) provides a means to study cerebral function. It is used routinely to study diseases such as epilepsy, cerebral infarcts, and Huntington's Disease. Normal subjects are studied as a control population and with various types of stimulation in order to map cerebral function. The function of the visual system is studied with (F-18)2-fluorodeoxyglucose (FDG), a glucose analog, to produce transaxial images. The brain derives 99% of its energy from glucose; i.e., glucose metabolism is equivalent to energy consumption. Normal subjects were scanned both with eyes closed (control) and with a visual stimulation. The sources of stimulation included bright white light, an alternating checkerboard pattern, and a complex visual scene. As the complexity of the stimulation increased, the metabolic activity in the Primary Visual Cortex (PVC) increased as much as a factor of 2. The metabolic response of the AVC increased at a faster rate, indicating the greater involvement of the higher order AVC in interpreting increasingly complex scenes. Progressive reduction of visual system input was studied in patients with visual deficits, specifically, those with lesions which affected the visual pathway but not the visual cortex. These lesions were confirmed by PCT and x-ray computed tomography (XCT). Stimulation studies (PCT) showed a functional deficit in the visual cortex which appeared anatomically normal by XCT. The results of these studies demonstrate the ability of PCT to detect and characterize functional deficits in regions of the brain that appear normal with conventional brain scans and XCT. This aspect of PCT can potentially expand the capabilities of Nuclear Medicine for diagnosing cerebral pathologies that are beyond other imaging modalities.

TECHNICAL CONSIDERATIONS IN POSITRON IMAGING. R. Dann, J. Colsher, G. Muehllehner, A. Alavi and M. Reivich. University of Pennsylvania, Philadelphia, PA.

In the young field of positron emission tomography a variety of technical problems occur, both in the imaging procedures and in the analysis of the images.

Considerations common to all machine designs and techniques are discussed briefly, followed by a more detailed presentation of metabolic studies of the brain using F-18-deoxyglucose. An atlas of the human brain has been developed to reduce the subjective nature of ROI selection. Patient alignment, with the help of lasers, and the kinds of errors introduced by mis-positioning, are presented, with some clinical examples. Partial volume effects due to the size of cortical structures and the presence of CSF and white matter lead to inaccurate measurement of glucose metabolism. Appropriate control measures are discussed, as environmental factors can greatly affect the results of this kind of study.

Systematic errors can be minimized by appropriate phantom studies, which are described in detail. Some early clinical studies help illustrate our solutions to some of the technical problems encountered.

Without being overly technical, this paper will suggest to the technologist methods of approaching the problems peculiar to PET imaging.

INITIAL STUDIES ON THE PETT-V, A SEVEN-SLICE POSITRON EMISSION TOMOGRAPH. R. Dann, A. Alavi, G. Muehllehner, J. Colsher, and M. Reivich. University of Pennsylvania, Philadelphia, PA.

The Pett-V has been used at our institution to study both patients and normal volunteers undergoing various types of stimulation to create functional maps of the brain using F-18-deoxyglucose.

Since most positron imaging devices are "homemade", it is essential to characterize the system with appropriate phantom work. Performance characteristics of the Pett-V, such as resolution, sensitivity, and slice-to-slice variability are presented.

Normal volunteers receiving an auditory stimulus consisting of an English story heard monaurally, showed increased glucose metabolism in the temporal cortex contralateral to the stimulated ear. A flashing pattern of lines presented to one visual hemifield produced increased uptake of the FDG in the contralateral side. In patients with visual deficits resulting from old strokes, full field stimulation demonstrated reduced metabolism in those areas corresponding to the lesions seen on CT and defined by perimetry.

The need for careful definition of machine parameters is emphasized, as well as the importance of caution in the interpretation of results in patients.

RADIONUCLIDE BLOOD POOL VENOGRAPHY (RNBPV)A NON INVASIVE MODALITY FOR THE DETECTION OF DEEP VEIN THROMBOSIS. W.M. Abel. Nassau Hospital, Mineola, N.Y.

A technique for the detection of deep vein thrombosis (DVT) in the venous system of the pelvis and both lower extremities has been developed at our institution in order to avoid the difficulties encountered in the application of currently available methods, i.e. the Fibrinogen uptake tests (FUT) lack of sensivity above the knee, the risk of hepatitis associated with its use, and its inability to localize physiologically inactive thrombi. It is also our aim to avoid the complications often associated with the dorsal pedal injection of radioisotopes and iodinated contrast media that may in and of itself initiate the onset of DVT, and that requires separate injections for the study of each lower extremity.

The entire contents of one commercial (Sn) PPi kit containing 3.4 mg of SnCl is diluted to a 3 ml volume with .09% NaCl and is injected intravenously (I.V.). 30 minutes later a 5 ml blood sample is drawn from the patient and is added to a sterile heperanized test tube containing 20 mCi of Tc-99m in a 1 ml volume. After 15 minutes of gentle inversion the entire contents of the tube is readministered to the patient via antecubital injection. 5 minutes following reinjection the abdomen and lower extremities are imaged using a standard LFOV scintilation camera.

Of 78 patients studied a total of 100 times by RNBPV only 8 underwent contrast venography (CV) in addition. Of this 8 however, 100% agreement was reached between RNBPV and CV in that 6 (+) CV's yielded 6 anatomically identical RNBPV's and 2 (-) CV's yielded 2 (-) RNBPV's. Correlation with the standard FUT, plethyseismography or phleborheography was not attempted due to the radically different nature (i.e. non anatomical) by which these techniques are designed to localize DVT. Positive scans appear as either partial or total obliteration of flow through the affected vessel often associated with increased collateral circulation about the abnormal area depending upon the age of the thrombus.

No complications were encountered among the 8 patients studied by CV nor were there any encountered among the 78 patients studied by RNBPV. It should be noted however, that minor adverse reactions commonly occur following the I.V. injection of iodinated contrast media with more serious reactions occurring less frequently. No morbidity or mortality with the I.V. injection of Tc-99m labeled erythrocytes have been reported to date.

Long term clinical follow up of the 78 patients studied by RNBPV have demonstrated the efficacy of this technique as a fast, reliable, painless, non invasive and risk free means of accurately delineating venous anatomy when compared with other currently available techniques. Selected case studies of clinical interest will be presented including certain anomalous findings not detected by other means.

CAN Tc-99m GLUCOHEPTONATE PROVIDE NEPHROLOGICAL FUNCTIONAL INFORMATION? F. Kontzen, M. Barber, M. Tobin, R. Lim, E. Dubovsky, W.N. Tauxe. University of Alabama and VA Medical Centers, Birmingham, AL.

While Tc-99m Glucoheptonate (GH) generally provides good anatomic renal scintigraphic detail, we have evaluated its use as an agent for functional information. Forty-eight patients with complete urological workup were studied on two consecutive days by a computer-assisted comprehensive renal function study (CRFS) using I-131-OIH and Tc-99m GH. Sequential renal images, net renographic uptake curves and total % dose excreted (voided + bladder residual) were compared.

Excellent correlation was found between individual (one minute) kidney uptake rates of GH during the first five minutes of the study and individual effective renal plasma flow (ERPF). (Ref., J Nucl Med Technol 5:81, 1977). The best agreement was obtained using the 2-3 min. uptake rates (Syx = 2.99).

Total quantitative evaluation of renal function was not achieved using GH. No correlation was found between: 1. % dose GH excreted at 35 min. and ERPF, creatinine or BUN in non-obstructive urologic disease. 2. % GH dose excreted and presence or degree of obstructive uropathy.

Measurement of residual urine volume by GH was greatly overestimated when compared with the values found by catheterization or OIH values.

In summary, while GH yields good anatomic detail of the renal parenchyma/collecting system, functional information is limited to differential ratios. A combination of GH and OIH clearance could provide differential ERPF and good anatomic detail.

QUANTITATING UPTAKE OF I-131 IN FUNCTIONING THYROID METASTASES. A.L. Omdahl and C.A. Gorman. Mayo Clinic, Rochester, MN.

Calculations of radiation dose to functioning thyroid carcinoma metastases have been hampered by imprecision in estimates of tumor I-131 uptake. We wish to describe an improved method for quantitating I-131 uptake in tumor.

Forty-eight hours after a 1-millicurie dose of I-131, functioning metastases are identified and the distance of each lesion from the body surface is defined on a Searle dual-probe full-body tomographic scanner. Functioning tumors are then imaged on a General Electric 400T gamma camera or a Searle LFOV gamma camera, and the information is stored on a Medical Data Systems (MDS) MODUMED computer. Lesions are outlined on a display screen with a light pen and the count rate of each area of interest is recorded. Comparison with a standard source of I-131 of known activity combined with a predetermined mathematical correction for tissue scatter permits quantitation of uptake in each lesion. This is expressed as percent dose.

This method has been applied to tumor deposits in lungs and in axial and peripheral skeleton. Lesions have been measured which have retained as little as 0.1 percent of administered dose and as much as 9 percent. Estimates of diffuse lung uptake in the anterior and posterior positions were compared in two instances and agreed closely.

We conclude that this technique aids in informed planning of therapeutic radioiodine programs, particularly in patients who require large and repeated doses of I-131 in whom safe dosage to critical organs might otherwise be easily exceeded.

Room R-2 3:30-4:15 pm

MONITORING OF GAMMA CONTAMINATION THROUGH URINE COUNTING. M. Potempa, H. Mermall, and S. Pinsky. Michael Reese Hospital and the University of Chicago, Chicago, IL.

Monitoring devices primarily detect surface contamination. In an attempt to detect absorbed radioactivity, 20-22 ml of urine was collected from nuclear medicine personnel having access to radioactive sources. Calibration sources of I-129, Cs-137, and Co-57 were used as reference standards to estimate the amount of activity in urine samples counted for 20 minutes. Nuclear Medicine personnel who inject or prepare and inject radiopharmaceuticals had activity in urine samples slightly above background and above that found in the samples of personnel not involved with the aforementioned activities. Therefore, it appeared that the injection procedure might be the source of contamination. The minimum detectable amount of radioactivity was approximately 2.5×10^{-5} µCi of 99mTc in 20 ml of urine and about 4.2×10^{-6} µCi of I-125 also in 20 ml of urine.

While attempting to locate sources of contamination, it was determined that lead pigs, pens, pencils, and even the outside of filled syringes were not significant sources of internal contamination. The main source of contamination appears to be the alcohol swab used to clean, wipe, and cover the patient's injection site. The reference standards used for the urine studies were also used to estimate the amount of radioactivity on these swabs. Approximately 19% had an average of 2.29×10^{-4} µCi of 99mTc per swab, 7% had an average of 2.26×10^{-3} µCi, 22% had an average of 1.84×10^{-2} µCi and 52% had an average of 1.9 µCi.

The use of latex gloves diminished internal contamination during the preparation and injection of radiopharmaceuticals which includes handling the contaminated swabs. No I-125 was detected in RIA laboratory personnel.

THE TECHNOLOGIST'S ROLE IN QUALITY ASSURANCE OF DIAGNOSTIC IMAGING. W.M. Hibbard and J.L. Dixon. Medical College of Georgia, Augusta, GA.

In addition to the responsibility of assuring instrument and radiopharmaceutical quality control, the technologist must also assume an active role in the assembling of patient information critical to the accuracy and completeness of the nuclear image. We have developed a patient information summary sheet that is completed with each study.

Prior to beginning a study the technologist should ask, "What question does the referring physician hope to answer as a result of this study?" The technologist responds by determining whether the study requested: 1.) is the appropriate study to provide the desired information, 2.) is planned in the appropriate sequence if subsequent studies are to follow, 3.) will be invalid because of prior or interfering diagnostic or therapeutic procedures. Next, the technologist needs to ask, "What information from the patient's clinical history will enhance the accuracy of the diagnosis?" This requires a review of pathology reports and C.T., x-ray, and ultrasound reports, as well as a summary of clinical symptoms. Third, the technologist must review the study upon completion to determine whether additional

views or delayed images are necessary, check for technical artifacts, and assure accuracy of labeling and image presentation.

This procedure for evaluating patient data and appropriateness of the study has proven to be a very effective adjunct to quality assurance in nuclear imaging.

IN VIVO DETERMINATION OF REGIONAL BODY HEMATOCRIT IN NORMAL HUMAN SUBJECTS. M.R. Boyd and R.J. Wilson. University of Tennessee Center for the Health Sciences, Memphis, TN.

Regional organ hematocrits (hct) were determined on eleven male and seven female subjects in order to estimate normal values.

The subjects were imaged posteriorly on a wide field of view gamma camera and data was acquired on a computer. The Red blood cell (Rbc) image was obtained following an injection with Tc-99m tagged Rbc and the whole blood image was obtained following an injection of Tc-99m Human Serum Albumin (HSA). The computer was programmed to divide the Rbc image by the whole blood image after background subtraction. The ratio image obtained from the division was proportional to the hct. Regions of interest were drawn around the heart, lung, liver, spleen, kidney, and spine to determine the regional organ hct. The regional hct relative to the heart hct was then calculated.

The maximum regional hct ratio in 16 of the subjects was found in the spleen. The lowest ratio was in the liver in all 18 subjects. Ratios in the lungs, kidney, and spine indicated that the percent of Rbc's in these areas closely resembled that found in the heart in all subjects.

Since actual organ hct can not be measured in vivo, this technique allows assessment of the regional organ hct using equipment and radiopharmaceuticals commonly available in nuclear medicine facilities.

Technologist Scientific Exhibits

Technologist Scientific Exhibits for the 28th Annual Meeting of the Society of Nuclear Medicine will be located in the Las Vegas Convention Center. The abstracts for them may be found in the *Scientific and Technical Exhibits Brochure*, which will be available on site. Exhibit titles and authors are presented below. They are listed alphabetically by the last name of the first author.

HOW TO PERFORM ROUTINE RADIOPHARMACEUTICAL QUALITY CONTROL USING INSTANT THIN LAYER CHROMATOGRAPHY. S. J. Ashley, M. A. Ashley, and Z. Dimitrieva. Flushing Hospital and Medical Center, Flushing, N.Y.

RADIOCHEMICAL IMPURITIES IN Tc-99m TAGGED RADIOPHARMACEUTICAL COMPOUNDS: UNDERSTANDING THEIR ORIGIN AND DETECTION. S. J. Ashley, M. A. Ashley and Z. Dimitrieva. Flushing Hospital and Medical Center, Flushing, N. Y.

SCINTIPHOTOGRAPHY OF RARELY ENCOUNTERED RENAL ANOMALIES WITH Tc-99m 2,3 DIMERCAPTOSUCCINIC ACID (Tc-99m DMSA). S. J. Ashley and Z. Dimitrieva, Flushing Hospital and Medical Center, Flushing, N. Y.

APPLICATION OF THE NOISE-EQUIVALENT BANDPASS TO SCINTILLATION CAMERA RESOLUTION MEASUREMENTS. A.G. Binford, D.W. Shosa. University of California, San Francisco, CA

XENON-133 VENTILATION STUDIES ON VENTILATOR PATIENTS. F.D. Ercole, J.P. Capuzzi, and H.P. Rothenberg. Crozer-Chester Medical Center, Chester, PA.

PRE-SURGICAL EVALUATION OF ISCHEMIC NECROSIS WITH TECHNETIUM-99m SULFUR COLLOID. W.R. Green, Nuclear Radiology, Loma Linda University Medical Center, Loma Linda, CA.

REPRODUCIBLE FIBRINOGEN STUDIES. L. J. McCutchen R.T. Penrose Hospital, Colorado Springs, Colorado, 80907

PITFALLS IN ^{201}THALLIUM MYOCARDIAL IMAGING. J. Patel, J. Henderson and C. Park. Thomas Jefferson University Hospital, Philadelphia, Pennsylvania.

PAINLESS JAUNDICE - CORRELATION OF ULTRASOUND, RADIONUCLIDE HEPATOBILIARY SCANNING AND TRANS-HEPATIC CHOLANGIOGRAPHY IN DIFFERENTIAL DIAGNOSIS. P.A. Webb, N.L. Kelty, and L.E. Holder, Union Memorial Hospital, Baltimore, Maryland

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