Abstracts for Technologist Scientific Program: SNM 26th Annual Meeting—Atlanta, Georgia

A Note from the Scientific Program Chairman

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 26th Annual Meeting. The papers will be presented in three sessions to run simultaneously beginning Tuesday afternoon June 26th at 1:30 p.m. They begin the Section's program and we believe their wide range and excellent quality is a fitting introduction to what we hope will be a memorable meeting for all technologists. The titles and authors of the Technologist Section's scientific exhibits are also to be found on the following pages and they too should interest all attendees. — *John J. Reilley*

TUESDAY, JUNE 26 Room 310
1:30 p.m.-5:45 p.m.

SUBMITTED PAPERS I

Moderator: Elizabeth A. Joyce

A TECHNIQUE FOR COMPUTER ANALYSIS OF CHROMATOGRAPHY. R.D. Kreitzer. Kettering Medical Center, Kettering, Ohio

An integral part of quality control for radiopharmaceuticals is chromatography to detect the presence and amount of free isotope. To avoid the purchase of a chromatography strip reader and the process of counting cut strips in a well counter, a simple method was evolved to allow quantitation of the free isotope using a gamma camera and computer. One drop of radiopharmaceutical is placed 1cm. from the end of a 1 X 6cm. strip of filter paper. The chromatograph is developed in a stoppered test tube containing 0.5ml. of acetone. The developed strip is then placed in a zip lock plastic bag and placed on the face of a gamma camera with a high sensitivity collimator. The strip image is then acquired in a 128 X 128 X 16 matrix for approximately 50K counts on the computer. One large rectangular area 120 pixels wide and 20 pixels high is positioned with the light pen to encompass the entire strip. This area represents the total count applied and is subsequently subdivided into six 20 X 20 pixel squares with number 1 being the origin and 2-6 being various stages of the solvent front. The proportion of bound isotope is then calculated by dividing the counts obtained in box #1 by the counts obtained in the total count area. Subsequent areas are quantitated in the same manner and represent the "free" portion. A graphical representation of the distribution of counts across the strip can be displayed by producing a histogram with the light pen. Any evidence of free label can be demonstrated immediately. In our pharmacy, abnormal amounts of free isotope have been demonstrated in certain lots of commercial kits. This technique described is believed to be a quick and reliable way to demonstrate free isotope and the amount present.

DIURETIC AUGMENTED Tc-99m DTPA RENOGRAPHY: A TECHNIQUE TO DISTINGUISH FUNCTIONAL FROM OBSTRUCTIVE HYDRONEPHROSIS. M.J. Tuscan, J.H. Thrall, S.A. Koff, and J.W. Keyes, Jr. University of Michigan Medical Center, Ann Arbor, Michigan.

Differentiation of obstructive from non-obstructive hydrouretronephrosis is an important clinical problem. A new renographic technique utilizing a diuretic challenge has been developed and used clinically to aid in this distinction. Patients receive 10 millicuries of Tc-99m DTPA intravenously (dosage adjusted downward for pediatric patients) and sequential 30 second images are acquired in the posterior projection on a digital computer for 45 minutes. At 15 minutes post dose, .3 mg/kg furosemide is given intravenously. Time-activity curves are generated for each kidney including the renal pelvis. To date over 130 patients have been examined using this technique. Approximately one-half of the population have been pediatric.

The normal renal curve shows a rapid rise and tracer clearance even before diuretic injection. In unobstructed functionally dilated collecting systems the curve rises until the diuretic is given and then declines. In dilated obstructed systems, the curve shows either a flat response or a progressive increase following the diuretic.

Using the above diagnostic criteria the results of the radionuclide study were correlated with long term clinical follow-up, operative findings and/or results of renal perfusion studies in 41 patients. The radionuclide technique correctly categorized all normal systems, 41/48 dilated unobstructed systems and 13/16 obstructed systems.

The diuretic Tc-99m DTPA renogram appears to be both sensitive and accurate in distinguishing obstructive from non-obstructive hydronephrosis and offers a new non-invasive means to evaluate patients with hydronephrosis.

EVALUATION OF CEREBROSPINAL FLUID DIVERSIONARY SHUNTS. S. M. Thorp, Milwaukee Children's Hospital, Milwaukee, WI

C.S.F. diversionary shunts are used in the treatment of hydrocephalus in an attempt to restore C.S.F. circulation. The more common systems direct C.S.F. from the cerebral ventricles to the right atrium, pleural space, or the peritoneal cavity. Unfortunately, these shunts frequently malfunction due to obstruction. Consequently, it is important to have a reliable technique to evaluate shunt performance as it is often difficult to evaluate shunt patency clinically.

A simple radionuclide method can be used to demonstrate shunt function. Tc-99m DTPA is injected into the reservoir of the shunt system. Sequential scintillation camera images of the head and thorax or abdomen demonstrate C.S.F. flow in a patent system and will indicate the site of obstruction in a malfunctioning system.

The procedure is reliable, easy to perform, and can be completed in less than 30 minutes.

CURRENT APPLICATIONS OF NUCLEAR MEDICINE PROCEDURES IN VETERINARY MEDICINE. S. A. Dunlap. University of Virginia Medical Center, Charlottesville, Va.

The use of radioactive isotopes in human medicine has become more advanced over the past several years. The

sensitivity and specificity of these procedures have proven to be a valuable diagnostic tool for physicians and veterinarians due to the increased correlation between the fields of human and veterinary medicine. Nuclear medicine procedures including lung, bone, liver and kidney scans, compartmental measures and thyroid studies are being performed on animals. In the past animals were used as the experimental basis for the majority of the human procedures being carried out today. Veterinary medicine in now benefitting from the diagnostic application of these studies.

The use of nuclear medicine procedures in animals is still somewhat poorly defined. There is a great deal of variability in the technique followed by many researchers. The positioning remains almost identical for human and animal studies but the doses for the same animal study may deviate by as much as 0.2 mCi/kg.

The necessity for the incorporation of nuclear medicine facilities into veterinary hospitals is still not in the immediate future due to the euthanasia option available to the owner, the expense and the general lack of demand. I would recommend a centrally located nuclear medicine facility available to a number of animal hospitals. Examples of the procedures utilized by veterinary medicine will be presented.

QUALITY CONTROL IN NUCLEAR IMAGING. M. Ramanujam, J. Weber and S.J. Goldsmith. Mt. Sinai Med. Ctr., New York, NY.

A routine imaging quality control program has been in operation in our department. This program evaluates all scans for technical quality and identifies problems in 3 categories: Instrument, film or operator related. Instrument related defects are due to improper calibration, dot focus, zipper effect and variable dot density on whole body bone scans, non-uniform calibration of gamma cameras or multicrystal scanners.

Film related artifacts include light leaks, improper positioning in cassette, finger prints and processing errors (over or under exposure), scratched film, fold marks and static exposure.

Operator related errors include improper scan length setting on whole body table, metal objects on patients, failure to remove catheters, I.V. lines, colostomy bags or prosthesis from field of views, improper positioning, and patient motion.

This type of analysis is helpful in identifying a technologist, instrument or departmental operation responsible for deterioration of quality, and provides a basis for corrective measures.

THE ANGER CAMERA AS A SENSITIVE AND RELIABLE AREA MONITOR FOR RADIATION PROTECTION. W.J. Decker and E.G. James. University of Chicago, Chicago, IL.

The modern nuclear medicine department continues to be faced with the need for a simple, convenient and easily manageable radiation protection program. Efficient cost management demands innovative utilization of existing equipment to assure the safety of personnel and patients.

Without collimation, the Anger camera functions as an area monitor for evaluation of surface and airborne contamination. The camera is elevated to its highest position and a 60 sec count is taken with a wide window setting. This count is compared with the background history of the camera. If the background is exceeded by more than 2 standard deviations, a G.M. survey meter is then employed to evaluate the specific source of the contamination.

Background activity levels are determined by serial counts taken on several successive days and compared with the minimum detectable activity for the camera. On a portable camera at our institution the minimum detectable activity was 0.4 μCi at 1 meter for Tc-99m with a background count of 5471 cpm. This compares favorably to G.M. survey meter readings of 0.02 mR/hr from the same source.

With little effort this method simplifies the evaluation of airborne contamination without the need for costly additional equipment. By incorporating this method into the daily quality assurance program, any department, especially the smaller community based laboratory, can benefit from the use of the Anger camera for radiation protection purposes.

LOCALIZATION AND QUANTITATION OF ACUTE MYOCARDIAL INFARCTIONS USING A DUAL ISOTOPE-COMPUTER SUPERIMPOSITION TECHNIQUE.
C.L. Sisodia, St. Joseph Hospital, Baltimore, MD

Localization of the myocardial region as distinct from surrounding bony structures is a major problem in the diagnosis of acute myocardial infarctions when using Tc-99m PyP. We have developed a simple, dual tracer superimposition technique which eliminates these uncertainties in localizing the myocardium.

The technique involves 1) performing a thallium perfusion scan 10-20 minutes post injection of 1.5 mCi of Tl-201 using the anterior, 40° left anterior oblique, and 70° left anterior oblique projections; 2) immediately following, 15 mCi Tc-99m PyP is administered intravenously; 3) 2-4 hour post PyP injection, sequential Tc-99m PyP--Tl-201 images are obtained initially in the anterior view projection by adjusting the gamma camera's pulse height analyzer first to the Tc-99m peak and then to the Tl-201 peak without moving the patient; 4) the same procedure is then used for obtaining both Tc-99m and Tl-201 images in the 40° and 70° left anterior oblique positions; 5) computer processing of these images is performed in a color code mode assigning Tc-99m red and Tl-201 green, followed by direct superimposition of these images.

When increased Tc-99m activity in the PyP image corresponds precisely to a region of decreased or absent activity in the Tl-201 image, there is a high probability that the patient has had an acute MI in that myocardial wall. The uncertainty in defining the exact area of the myocardium is minimized by taking this additional thallium image. Superimposition of these images allows accurate sizing of the acute myocardial infarction.

XENON-127 VS XENON-133 A PRACTICAL OVERVIEW. L. M. Oxaal. University of Virginia Medical Center, Charlottesville, Va.

Most nuclear medicine labs are currently using Xe-133 for lung ventilation studies, along with Tc-99m for perfusion scans, in the diagnosis of lung disease. Numerous reports verify the clinical advantages of using Xe-127, including physical characteristics, spatial resolution, photon yield, radiation dose to patient and ventilation following perfusion scans. Several practical considerations must be taken into account before a lab can convert to the preferred Xe-127 isotope.

An important advantage in using Xe-127 is that the ventilation study can be performed after the perfusion scan only when required to complete a diagnosis. From July 1977-June 1978 only 40% of our perfusion scans were followed by ventilation studies with Xe-127. Thus 60% of our lung scan patients were spared an additional expense, camera time was saved and unnecessary radiation exposure to patients and technologists was prevented.

Xe-127 is expensive. Its current market price is $2.75/mCi compared to $0.14/mCi for Xe-133. With Xe-133's short half life, wasted decay is an important expense factor, especially when large, Curie amounts are purchased. Another factor is dosage. The U.Va. average dose/patient of Xe-133 is 16.7 mCi while that of Xe-127 is only 11.8 mCi. Recycling may someday become a possibility with Xe-127 which should further reduce cost/mCi but the major reduction in price will come from increased production and widespread demand and usage. Shielding of delivery systems must be considered since many systems do not meet shielding requirements for the higher energies of Xe-127.

When Xe-127 becomes more readily available and approved for human use, hospitals should consider these costs of conversion versus the benefits derived.

TECHNETIUM 99m PIPIDA FOR EVALUATION OF HEPATOBILIARY SYSTEM. J. Patel, C. Park and K. Shalan. Thomas Jefferson University Hospital, Philadelphia, Pa.

We have evaluated 125 patients suspected to have various hepatobiliary diseases using 99m PIPIDA. Hepatobiliary scan was obtained following the intravenous injection of 0.1 mCi 99m PIPIDA per Kg of body weight.

Histogram (Table 1) over the regions of interest was obtained for 40 min. using gamma 11/40 in some patients. This was followed by sequential scintiphotos at 5 min. interval up to 60 min. Delayed views were also obtained when this was needed. Routinely an anterior 3" sequential dynamic scan was obtained on patients who have suspected tumor or pseudotumor. This was followed by anterior blood pool scan and routine anterior, posterior and right lateral views. The study was carried out until biliary system and small intestine were visualized.

The results are summarized in Table 2. Sixty-seven of the 125 patients were evaluated for space taking lesion and 44 of these 67 cases were evaluated primarily by PIPIDA. Fifty-eight of 125 cases were evaluated for jaundice, acute cholecystitis, chronic cholecystitis and other indications.

In conclusion we found that Tc99m PIPIDA is useful in evaluation of the following conditions.

1. Evaluation of jaundice.
2. Suspected acute cholecystitis.
3. Tc99m PIPIDA is far superior to Tc Sulfur Colloid in evaluating the problems of pseudodefect due to normal or intrahepatic gallbladder and biliary system.

A RADIONUCLIDE TECHNIQUE FOR GASTRIC EMPTYING STUDIES. C. D. Kauffman and C. D. Teates. University of Virginia Medical Center, Charlottesville, Va.

Scans to determine gastric emptying time have been used to evaluate the post-op status of gastric surgery patients and to determine levels of gastric motility and reflux in patients with obstruction, neuropathology or ulcers.

The radiopharmaceutical was prepared with 2 ozs. oatmeal, 4 ozs. milk, 0.5 ozs. sugar and 1 mCi Tc-99m Sulfur Colloid.

To avoid erroneous results from stomach movements during the scan a dual probe Ohio-Nuclear rectilinear scanner was used in conjunction with an Ohio-Nuclear 8417 color scan interactive video display unit with region of interest capability.

The patient rapidly ingested the pharmaceutical and the probes were passed across the abdomen to determine maximum count rates. The speed was set to obtain an I.D. of 1500 or a maximum scan time of 3 minutes. The abdomen was scanned and a ROI for both probes was set over the stomach. The counts were recorded for both probes and totaled. The same ROI's were retained for each subsequent 3 minute scans. The 3 minute repeat scans were continued until the initial stomach activity was reduced to half, approximately 45 minutes.

A graph was constructed using the log of the total counts of both ROI's for each scan as the dependent variable vs time. The $T_{\frac{1}{2}}$ of the gastric emptying was determined and gastric reflux, if present, detected.

The use of gastric emptying scans have been helpful in detecting abnormal emptying time, gastric reflux, and variance in anatomical structure.

A PHANTOM FOR CLINICAL EVALUATION OF TOTAL SYSTEM RESOLUTION. Gary W. Enos. Holy Family Hospital, Department of Nuclear Medicine, Spokane, Washington.

The intrinsic spatial resolution specifications provided by Anger camera system manufacturers, usually reflect the most favorable experimental circumstances. Intrinsically, current models are capable of resolving high contrast objects separated by 2.5 to 3.0 mm. in the energy region of 140 kev. A more realistic assessment of the resolving power is obtained with the presence of sufficient scattering material to simulate clinical conditions. With hopes of providing a more practical evaluation of Anger system resolution, a phantom designed to simulate clinical parameters was constructed and evaluated. The phantom permits the subjective evaluation of spatial resolution at depths, in the presence of scattering medium and varied input contrast.

COMBINATION GH AND OIH STUDIES FOR STRUCTURAL AND FUNCTIONAL studies of the kidneys. P. Bischoff, J. Washington, F. Kontzen, E. Dubovsky, W. N. Tauxe. University of Alabama/VA Medical Center, Birmingham, AL.

A comprehensive renal function study (CRFS) using 150uCi OIH is a major way to evaluate renal function in transplant recipients in our institution. 1560 such quantitative studies were performed in 326 patients over a six year period. Effective renal plasma flow (ERPF) and excretory index (EI) (ratio of % activity excreted to predicted) differentiate with high precision and sensitivity the type and degree of functional impairment (acute, chronic rejection, ATN and obstruction). However, the anatomical definition of the graft is sub-optimal due to the properties of OIH. 5mCi of Tc-99m-glucoheptonate (GH) were used in a group of 25 patients to see if functional information could be obtained. Poor correlation was found between plasma creatinine, BUN, ERPF and computer calculated quantitative uptake of GH by the graft. No correlation was found between the function and quantitative excretion of GH (% injected dose) at different times after injection. However, sequential scintigrams collected in 3 min frames for 30 min revealed excellent anatomical details of both renal parenchyma and collecting system. Since then 30 additional studies were performed in selected patients, to diagnose segmental infarction, incomplete obstruction by clot, lymphocele, ureteral stricture or edema and urinoma. Information obtained was felt to be as valuable as EXU and sonography.

In summary, while CRFS remains the best way to evaluate functional status of the transplanted kidney, GH scintigrams are excellent way to evaluate complications involving segmental parenchymal lesions and the collecting system.

WHOLE BODY SINGLE-EMISSION COMPUTED AXIAL TOMOGRAPHY. L.A. Bindseil and G.S. Johnston. National Institutes of Health, Bethesda, MD.

Emission computed axial tomographic (ECAT) imaging is gaining some popularity in research using positron emitting nuclides. A more clinically useful aspect of ECAT imaging uses single-photon detectors and therefore the routine radionuclides such as technetium-99m and gallium-67. Following the lead of transmission computed tomography (TCAT), head studies were performed first and more recently whole body imaging has been attempted. At NIH, a prototype whole body, single-photon detector ECAT imager* has been in use for several months. Patients with a wide variety of diseases who were being studied with routine radionuclide imaging were asked to have additional views performed using the ECAT scanner. The liver is particularly well defined and permits easier orientation than other organs. Liver imaging has been selected for presentation of this ECAT technique and for comparison with routine radionuclide images.

From a total of 47 liver studies performed, four have been selected for presentation; a normal one, one showing metastatic tumor, one with infection and one with metabolic disease. The ECAT imager and its operation will be described.

ECAT scanning permits axial tomographic display or radionuclide distribution in most organs and adds another dimension to the routine nuclide imaging study.

*Union Carbide's Cleon 711

IMPROVED VENTILATORY STUDIES UTILIZING NEW DISPENSING DEVICE. J.P. Capuzzi, A.J. Borda, and H.P. Rothenberg. Crozer-Chester Medical Center, Chester, PA.

The necessity of performing the Xenon-133 ventilation study in conjunction with the perfusion lung scan in order to rule out pulmonary embolism has been well documented. However, the patients who need the study most are usually the ones who are least able to tolerate it and are the most uncooperative, making it one of the more difficult studies to successfully complete. The main causes are the inability of the patient to attain full tidal volume on inspiration and the dead space in the tubing between the oxygen bag in the Xenon apparatus and the patient. Because of the first problem, the second is more difficult to overcome and creates added and undue stress. However, by utilizing a new dispensing device, (Auto Mate) the problem is alleviated. The device, which is connected to an oxygen outlet, dispenses the Xenon gas in bolus fashion and enables the technologist to supplement breathing by manually administering oxygen directly to the patient as required. Since the device is coupled to the patient intake assembly and precedes the tubing, there is virtually no dead space. Implementation of this system has improved the quality of the ventilation studies and has made them more tolerable for the patient. It has also facilitated performing ventilation studies on patients on a respirator.

THE COMPLEMENTARY ROLE OF Tc-99m SULFUR COLLOID IN THE INTERPRETATION OF In-111 LABELED WHITE BLOOD CELL SCANS FOR THE DIAGNOSIS OF INTRA-ABDOMINAL ABSCESSES. L.M.Huls, M.P.Frick, M.K. Loken. University of Minnesota Hospitals, Minneapolis, MN.

In-111 whole body scans are useful in diagnosis of intra-abdominal abscesses. Problems of interpretation may result because of normal sequestration of In-111 labeled white blood cells (WBC) in the liver. This may obscure an abnormal In-111 WBC accumulation in an intrahepatic infectious or inflammatory foci. In addition a prominent left lobe may simulate abnormal In-111 WBC accumulation.

To improve diagnostic accuracy, we have employed Tc-99m Sulfur Colloid (Tc SC) at the conclusion of In-111 WBC scans to accurately display distribution of Kupffer cells throughout the liver.

Thirty-five patients were studied by a double isotope approach using In-111 WBC, followed by Tc SC images of various projections on a gamma camera. By visual comparison, the Tc SC study was subtracted from the In-111 scan. In five of thirty-five (14%) patients, the correct diagnosis was facilitated by combining results of In-111 WBC and Tc SC scans. Diagnosis of occult intra-abdominal abscesses is possible by In-111 WBC scans alone in most instances. Diagnostic accuracy may be improved by addition of Tc SC scan in selected patients.

TUESDAY, JUNE 26 — Room 309
1:30 p.m.-5:45 p.m.

SUBMITTED PAPERS II

Moderator: Margaret I. Wilson

COMPARISON OF EXERCISE METHODS USED TO EVALUATE VENTRICULAR PERFORMANCE IN CORONARY ARTERY DISEASE AND CHRONIC OBSTRUCTIVE PULMONARY DISEASE. L. Pytlik, H.J. Berger, A. Gottschalk, B.L. Zaret. Yale University, New Haven, CT

Exercise is a valuable adjunct to the assessment of ventricular performance in man. Since exercise is limited by cardiac function in coronary artery disease (CAD) and by respiratory status in chronic obstructive pulmonary disease (COPD), the exercise procedures needed to reliably evaluate each disease are different. Cardiac performance was measured at rest and during bicycle exercise in 23 patients (pts) with CAD and 16 pts with COPD. Right ventricular (RV) and left ventricular (LV) ejection fractions (EF) were determined from Tc-99m first-pass radionuclide angiocardiograms using a computerized multicrystal camera. In CAD, pts were exercised maximally until limited by fatigue or ECG evidence of myocardial ischemia. Workloads were increased every 3 min in a graded protocol. In COPD, pts were exercised submaximally at a pre-determined level corresponding to 50% of maximal workload. A single 4-6 min exercise load was used. On-line oxygen consumption was measured from expired air to assure steady-state exercise conditions.

The normal (nl) cardiac response to exercise, determined in 15 nl controls, was an absolute increase of $\geq$5% in both LVEF and RVEF. In CAD, an abnl LV response to exercise was the predominant hemodynamic finding (18/23 pts). Abnormal exercise RV performance occurred only secondary to LV dysfunction (12/23 pts). However, in COPD, an abnl RV response to exercise was the predominant finding (12/16 pts). Abnormal exercise LV performance was less common and probably due to latent CAD (5/16 pts). Thus, different patterns of abnl exercise ventricular performance occur in CAD and COPD. The exercise techniques and end-points needed to induce these hemodynamic responses also are different.

TECHNICAL ADVANTAGES AND PROBLEMS IN THE USE OF A BILATERAL COLLIMATOR FOR FIRST TRANSIT CARDIAC STUDIES. R.G. Balon, B.A. Patel, D.G. Pavel, University of Illinois, Medical Center, Chicago Il.

The bilateral collimator provides two simultaneous views which are 60 degrees apart. A 30 degree LAO is obtained on the left half of the detector and a 30 degree RAO on the right half. The main advantage of this collimator is that it provides two simultaneous views during a first transit study. At the same time, the collimator can be kept in close proximity to the chest wall because there is no need to use oblique positions. The bilateral collimator was used on a large field of view camera and was found suitable for first transit studies on normal size as well as on enlarged hearts.

From the technologist's viewpoint, the most difficult problem was to correctly position the collimator, i.e. to correctly place the separation line between the two collimator halves over the heart. This difficulty was due to the fact that the heart is not delineated at the time of positioning, because no radioactivity has been injected yet. Any mispositioning results in a cut of the apex on the RAO view, or of the septum on the LAO view.

In order to facilitate the positioning, a protocol was devised which consists of placing three Co-57 markers on the suprasternal notch (S), the xiphoid (X), and the apex (A) with the patient's thorax perfectly centered under the collimator. Taking advantage of the grid on the persistence scope, which is spaced at intervals of 1 cm, the patient is progressively pulled out toward his right side until the (X) marker is displaced by approximately 1.2 cm for an expected normal heart, and by approximately 1.6 cm for an expected large heart. Using this technique, the positioning has been appropriate in 95% of the cases.

QUANTITATION OF SEQUENTIAL TL-201 IMAGES. G.I. Petroff, T.J. Levy, D.D. Watson, C.D. Teates, G.A. Beller. University of VA Medical Center, Charlottesville, VA.

The purpose of this study was to determine the interobserver reproducibility of a new method for the quantitation of segmental myocardial thallium uptake in sequential studies performed following a single injection. Following thallium injection, images are obtained at 5-20 minutes, 60-80 minutes, and 2-4 hours post injection in anterior and LAO projections. Images are recorded on a computer

for a constant time interval of 10 minutes per image. A special computer program is used which generates a non-uniform background function for each image using non-linear interpolation from a region outside the heart. After background subtraction, the resultant images are translated along x or y axes to cause overlap of the sequential images for corresponding views. Standard software is then used to generate multiple profiles across the repositioned background-free images and peak myocardial rim counts are determined in myocardial segments corresponding to the distribution of the principal coronary arteries. A double blind analysis was performed independently by two people and the quantitative results compared for 83 randomly selected nonoverlapping myocardial segments. A correlation coefficient of 0.99 was obtained between the paired samples with RMS deviation of less than 5 percent. We conclude that the technique is highly reproducible and operator independent. The quantitative results have been used in over 100 clinical studies in which catheterization results are available for comparison and have produced sensitivity and specificity figures both in excess of 90 percent.

THE THREE PHASE LUNG PERFUSION-VENTILATION STUDY. K.L.Barat. Truman Medical Center, Kansas City, Missouri.

Nuclear Medicine has seen many changes in its arsenal of procedures and techniques. The lung scan is one which has seen some of these changes. It has gone from the four view perfusion scan to the combination ventilation perfusion study. If the latter is where you are now, that is three(3) steps behind what we would like to call today's state of the arts lung study.

The missing steps involve both the ventilation and perfusion study. If your institution has a computer, regional ventilation curves and data should be part of your studies. As for the perfusion scan, there are two(2) parts.

First there is the addition of oblique views, both sets if possible, anterior and posterior. Several well documented studies have demonstrated the diagnostic value of these views. The other step has two(2) different routes. If you tend towards injecting your patients in the arm, dynamic perfusion imaging should be done. The technique is very simple and can aid in explaining some perfusion defects and give data possibly otherwise unnoticed. Such as superior vena-cava obstruction, left pulmonary artery obstruction and an indication of cardiac valve disfunction.

The other choice for an injection site is the dorsal veins of each leg. Therefore performing a radionuclide venogram as part of every lung scan.This will enable you to detect venous thrombosis, collateral flow, and venous stenosis.

There is little needed in the way of additional equipment for the perfusion changes. While each one of these steps add time, the diagnostic output is well worth it.

VENTILATION AND CLEARANCE OF THE SINUSES AND MIDDLE EARS UTILIZING XENON-133. J.H. Christie, R.G. Robinson, F.R. Kirchner, D.F. Preston, A.V. Wegst. University of Kansas Medical Center, Kansas City, KS.

Ventilation and clearance of Xenon-133 from the pneumatic spaces of the sinuses and middle ears offers the clinician a non-invasive method for the assessment of regional ventilatory function of the sinus and middle ear cavities.

Five millicuries of Xenon-133 is insufflated using the bilateral negative-positive displacement technique. The subsequent rate of egress is measured by a Searle Pho/Gamma III-HP scintillation camera interfaced to a DEC-PDP-15 computer.

Reliability has been demonstrated by repeated measurements in forty subjects. Preliminary data shows the mean biologic half-time in 68% of the normal population to be: 10.8 min. $\pm$ 5.9 min. for the maxillary sinuses (N=37); 8.7 min. $\pm$ 2.5 min. for the frontal sinuses (N=21); 12.1 min. $\pm$ 2.7 min. for the ethmoid and sphenoid cluster (N=6); and 27.7 min. $\pm$ 12.1 min. for the middle ears (N=17). Abnormal pathology has demonstrated delayed half-time clearances; 78 min. for the ethmoid and sphenoid cluster (chronic sinusitis), and 68 min. for the frontal sinus (rhinitis and barotrauma). Five millicuries deliver an absorbed dose conservatively estimated to be 0.34 rads to the mucosal lining of the sinuses and 0.67 rads to the mucosal lining of the middle ears.

Xenon-133 insufflation provides the otorhinolaryngologist with an additional diagnostic procedure to give objective evidence of the efficacy of medical and surgical therapy.

THE SQUAT SHOT: CAUDAL-CRANIAL AXIAL VIEW OF THE PELVIS IN BONE IMAGING. M.L. Steele, D.F. Preston, N.L. Martin, R.G. Robinson, S.J. Davis; University of Kansas Medical Center, Kansas City, Kansas.

Improved visualization of the pelvic area normally obscured by the urinary bladder in routine bone imaging has been demonstrated by utilization of the squat shot.

After intravenous injection of Tc-99m labeled phosphates, whole body imaging and two additional squat shots were obtained on sixty-one patients selected at random, using an Ohio Nuclear Series 100 Scintillation Scanning Camera. To obtain the squat shots the detector was placed beneath the imaging table with the patient seated above. In the first view the patient's torso was perpendicular to the detector head. In the second, or modified, view the patient's torso was tilted posteriorly forming an approximate 60 degree angle to the detector head. Although the pubis is actually seen better on the modified view, two views were deemed necessary to show the degree of change in the bladder's location.

Three physicians participated in a study to test the validity of this procedure. The physicians diagnosed the sixty-one squat views as normal (28), abnormal (15), or equivocal (18). Whole body studies of the thirty-three patients diagnosed as either abnormal or equivocal interspersed with eleven normal scans were then reviewed and impressions recorded. The final review included both the squat shots and their corresponding whole body images. Review of the squat shots alone demonstrated 30% diagnosed equivocal, whole body images read alone demonstrated 62% diagnosed equivocal, and when the whole body images and their squat shots were reviewed together the equivocal percentage was reduced to 11%.

The squat shot significantly reduces the superimposition of the urinary bladder on pelvic structures, and further aids the physician in definitive diagnosis of the pelvic region.

FILM TECHNIQUE CONVERSION. R. E. Exten, Newcomb Hospital, Vineland, N. J.

One of the problems when evaluating new film for the multi-formaters for the Anger Camera is establishing the proper intensity for patients and quality assurance procedures. The described method enables the technologist to convert techniques from one film to another film rapidly.

With a densitometer, the optical density of floods that were acquired at various intensities is measured for all the films being evaluated and for the film currently being used. Applying a Least Squares Fit to the data, the slope y-intercept and the correlation coefficient for each film is calculated. The optical density for a given technique for the current film is calculated: O.D. = INTENSITY * SLOPE + Y-INTERCEPT. Then, the corresponding intensity setting for the new film is found: INTENSITY' = (O.D. - Y-INTERCEPT') / SLOPE.'

In a double blind study comparing the old film against various new films at their calculated intensity setting, the only visual differences in the films were their contrast and the improved resolution of the single emulsion over the double emulsion film.

CONSIDERATION OF BACKGROUND IN GATED CARDIAC BLOOD POOL STUDIES FOR CALCULATION OF EJECTION FRACTION.
V. R. Reed, ADAC Laboratories, Sunnyvale, Ca.

Background is well understood in nuclear medicine, but the extent to which these counts exist in gated cardiac blood pool studies requires special attention. The main sources of background counts are anatomical overlap of cardiac chambers and vessels, breakdown of radionuclide and scattered radiation. Together, they contribute approximately 50% of the counts in the left ventricle. The general formulation of background with regard to ejection fraction is: $\frac{\text{ED Cts - ES Cts}}{\text{ED Cts - BKG}} = \text{E.F.}$

There have been several techniques to correct for background:
1. A background region defined outside the left ventricle at end diastole.
2. A background region defined by selecting the area that is resulted by subtracting the left ventricle at end systole from the left ventricle at end diastole.
3. No correction of background at all, producing a value that is only an index of ejection fraction.
4. Automatic programs which calculate the background mathematically. There is no manual selection by an operator

Fifteen gated cardiac studies have had ejection fractions calculated by each of the four methods. Each study was acquired by accumulating sixteen images at a matrix size of 64X64 from the 45° LAO view at equilibrium following an injection of 20mci of Tc-99m HSA. Each of the 16 segments represent 1/16th of the cardiac cycle as determined by R-wave markers from a physiological monitor. It is shown that each method has its advantages and difficulties; and also each method yields different results for the ejection fraction. It is important that the method selected is used consistently by everyone in the department.

STUDIES OF VENTILATION IN CHILDREN WITH KRYPTON-81m.
A. Samuel, Y. Lanoie, R. Grant, B. Babchyck, and S. Treves. Children's Hospital Medical Center, Boston, MA.

The use of Krypton-81m for lung studies in children has been evaluated. The advantages found are: 1) a low radiation dose; 2) the ability to obtain quick multiple projections with improved imaging; and 3) simplicity of doing a dual perfusion study with Tc-99m-MAA in the same projection without moving the patient, permitting an accurate matching of ventilation and perfusion.

The patient is examined at tidal breathing. Multiple projections (anterior, posterior, LPO, RPO) are obtained for 500,000 counts on a digital computer on a 64 x 64 matrix format. A perfusion study is obtained simultaneously in the same projection using Tc-99m-MAA with a dose of 50 μCi per kilogram.

The exposure to the lungs in a one year old is approximately 18.6 mrads/mCi/minute with a whole body dose of .32 mrads/mCi/minute. Lung exposure in a fifteen year old is approximately 3.6 mrads/mCi/minute with a whole body dose of about .07 mrads/mCi/minute. These figures are estimated on average lung size.

Krypton-81m is preferred in pediatrics because it has a short half life of thirteen seconds and a low radiation exposure. The high photon flux gives better scintigraphic images in a shorter time than with xenon-133 and dual isotope imaging of the same projection is also something that can be done routinely.

COMPUTERIZED RADIONUCLIDE VOIDING CYSTOGRAPHY.
B. Babchyck, A. Samuel, Y. Lanoie, R. Grant, and S. Treves. Children's Hospital Medical Center, Boston, MA.

Computerized analysis of radionuclide voiding cystography is useful in the diagnosis and management of vesicoureteral reflux in children. Radionuclide cystography results in lower patient radiation exposure compared to the radiographic technique. The purpose of this presentation is to underline the advantages of the use of the computer for a more accurate diagnosis.

The patient is placed supine over a gamma camera fitted with a low energy high sensitivity collimator which includes the bladder and both kidneys in the field of view. The patient is catheterized and residual urine is measured. The bladder is infused with a premixed solution of one mCi of Tc-99m pertechnetate in 500 mls of normal saline. The filling phase is recorded on the computer at one frame per five seconds on a 64 x 64 matrix until the bladder is full. The catheter is then removed and the patient is allowed to void, preferably in the sitting position. The voiding phase is recorded on the computer at one frame per two seconds. Regions of interest are drawn over the renal areas and the bladder. Time versus activity curves, corrected for background, are plotted. The infused and voided volumes are recorded.

Use of contrast enhancement in computerized radionuclide voiding cystography permits the detection of the smallest of refluxes. This method also provides an estimation of bladder volume, refluxed volume, voiding rate and residual urine volume.

RADIONUCLIDE EVALUATION OF GASTRO-ESOPHAGEAL REFLUX AND ASPIRATION IN CHILDREN.
A. Samuel, S. Heyman, B. Babchyck, Y. Lanoie, R. Grant, and S. Treves. Children's Hospital Medical Center, Boston, MA.

We are currently evaluating a new technique in detecting gastro-esophageal reflux and aspiration in children. This method has been found to be an accurate and simple one and should be of particular interest to the technologist working in pediatrics.

One mCi of technetium-99m labelled sulfur colloid is mixed with milk or juice and given orally to the patient. The patient is then placed in the supine position under a gamma camera with a low energy high sensitivity collimator to view the stomach and thorax. The study is recorded on a computer at one frame per minute for one hour on a 64 x 64 matrix format. Image enhancement is used to eliminate the higher counts from the stomach content and to make any esophageal activity apparent.

At approximately two hours after injection, the patient is returned for a delayed computerized image to detect possible activity in the lungs due to aspiration. If activity is present in the stomach, the patient is returned for a twenty-four hour computerized static image.

This method of detecting gastro-esophageal reflux and aspiration has been found to be more sensitive than the conventional x-ray study. Continuous monitoring can detect reflux and aspiration which could be missed otherwise. Computer enhancement increases the chances of detecting abnormalities which may not be seen with the naked eye. It is also a simple procedure for the patient and the technologist because no patient manipulation is required.

HOW TO MEASURE VALVULAR REGURGITATION USING GATED CARDIAC BLOOD POOL SCANS.
Sally L. Merchant, Philip O. Alderson, Gregory R. Schindledecker, Lewis C. Becker, and Pierre Rigo. The Johns Hopkins Medical Institutions, Baltimore, Md.

Several methods for measuring valvular regurgitation from gated cardiac blood pool scans (BPS) were compared in 15 patients (pts) who had left ventricular contrast angiograms. ECG-synchronized BPS were performed in the LAO 40° projection following the intravenous injection of 25 mCi of Tc-99m human serum albumin. The BPS obtained in end-diastole (ED) was displayed and a region of interest (ROI) was drawn around the left ventricle (LV), then the right ventricle (RV). The counts (cts) in these ROIs in ED and end-systole (ES) were determined, using the LV and RV activity curves separately to pick the ES frame. The ES cts were then subtracted from the ED cts to obtain LV and RV count differences and their ratio (LV/RV ratio). Then an ES ROI was drawn over each ventricle using the ES display, and the LV/RV ratio was recalculated using the original ED ROIs, but determining ES cts from the ES ROIs. Finally, these same four ROIs were used, but a background (bkg) subtraction was added for both ventricles. In 8

pts whose angiograms revealed no valvular regurgitation, the ED ROI method gave a ratio of 1.16 + 0.14 SD. The ED, ES ROI method gave a ratio of 0.73 + 0.26. The ED, ES ROI plus bkg method gave a ratio of 0.86 + 0.22. In 7 pts with regurgitation the ED method again gave the highest readings (x ratio 2.6). Both the ED method and the ED, ES method with bkg showed good qualitative agreement with the results of angiography. Either the ED or ES, ES plus bkg methods can be used to measure the degree of valvular regurgitation from gated BPS.

WORKLOAD RECORDING IN NUCLEAR MEDICINE AS A MANAGEMENT TOOL. M. D. Sinclair, J. E. Bertram, and H. W. Wahner. Mayo Clinic and Mayo Foundation, Rochester, MN.

Nuclear medicine tests are labor-intensive and patient-involved procedures. These tests, particularly performed in low volume, present difficulties in planning and in maintaining good quality control. Accurate measurements of time and effort for doing many of these tests have not been properly documented; however, this information is important for pricing tests, determining staff needs, purchasing new equipment, and allocating laboratory space.

We adopted the procedures for workload recording from the College of American Pathologists (Laboratory Workload Recording Method, CAP, 3rd Ed., 1976) and modified them to fit nuclear medicine tests. In this method, the workload recording unit value for a procedure represents the total number of minutes a technologist, clerk, and aid must work in order to complete and report a test. The format identifies eight fields of activities that contribute to the completion of a single test. These are (1) initial handling (clerical), (2) patient testing, (3) recording and reporting, (4) daily preparation, (5) maintenance and repair, (6) solution preparation, (7) glassware washing, and (8) technical supervision. Flow charts were developed for each test and surveyors were trained to properly observe and time the procedures.

Results were tabulated as total time per test for 40 procedures. There was a wide range of work unit values between different tests, in-vivo tests being on the high end and certain camera imaging procedures on the low end of the range. Results of this survey were used to redesign tests for efficiency, evaluate minimum training requirements for laboratory personnel, and set a basis for a realistic fee structure.

THE USE OF MULTIPLANER TOMOGRAPHY FOR IMAGING MYOCARDIAL Tl-201 PERFUSION. C. Ninos, W. Majewski, K. Zimmer, Northwestern Memorial Hospital, Chicago, Illinois.

In an attempt to achieve improved sensitivity of Tl-201 cardiac imaging, a specially constructed multiplaner tomographic collimator is presently being evaluated in our department. This collimator consists of seven independent pinholes and is fitted to a large field of view gamma camera. Using a mini-computer interfaced to the camera, tomographic images of the heart are reconstructed. The patient is injected with Tl-201 under maximum stress and imaging begun within ten minutes of injection. The collimator is positioned in the 40 degree LAO projection at a distance of about four cm. from the chest. 750k of raw data are acquired on the computer in two frames, taking a total of 12-15 minutes of computer time. This procedure is repeated four hours post injection for reperfusion analysis. In order to process this data the images must be corrected for nonuniformity of pinhole response. A flood field using an extended Au-198 source as well as a point source of Au-198 are imaged through the collimator and are stored in the computer. Following flood correction, geometrical reconstruction of the raw data is performed with a Fortran program yielding ten planes, one-two cm. in thickness encompassing the heart. This reconstruction takes ten minutes. Another program is used to construct a graphic profile of perfusion as a function of location. These results allow for easier interpretation of Tl-201 images due to the quantification of the data obtained. This also simplifies comparisons of stress and rest images. The collimator can be used with conventional equipment, and imaging in this fashion requires less time than traditional methods. The additional information obtained from tomographic views may aid in the interpretation of myocardial perfusion images.

IMPROVED VISUALIZATION OF THE GATED LEFT VENTRICLE IN THE RIGHT ANTERIOR OBLIQUE PROJECTION. J.W. Fain, E.V. Garcia, M. Hourani and A. Serafini, University of Miami, Jackson Memorial Hospital, Miami, Florida.

We previously reported a method for isolating the left ventricle (LV) in the right anterior oblique (RAO) projection from equilibrium (EQ) gated blood pool radionuclide imaging*.

We aim to describe a new improved subtraction technique for single injection gated studies to eliminate the right heart (RH), liver and lung activity for improved visualization and definition of the LV walls in the RAO view. A first pass end-systole, end-diastole (ES/ED) gated flow was acquired in RAO following IV injection of 20mCi of Tc - 99m human serum albumin utilizing a mobile gamma camera, physiologic synchronizer and a computer. ES/ED EQ blood pool images were then acquired without moving the patient. A multiple gated acquisition was then performed in the left anterior oblique projection. Elimination of background was done by subtracting fully the gated LV first pass from the corresponding EQ images in the RAO leaving a background mask of RH, liver and lung. Sequential subtraction of the computer smoothed mask from the EQ images then produced enhanced definitive ES/ED LV images. These isolated ES/ED LV images demonstrated the inferior, infero-basal and antero-basal walls more sharply. This improved visualization of the gated LV walls facilitated computer edge detection for calculation of ejection fraction and evaluation of wall motion.

*Garcia, E., Et. al.: Circulation, Volume 55-66: Suppl. #3 1977.

TUESDAY, JUNE 26 — Room 308
1:30 p.m.-5:45 p.m.

SUBMITTED PAPERS III

Moderator: Marion J. Allen

TECHNETIUM-99m PERTECHNETATE EVALUATION OF CSF-SHUNT PATENCY. J.A. Fierce, D.F. Wolczak, and P. Matin, Washoe Medical Center, Reno, NV and Roseville Community Hospital, Roseville, CA.

A simple procedure for the evaluation of CSF shunt patency in patients with diversionary shunts has been utilized in our institutions. It entails injection of a small bolus of Tc-99m pertechnetate directly into the bulb of the shunt, followed by rapid-sequence scintiphoto imaging of the head, chest, and abdomen of the patient. In instances where spontaneous flow did not occur, gentle pumping of the bulb established patency or blockage of the shunt. The procedure requires the same amount of time to perform as a cerebral blood flow; and has been accepted well by pediatric patients.

TECHNETIUM-99m TIN COLLOID: A NEW LIVER IMAGING AGENT. S.M. Giardina, D.F. Wolczak, J.K. Monk, and R.F. Carretta. Roseville Community Hospital, Roseville, Ca.

To assess the efficacy of technetium-99m tin colloid as a liver imaging agent, Phase I,II, and III investigational new drug studies were obtained using volunteers and patients referred to the

Nuclear Medicine Department for liver imaging. The lyophilized tin colloid preparation requires only the addition of technetium-99m pertechnetate to the vial which is then inverted several times to accomplish mixing and tagging of the liver preparation. No boiling, pH adjustment, or multiple preparation steps are needed in comparison to the currently available technetium sulfur colloid preparation. Blood clearance studies show a $T_{\frac{1}{2}}$ of approximately 15 minutes. Thin-layer chromatography shows 98% binding at the time of preparation. High resolution images are routinely obrained using this preparation and the images equal or surpass those obtainable with sulfur colloid. The rapid and simple preparation with excellent binding to technetium-99m makes tin colloid a preferred imaging agent for emergency studies.

IMPROVED CALCULATION OF IODOMETHYLNORCHOLESTEROL (NP-59) ADRENAL GLAND UPTAKE. M. Reeder, K. Koral, M. Gross and W. Beierwaltes. University of Michigan Medical Center, Ann Arbor, MI.

Semi-operator-independent algorithms have been constructed to determine the percent radiotracer uptake (%UPT) into the adrenal glands. The algorithm (A-1) presently in use localizes adrenal activity by locating high count data points surrounding a given center point. A-1 provides accurate estimates of %UPT in normals (N) and patients with adrenal hyperactivity but fails in some cases to adequately localize adrenal activity in dexamethasone suppression (DS) scans as a result of lower target to background ratios (T:B). A-1 was modified to address this problem of low T:B (A-2). A-2 utilizes the A-1 approach and, in addition, weighs activity by the inverse of the distance from the center point. Thus, high count regions in the vicinity of the adrenals, i.e. liver and bowel activity, are excluded from the outlined adrenal area. %UPT calculations from DS adrenal scans of normal (N) patients (n=4), patients with bilateral adrenal hyperplasia including hyperandrogenism (HA) (n=4), and primary aldosteronism (PA) (n=3) were performed using both A-1 and A-2.

Criterion for success in resolving the adrenal image involved acquisition of an accurate outline of the visualized adrenal gland with no more than a 3 pixel displacement from adrenal activity. A-1 was successful in resolving 2 of 11 cases. A-2 was successful in resolving 11 of 11 cases. The mean (L/R) ratio value for all patients was 2.27 using A-1 and 0.94 using A-2. Normal adrenal asymmetry was less accentuated with A-2 (L/R approaching 1), allowing a more accurate estimation of %UPT for interpretation of the DS adrenal scan.

ACCURACY OF NUCLEAR MEDICINE TECHNOLOGIST CALCULATED EJECTION FRACTIONS IN REST AND EXERCISE RADIONUCLIDE VENTRICULOGRAPHY. J. M. Clare, T.J. Brady, K. Lo, J.H Thrall, and B. Pitt. University Hospital, Ann Arbor, MI.

To establish the role of the Nuclear Medicine Technologist (NMT) in the routine quantitative analysis of left ventricular function from radionuclide ventriculograms (RNV) a study was undertaken to correlate left ventricular ejection fractions (EF) between RNV and contrast ventriculography (CV) and to correlate intraobserver EF calculations between Nuclear Cardiologists (NC) and NMTs.

Rest and exercise CV and RNV were obtained on 35 patients within 3 days of each other. RNV EFs were calculated using the time-activity method. Left ventricular regions of interest were assigned frame by frame in the multi-frame RNV using a computed assisted semi-automatic edge detection algorithm. The area-length method was used for the CV ejection fraction calculation.

In 35 patients the NMT calculated RNV EFs correlated well with CV EF having r values at rest of .87 ($p<.01$) and at exercise .89 ($p<.01$). In 26 patients the intraobserver calculations between NMT and NCs also correlated well at rest and exercise.

Summary of Intraobserver Correlations

	Rest	Exercise
NMT vs NC 1	.94 p<.001	.97 p<.001
NMT vs NC 2	.97 p<.001	.92 p<.001
NC 1 vs NC 2	.96 p<.001	.95 p<.001

NMT calculated RNV EFs are accurate compared to CV EFs and correlate well with the values obtained by NC showing that the properly trained NMT can play a primary role in the quantitative analysis of RNVs.

DIFFERENCES IN FILM CONTRAST- A BASIS FOR FILM SELECTION. S. Johnson, Lower Bucks Hospital, Bristol, Pa.

This investigation was undertaken to determine the differences in film contrast and if a particular film is more suited for a specific study. Flood fields and static images were done on different kinds of film. Each film was then exposed with a sensitometeric strip and processed. Visual inspection indicated varying grey scale levels,dot size and clarity. Sensitometeric curves were plotted and contrast, sensitivity, latitude and maximum density were found. With all factors constant, of the seven films tested, two had a reasonably shorter scale of contrast. These might be preferred for dynamic studies. Three films showed longer slopes, depicting a wider latitude film. With more shades of grey, these films might be useful for certain static images. From this study, distinct differences are shown, and in the author's opinion, these differences validate a basis for choice.

MOBILE SCINTILLATION CAMERA VENOGRAPHY TECHNIQUE, Pauline L. Bayer, Harrisburg Hospital, Harrisburg, PA.

The technique described is an easily performed, non-invasive procedure for imaging the venous system of the lower extremities and pelvis using a mobile gamma camera.

Two separate doses of 3 mCi of Tc-99m Microspheres are diluted into two separate volumes of 16-18 cc of normal saline solution (qns to 20 cc) in 20 cc syringes. The mobile gamma camera and materials needed for the venography procedure are transported to the patient's bedside. Butterfly infusion set needles (gauge 23) are inserted into the dorsal vein of each foot. Two tourniquets are applied to each leg, one above the ankle and the other below the knee. The patient is positioned beneath the mobile gamma camera equipped with a low energy diverging collimator. By moving the patient's bed or the mobile camera three sets of serial images consisting of lower legs, knees, femurs, and pelvis are taken: with tourniquets on, with ankle tourniquets released, and with all tourniquets released. For each image 20,000 counts are collected after simultaneous injection of approximately 1-1.5 cc of the dose through the dorsal veins.

After completion of the venogram a perfusion lung scan is performed without an additional injection of Tc-99m Microspheres.

The scintophotos obtained with this effective method are useful in assessing thromboembolic disease in critically ill patients that cannot be transported to the nuclear medicine department.

TECHNIQUE FOR PREPARATION OF TECHNETIUM-99m PYROPHOSPHATE AUTORADIOGRAPHS. J. E. Baxter, Harrisburg Hospital, Harrisburg, PA.

This autoradiograph technique is an effective method for demonstration of radioactive tracer distribution and concentration within tissue. A simplified method for

preparing Technetium-99m Pyrophosphate autoradiographs using the dipping emulsion technique is described.

Specimens are fixed in absolute alcohol or Carnoy's solution for 24 hours prior to paraffin block preparation. Sections of 6 micron thickness are cut. Kodak NTB-2 emulsion, which has been stored at 5°C., is placed into a thermostatically controlled waterbath at 40-45°C. for at least one hour. Under darkroom conditions, the slides are dipped, drained, backs wiped clean of emulsion, and placed into a light-tight box. Exposure period of Technetium-99m Pyrophosphate labeled autoradiographs varies depending upon the findings from the previously developed sections. Autoradiographs are developed in Kodak D-19 developer for 4-6 minutes, rinsed in tap water for 2-5 seconds, and fixed in Kodak fixer for 12 minutes, and dried.

This autoradiographic technique has been successful in demonstrating cellular localization of Tc-99m Pyrophosphate in damaged rabbit myocardium.

IMPLEMENTATION OF AN AUTOMATED PIPETTING STATION FOR RIA'S. L.A. Proctor, D.R. Patrick, and J.A. Faulkner, V.A. Hospital, Oklahoma City, OK.

More RIA laboratories are considering the purchase of an automated pipetting station as their RIA workloads increase. The suitability of such an instrument for any particular laboratory requires careful consideration. In addition, there are no established guidelines for evaluation of automated systems due to their recent availability.

A "PRIAS" automated pipetting station from Packard Instruments was recently purchased for use in our RIA laboratory. We have developed an evaluation procedure which is divided into three phases: 1) Familiarization with the unit; 2) Establishment of quality checks; and 3) Determination as to which RIA procedures will efficiently utilize the unit. The quality checks are subdivided into five areas: 1) timing (pipetting cycle and technologist set up), 2) reproducibility, 3) accuracy, 4) cross-contamination, and 5) recovery of reagents.

We found 1.5% cross-contamination from one sample to the next. The coefficient of variance of both the dispensing and sampling reproducibility was 1.8%. The accuracy checks were comparable. Technologist time was acceptable and the cycle time for sampling and dispensing 50% of the pump capacities was 6.5 minutes per 24 tubes.

The cycle time was found to be the principal factor in selecting the appropriate RIA procedures. For those with short incubations, there is often too great a time lapse between the beginning and end tubes.

The use of the unit does free the technologist for other duties and provides a distinct improvement in technical error, skipped tubes, inaccurate pipetting, etc.

EXTRACTION FRACTION USED TO TEST CLINICAL RENAL AGENTS. P. Fernandes, M. Roskopf, G. Gagne, Z.D. Grossman, J.G. McAfee, A.L. Zens, F.D. Thomas. Upstate Medical Center, Syracuse, New York.

Routine evaluation of renal agents commonly involves imaging, organ distribution and blood clearances on animals. In addition the determination of the extraction fraction (E.F.) further evaluates renal agents. The E.F. is the percentage extracted from the blood during one pass through the kidney at various time intervals.

In dogs two catheters are positioned transfemorally using the Seldinger technique. The venous catheter is placed in a renal vein and the arterial catheter in the aorta, just craniad to the renal arteries. Following peripheral intravenous injection of the renal agent under study and I-131 hippuran, which is used as a control, simultaneous arterial and renal venous blood samples are collected at 16 intervals up to an hour.

The percent extraction fraction is calculated by $A-V \div A(100)$, where A = arterial cpm and V = renal venous cpm. The E.F.'s of four common renal agents are determined over one hour: Tc-99m DTPA declines from 34% at 30 seconds to 25% at 1 hour, Tc-99m GHA from 35% to 32%, Tc-99m DMSA from 8% to 7%, and Hg-197 chlormerodrin from 20% to 12%. The I-131 hippuran E.F. declines from 88% to 50%.

In conclusion, the E.F. method is an ideal way to establish the amount of the renal agent extracted by the kidney during a single pass. This procedure is simple, reproducible, and does not involve sacrificing the animal. None of the Tc-99m-labeled agents studied to date have approached the E.F. of hippuran.

A WORKBOOK FOR N.M.T. STUDENTS. A.M. Steves. Veterans Administration Medical Center, Buffalo, NY.

One of the problems in the clinical training of nuclear medicine technologists is teaching students how to combine their new skills into a correctly sequenced clinical routine.

This paper describes a case study form as a method of providing guided learning experiences during clinical training. In a workbook format the case study form presents the series of skills, arranged in logical sequence, that comprise a clinical procedure. The case study begins with a brief patient history which includes the clinical indication for the nuclear medicine procedure. The section on dose preparation requires the student to enter the radiopharmaceutical label information and the decay factor used to perform the decay corrections as well as the activity and volume administered. The student is also asked to describe aseptic technique and the radiation protection practiced during dose preparation. Other sections of the case study include dose administration, patient handling and positioning, instrumentation, examination procedure and results.

The case study form described is used in the SUNY/B N.M.T. Program. Each student completes 25 case studies during the clinical year; a certain number of specific clinical procedures is required (eg.-5 bone studies). In addition, each student presents 5 case studies of his choice each semester during weekly student clinical conferences.

The case study method not only reinforces and integrates clinical skills, but also provides a means of assessing a student's ability to relate theory and practice. In addition, discussions of the difficulties encountered in the case presentations develop problem solving abilities.

HUMAN RELATIONS WORKSHOP FOR NUCLEAR MEDICINE TECHNOLOGISTS. A.M. Steves. Veterans Administration Medical Center, Buffalo, NY and L.M. Clarke. Erie County Medical Center, Buffalo, NY.

Many nuclear medicine technologists lack the ability to manage their relationships with patients and physicians successfully. Technologists need to discuss the problems arising in these relationships and to learn how to deal with them effectively.

To satisfy this need, a workshop about interpersonal communication was presented. The workshop consists of a series of guided group discussions based on a series of exercises.

The first exercises concern the technologist's perception of himself as a professional. From a list of adjectives, each technologist chooses three words describing who he is, who he would like to be and who he is not as a technologist. To demonstrate the technologist's self-image, small groups each produce a technologist's professional code of ethics.

Before the final exercises, response techniques based on transactional analysis are introduced. The technologists practice these techniques by role playing problem situations they have observed involving patients and physicians. After each role play situation, the options in response patterns are reviewed.

This type of workshop, unlike the usual scientific presentations, offers an opportunity for active participation by all technologists. The response techniques offer some insight into interpersonal communication and new options in dealing with people. Although no solutions to specific problems were found, the tensions stemming from these problems were alleviated through discussion and role playing.

USE OF A BILATERAL COLLIMATOR FOR FIRST-PASS NON-INVASIVE CARDIAC ANGIOGRAPHY. K. Wilkins, L. Reese, P. Purves, S. Dadswell, St. Joseph's Hospital, London, Ont.

First pass, non-invasive left ventricular angiography was performed on 135 patients at rest using the Cordis-Baird System 77 multicrystal camera. A CMS bilateral collimator, which allows simultaneous recording of two projections 60 degrees apart, was used in this study. The patients were injected with a 25 mCi dose of a Tc-99m product and cardiac angiography was performed in the 30 degree left anterior oblique (LAO) and the 30 degree right anterior oblique (RAO) projections.

Use of this new collimator reduces the radiation dosage to the patient since, prior to this, two injections were necessary in order to obtain both an LAO and RAO projection. However, it only allows a field of view of approximately 10-1/2 cm x 14 cm for each projection, therefore, positioning is critical. A protocol was established in our department to minimize the number of repeat studies due to positioning error. The protocol involves the technologist becoming familiar with cardiac axis variation, recognizing it on an ECG report and applying it in order to position the patient accurately.

Utilizing this method, repeat injections were needed on only 15 of the 135 patients studied. Of these 15 repeats, 10 were performed on out-patients on whom no ECG reports were available. The rate of repeats on these out-patients was significantly greater than expected when it was compared to the rate of repeats on in-patients as determined from Chi-square analysis ($p < 0.005$). Therefore, we determined that use of our protocol was indeed significant for proper positioning with this collimator.

We have found this collimator to provide adequate data with a reduction of patient and technologist exposure.

THE TECHNIQUE OF ESOPHAGEAL SCINTIGRAPHY. J. Reilley, G. Applegate, R.D. Tolin, L.S. Malmud and R.S. Fisher. Temple University Hospital, Philadelphia, PA.

The technique of esophageal scintigraphy employing orally administered Tc-99m sulfur colloid has been introduced as a noninvasive technique for the evaluation of patients with esophageal disorders, including symptomatic esophagitis. The technique is also suitable for re-evaluating patients following the application of various therapeutic modalities. The purpose of this study is to review the specific technique for the performance of routine esophageal scintigraphy.

Following an overnight fast,the patient is placed supine under a large field of view gamma camera or standard field of view gamma camera fitted with a diverging collimator. The patient is then given a 15 ml bolus of water containing 300 uCi Tc-99m sulfur colloid, and instructed to consume the entire bolus in one swallow. The patient is then instructed to dry swallow at 15 second intervals for the duration of the study. Data is collected using the gamma camera on-line to a computer for a period of 10 minutes. The data is processed at 1 second intervals for the first 15 seconds and the data summed for 15 second intervals for up to 10 minutes. The results are plotted on time-activity curves. Using this technique,disorders of esophageal motility can be quantitated noninvasively. For example, patients with achalasia or scleroderma have clearly different (abnormal) esophageal clearances using this technique than do normal patients. Similarly, alcoholic patients have abnormal clearance. The technique is also suited to evaluating the effect of various therapeutic modalities in patients with esophageal disorders.

OPTIMIZATION OF RED BLOOD CELL IN VIVO LABELING TIME IN PATIENTS. L.Boshko, J.Reilley, H.Stern, P.T.Makler,Jr., L.S.Malmud, and N.D.Charkes. Temple University Medical School, Philadelphia, PA.

Gated studies of the cardiac blood pool are rapidly becoming one of the most commonly performed tests in nuclear medicine. Tc-99m labeled albumin was the initial radiopharmaceutical for the performance of these multiple pass studies. More recently, red blood cells labeled with Tc99m in vivo, have been shown to provide better contrast between the cardiac chambers and background than was possible in studies performed with Tc-99m labeled albumin. The purpose of this report was to substantiate the optimal time between administration of stannous pyrophosphate (Sn-PYP) and the radionuclide Tc-99m-pertechnetate.

Laboratory studies in mice were performed. Sn-PYP was administered at time zero. Pertechnetate was administered from 15 to 120 minutes later. Blood samples were obtained for up to 60 minutes following administration of the pertechnetate. Optimal red blood cell to background radioactivity occured when the pertechnetate was administered 30 minutes after administration of the pyrophosphate. Time intervals of less than 20 minutes resulted in increased activity in the liver, while delays of greater than 30 minutes resulted in increased relative splenic activity. Optimal imaging in patients was obtained at 20 to 30 minutes following administration of the pertechnetate.

These data suggest that gated cardiac blood pool studies can be performed optimally when these time intervals are adhered to, and that due to institutional logistics, it might be best to keep the patient within the department for the entire study rather than administering the stannous pyrophosphate at the bedside.

THE TECHNIQUE OF GASTRO-CHOLECYSTIC SCINTIGRAPHY (DUAL ISOTOPE SCANNING OF THE UPPER GASTROINTESTINAL TRACT). G. Applegate, J. Reilley, F. Stelzer, P.T. Makler, Jr., R.S. Fisher, L.S. Malmud. Temple University Hospital, Philadelphia, PA.

The technique of combined gall bladder and gastric imaging has been employed to establish normal gastro-cholecystic function on a quantitative basis. In addition, the technique has been employed to characterize abnormal gastro-cholecystic function in patients with a variety of disorders, including alkaline gastritis, chronic cholecystitis functional dyspepsia, diabetes, and the variety of post-gastrectomy syndromes. The technique is also applicable to the in vivo evaluation of various pharmaceuticals.

The purpose of this study is to describe dual isotope gastro-cholecystic scintigraphy.

Equipment required includes a gamma camera with dual isotope windowa capable of producing two images, one at each peak and a gamma camera computer system capable of handling two isotopes. Following overnight fast, the patient is given 5 mCi Tc99m HIDA i.v. One hour later, the patient is fed a 300 ml liquid meal containing 250 uCi In-111 DTPA while positioned supine under the gamma camera on line to the computer. Images are obtained for 1 minute at 15 minute intervals for up to 2 hours. Data is processed and time activity curve generated for gall bladder and gastric areas of interest. Time activity curves were also generated for the ratio of gall bladder to gastric emptying.

Using this technique,the relationship between gall bladder and gastric function in man may be studied in normals and in patients with disease states. Enterogastric reflux can be both imaged and quantitated.

Author Index: Technologist Abstracts

Technologist Scientific Exhibits

Technologist Scientific Exhibits for the 26th Annual Meeting of the Society of Nuclear Medicine will be located in the Exhibit Hall of the Georgia World Congress Center. Full exhibit abstracts and information on times of showings may be found in the Exhibit Program for the meeting. Exhibit titles and authors are arranged below alphabetically by the last name of the first author.

CONTINUING EDUCATION FOR THE COMMUNITY CLINIC. K.L. Barat. Truman Medical Center, Kansas City, MO.

UNIFORMITY COMPUTER ARTIFACTS: THEIR APPEARANCE AND EXPLANATION. K.L. Barat and M. Moretto. Truman Medical Center, Kansas City, MO.

LIVER COMPARISON OF A WHOLE BODY EMISSION CAT SCANNER. L.A. Bindseil, G.S. Johnston, J.R. Herdt, and T.H. Shawker. National Institutes of Health, Bethesda, MD.

Tc-99m HMDP HYDROXYMETHYLENE DIPHOSPHONATE IMAGE QUALITY ANALYSIS. K. Blair. Good Samaritan Hospital, Cincinnati, OH.

A DYNAMIC HEART PHANTOM FOR SIMULATING LEFT VENTRICULAR IMAGING CHARACTERISTICS. J.R. Carr, J.R. Petty, A.T. Yates, R.W. Kyle, R.J. Corcoran, and R.J. Kaminski. Walter Reed Army Medical Center, Washington, DC.

A METHOD TO INDEX THYROID SIZE FOR ANGER CAMERA PINHOLE COLLIMATOR IMAGING. J.R. Carr, J.M. Wilk, P.W. Blue, R.J. Corcoran, and R.J. Kaminski. Walter Reed Army Medical Center, Washington, DC.

A NEW QUALITY CONTROL DEVICE - THE BEARING PHANTOM. J.R. Carr, R.J. Corcoran, F.B. Atkins, R.W. Kyle, and R.J. Kaminski. Walter Reed Army Medical Center, Washington, DC.

THE ANGER CAMERA AS A SENSITIVE AND RELIABLE AREA MONITOR FOR RADIATION PROTECTION. W.J. Decker and E.G. James. University of Chicago, Chicago, IL.

TECHNETIUM-99m TIN COLLOID: A NEW LIVER IMAGING AGENT. S.M. Giardina, D.F. Wolczak, R.F. Carretta, and P. Matin. Roseville Community Hospital, Roseville, CA.

TWO LATERAL VIEWS IN THALLIUM MYOCARDIAL IMAGING. M. Koshy, E. Joyce, and B.P. Sherman. Albert Einstein Medical Center, Philadelphia, PA.

QUALITY CONTROL OF TECHNETIUM-LABELED RADIOPHARMACEUTICALS. D.P. McClure and J.D. Gray. William Beaumont Army Medical Center, El Paso, TX.

QUALITY CONTROL OF QUALITY CONTROL OF NUCLEAR MEDICINE INSTRUMENTATION. Walter L. Robinson. Bionucleonics, Inc., Lancaster, PA.

ATTENUATION NOMOGRAM FOR DOSE-RELATED RENAL UPTAKE OF Tc-99m RADIOPHARMACEUTICALS. J. Shelton, F. Ordway, R. Yost, and E.A. George. VA Medical Center, St. Louis, MO.

TECHNETIUM-99m PIPIDA BILIARY TRACT IMAGING IN CHILDREN. N.A. Thompson. Milwaukee Children's Hospital, Milwaukee, WI.

EVALUATION OF CEREBROSPINAL FLUID DIVERSIONARY SHUNTS WITH Tc-99m DTPA. S.M. Thorp. Milwaukee Children's Hospital, Milwaukee, WI.

SCINTIGRAPHY OF SICKLE CELL ANEMIA. S.M. Thorp. Milwaukee Children's Hospital, Milwaukee, WI.