Abstracts for the Technologist Section Scientific Papers:
29th Annual SNM Meeting Program— Miami Beach, Florida, 1982

A Note on the Scientific Papers

The Scientific and Teaching Sessions Committee of the Technologist Section, Society of Nuclear Medicine, is pleased to present the abstracts of the scientific papers for the 29th Annual SNM Meeting. The scientific papers will be presented on Wednesday, June 16, in simultaneous sessions that will begin at 8:30 am.

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

—Frances Neagley, Chairman

RADIOPHARMACOLOGY/RADIOASSAY

8:30am-11:45am **June 16** **Room 207**

Moderator: Elaine M. Hickman

FREQUENT SEQUENTIAL FIRST PASS RADIONUCLIDE VENTRICULOGRAPHY: IS THE DOSE ELUTED EVERY THREE MINUTES FROM THE NEW AU 195m GENERATOR REPRODUCIBLE? J. Fain, D. Rasmussen. I. Mena. Harbor-UCLA Medical Center, Torrance, CA.

We aim to describe the reproducibility of the new radionuclide generator,Hg-195m, whose daughter, Au-195m, T 1/2 of 30.2 sec., can be used successfully for multiple sequential imaging of the right and left ventricles during graded exercise first pass ventriculography.

The generator was placed at bedside with the patient in a 30° RAO or 45° LAO position. The 2 ml elution was performed with a 5 ml syringe immediately prior to injection. This eluate was flushed with 30 ml dextrose solution through a 3 ml intravenous line (IV) in a bolus fashion into the patient. Measurements with a sodium-iodide probe were taken of the IV line, at 3 sec intervals immediately prior to injection to assess the reproducibility of the counts per injection.

Statistical analysis of this data showed a coefficient of variation of 2.58%±1.88% in 81 injections, thereby substantiating that this generator when eluted every 3 minutes will produce a yield that is not only reproducible but high enough in counts to do successful radionuclide ventriculography sequentially. The variation that was found could be accounted for by the slight volumetric differences produced by manual elution.

There is significant radiation exposure to the operator's hands and eyes due to the technique of operating the valves adjacent to the generator. Repeated elutions (8 per patient) result in a total exposure of approximately 180 mCi and require special precaution. It is advised that a remote control valve system be designed that would prevent manual manipulation of the valves.

RADIOMETRIC MICROBIOLOGIC AND COMPETITIVE PROTEIN BINDING RADIOASSAY FOR PLASMA AND RED BLOOD CELL FOLATE. G.M. Garrison, I.S. Engin, B. Kasecamp, J.M. Waud, E.E. Camargo, T.R. Guilarte, P.E. Dibos, H.N. Wagner, Jr. The Johns Hopkins Medical Institutions, and Franklin Square Hospital, Baltimore, MD

Both competitve and non-competitive protein binding methods for measuring plasma folate levels have been described recently. However, not all of these methods show good agreement with the reference microbiologic assay. A radiometric microbiologic assay (RMA) which shows excellent correlation with the reference microbiologic assay for both plasma and red blood cell (RBC) folate has been described from this laboratory. In the present study we have compared our RMA to a widely used competitive protein binding radioassay (CPBR) for both plasma and RBC folate levels in 63 patients and 12 normal volunteers. In the RMA, duplicate 20 ml vials containing 5 ml of assay medium, 4.8 ml of phosphate buffer, 0.5 uCi (0.1 ml) of [1-^{14}C] glucohate and 0.1 ml of L. casei suspension were prepared for each standard, plasma and hemolysate (RBC) sample. The amount of $^{14}CO_2$ evolved after 18 hour incubation at 37°C was measured with a Bactec 225 system. In the CPBR, a milk-derived folate binder and the pteroylglutamic acid [PGA-^{125}I] form of folate were used. Duplicate tubes for each standard, plasma and RBC samples were prepared. Endogenous serum binders were heat inactivated at pH 9.3. The correlation coefficients between these two methods were r = 0.76 for plasma folate levels and r = 0.82 for RBC folate levels. However, the RMA RBC folate was found to have a better correlation with the patient's clinical status. Therefore, the use of the RMA may be of choice for routine measurement of plasma and RBC folate of clinical specimens.

IN SEARCH OF A PRACTICAL SOLID PHASE MARKER--IN VITRO MODEL. G.M. Thomforde, M.L. Brown, M.K. Dewanjee, J.-R. Malagelada. Mayo Clinic, Rochester, MN 55905.

This study was undertaken to find a marker of the solid phase of gastric emptying that would remain in the solid phase for at least 3 hours, not bind an aqueous marker and be easily labelled with Tc-99m as needed. The in vitro stomach model was a 1 L beaker constantly agitated at 120 rpm's. In the beaker was 500 ml of isotonic saline kept at 37°C. An acid (.2N HCl)-pepsin (1200 µg/ml) solution was infused at 0.7 ml/min. The solid meal consisted of 30 g pancake mix, 10 g eggbeaters and 3 g flour; marker was added. The meal was cooked and cut into 5 mm pieces. The meal was placed in the stomach model. Gastric samples (10 ml) were collected every 30 min. for 3 hours and centrifuged at 640 g for 10 min. Liquid and solid samples were counted to determine the percentage of marker in the solid phase. In vivo labeled liver was used for comparison. Duplicate experiments were performed. Unmarked pancake was tested in a liquid marker to determine the amount of liquid marker attached to the solid phase.

	% in Solid Phase		
Marker	1 hr.	2 hr.	3 hr.
Tc-99m pertechnetate	36.3	33.8	30.4
Tc-99m Sulfur Colloid (SC)	98.7	97.7	95.2
Tc-99m Macroaggrated Albumin	99.6	99.1	98.5
Tc-99m SC in Liver	100.0	100.0	100.0
IN-111 DTPA	7.8	7.0	9.1
IN-111 DTPA (1% Albumin)	1.8	2.8	4.4

Conclusion: The agent which best met the above criteria was technetium-99m macroaggrated albumin in pancake as a solid phase marker and indium-111 DTPA (stabilized with 1% bovine albumin) in water. Although the stability of solid marker is slightly less than in vivo labeled liver, the ease of preparation justifies its use.

PREPARATION OF GALLIUM-68-LABELED PROTEINS, POTENTIALLY USEFUL POSITRON-EMITTING RADIOPHARMACEUTICALS. K.T. Hopkins, K.D. McElvany, and M.J. Welch. Washington University School of Medicine, St. Louis, MO.

Three germanium-68/gallium-68 generators are being evaluated as sources of the positron-emitter gallium-68. Two systems that yield the radionuclide in ionic form appear superior to the commercially-available Ga-68-EDTA generator. The generators are compared with respect to Ga-68 elution efficiency, Ge-68 parent breakthrough, and levels of chemical contaminants. Deferoxamine(DF) has been coupled to human serum albumin(HSA) as a model compound for labeling proteins with Ga-68. The attachment of DF to HSA is accomplished by incubating DF, HSA, and glutaraldehyde, followed by purification via gel permeation chromatography on Sephadex G-50 to remove unreacted glutaraldehyde and deferoxamine. The concentration of the resulting DF-HSA solution is determined by measuring the absorbance at 280 nm. Attachment of radiogallium to DF-HSA is effected by incubation for 15-20 minutes; the radiolabeled protein is then purified of free radiogallium by gel permeation chromatography on Sephadex G-25. The stability of the radiolabeled proteins has been studied by incubation with a 100-fold molar excess of EDTA, followed by chromatography on Sephadex G-50 to separate Ga-EDTA from Ga-DF-HSA. The effect of pH on the labeling of radiogallium was also investigated; labeling at pH 3.5 resulted in minimal non-specific attachment of gallium to the protein. Labeling yields >80% can be obtained at pH 3.5, depending on the amount of DF-HSA used. The use of this technique to attach gallium-68 to various proteins and possibly antibodies should provide a series of useful positron-emitting radiopharmaceuticals.

BIOAVAILABILITY OF p,5n SODIUM IODIDE I-123 FORMULATIONS. W.L. Dunn, H.W. Wahner, H.J. Dworkin. Mayo Clinic and Mayo Foundation, Rochester, MN, and William Beaumont Hospital, Royal Oak, MI.

Sodium iodide I-123 produced by p,5n bombardment contains less than 2% I-125 as the only detectable contaminant at manufacturer's time of calibration. This radiopurity decreases patient absorbed dose and potentially improves thyroid imaging. Past experience (Robertson et al, J Nucl Med 15:700, 1974) indicates drug formulation did not always provide anticipated bioavailability of I preparations. Recently, available formulations of p,5n sodium iodide I-123 were studied for bioavailability at two medical institutions using dual isotope methods.

Radiopurity of p,5n Iodine-123 provided in capsule formulations was established with a Ge(Li) detector and standard multichannel analyzer methods. Spectrum analysis demonstrated high purity I-123 with fewer radiocontaminants than previously tested commercially available products.

Bioavailability of p,5n sodium iodide I-123 in capsule formulation was compared against sodium iodide I-131 in solution simultaneously administered to patients at two medical institutions. Thyroid uptake measurements obtained 2-30 hrs postadministration in 14 patients varied less than 2.4% (uptake) between capsule I-123 and liquid I-131 (0.6% difference at 3.7% uptake and 1.6% difference at 86% uptake). Expressed as a percentage of the I-123 uptake, the relative difference averaged 7.5% ± 9.5% (n=34, 1 SD). For the 24-hour measurement, the relative difference averaged 2.8% ± 1.2% (n=13).

This study demonstrated high radiopurity and excellent bioavailability of recently available formulations of p,5n sodium iodide I-123 for thyroid uptake and imaging studies.

HYDROLYZED REDUCED Tc-99m DETERMINATIONS IN Tc-99m PYROPHOSPHATE. W. Majewski, A.M. Zimmer, S.M. Spies, and L. Sweeney. Northwestern Memorial Hospital, Chicago, IL.

High levels of hydrolyzed reduced Tc-99m (Tc-HR) are sometimes encountered, particularly in Tc-99m pyrophosphate, which does not correlate to clinical images. This study was performed to evaluate Tc-HR levels in Tc-99m pyrophosphate with different chromatography systems. The systems evaluated included heat dried ITLC-SG strips with distilled water, dessicator dried ITLC-SG strips with distilled water, water saturated ITLC-SG strips with distilled water, dessicator dried ITLC-SG strips and dilute pyrophosphate solution, and dessicator dried ITLC-SG strips and distilled water (prespotted with stannous pyrophosphate). Tc-99m pyrophosphate was formulated by adding approximately 300 mCi of pertechnetate and incubating the solution for four hours. Chromatographic analysis was performed using the systems outlined and the data statistically summarized. A comparison between miniaturized chromatography and gel chromatography in determining Tc-HR levels in Tc-99m pyrophosphate was also performed. Tc-99m pyrophosphate was prepared as described and chromatography performed after 6 hours. Results showed no significant differences in Tc-HR between all the systems evaluated ranging from 7.0% ± 0.2% (S.D.) to 8.2% ± 0.1% (S.D.). No specific chromatography system was superior in evaluating Tc-HR in Tc-99m pyrophosphate. Significantly higher Tc-HR levels were observed with miniaturized chromatography system (20.5%) when compared to gel chromatography (9.1%). We conclude that all chromatography systems evaluated were about equal in determining Tc-HR levels in Tc-99m pyrophosphate and miniaturized chromatography tends to overestimate the levels of Tc-HR when compared to gel chromatography.

USE OF Cr-51 LABELED SAMPLES OF HOMOLOGOUS PACKED RED BLOOD CELLS TO PREDICT ACUTE TRANSFUSION REACTIONS. L. W. Weiss and J. A. Senecal. VA Medical Center, Albany, New York.

Cr-51 has been used to chart red blood cell survival in clinical nuclear medicine since the 1950's. However, the technique of using Cr-51 tagged homologous red cell samples of potential donor blood units to predict potentially fatal acute transfusion reactions has been used very infrequently. We have had the opportunity to utilize this method to monitor nine transfusions given to patients with complex cross-matching difficulties. Discussion of acute transfusion reactions and proper tagging and handling of donor blood is included. Comparisons are made between the one-hour transfusion survival method and the twenty-four hour method. Results of the nine monitored transfusion survival studies are presented and compared to the success of each actual respective transfusion. Our findings show that the one-hour survival method was as accurate as the twenty-four hour method in predicting acute transfusion reactions. Of the total number of transfusions given, the Cr-51 survival study predicted accurately the success of the transfusions prior to administration.

ADAPTATION OF THE ANGER CAMERA FOR CHROMATOGRAPHIC QUALITY CONTROL OF NUCLIDE BINDING AFINITY. Thomas D. Kay, Mary E. Thompson, Douglas V. Porter, David L. Johnson, David Romo, and Sandy J. Riahi. USAF School of Aerospace Medicine, Brooks Air Force Base, Texas.

Chromatographic quality control of radiopharmaceuticals is an important aspect of nuclear medicine. Chromatography is a reliable means of assay and several methods are available to evaluate the results.

Autoradiology, exposing x-ray film to the developed chromatograms, provides results comparable to that of the original chromatogram. Although it provides permanent record of the distribution of radioactivity exposure time, autoradiology can take several hours to several days or weeks, depending on the level of radioactivity. Other methods require sections of the absorbent to be cut-up and counted in gamma or liquid scintillation counters. These are time consuming and do not give adequate resolution. Chromatogram strip scanning provides a linear display of CPM on chart paper and represents distribution of radioactivity on the chromatograph sample.

A new technique has been developed using the Anger Camera interfaced with the computer to evaluate chromatograph strips. The chromatograph strip is wrapped in

plastic (to avoid contamination) and imaged. The computer algorithm searches out the area of interest, plots relative flow, calculates vital statistics which are stored in the image header block for future reference. Advantages of this technique are short scanning times, detection of multiple energy isotope samples, improved resolution, utilization of on hand equipment, a hard copy output and a permanent digital chromatogram for future analysis.

INSTANT RADIOPHARMACEUTICAL IDENTIFICATION BY SIMPLE COLORIMETRIC ASSAY. J.T. Bushberg, P.B. Hoffer, Yale University School of Medicine, Department of Diagnostic Radiology, New Haven, CT.

Despite advances in radiopharmaceutical integrity, sensitivity and specificity, there still exists a need for simple, fast, yet effective quality control (q.c.) procedures. Failure to routinely practice good q.c. inevitably leads to increased incidence of misadministrations with the subsequent burden this imposes on the patient as well as the department. This is particularly a problem with the ubiquitous Tc-99m-labeled compounds. Thus it is desirable to have a simple test that will instantly identify the radiopharmaceutical prior to injection.

We have developed specific colorimetric assays for various radiopharmaceuticals that allow the technologist to instantly determine the postpreparation identity of the labeled pharmaceutical. The procedure is simple, quick and does not result in any increase radiation dose to the technologist.

Qualitative verification of the radiopharmaceutical is achieved by placing a small drop of the dose on a small pretreated test strip and comparing the color change to a standard. The mechanism by which the color changes occur depend on detecting either the specific oxidation-reduction potential, complex ion formation, and/or the hydronium ion concentration of the labeled pharmaceutical. We have developed specific analyses for Tc-99m-DTPA, Tc-99m-Pertechnetate, Tc-99m-MAA, Tc-99m-MDP, Tc-99m-glucoheptonate and In-111-DTPA.

We are currently developing similar tests for Ga-67, Tl-201, Tc-99m-sulfur colloid and Tc-99m-Desofenin. In addition we are investigating intervendor differences which may complicate this analysis.

RADIOCHEMICAL EVALUATION OF COMMERCIAL Tc-99m HYDROXYMETHYLENE DIPHOSPHONATE. W. Majewski, A.M. Zimmer, and S.M. Spies. Northwestern Memorial Hospital, Chicago, IL.

This study was performed to determine the radiochemical purity and stability of Tc-99m hydroxymethylene diphosphonate (HDP) over a five week clinical period. Chromatographic analysis was performed daily up to 8 hours after reconstituting with 150-250 mCi pertechnetate in a total volume of 5.0 ml. Miniaturized chromatographic analysis included Whatman 31 ET with acetone to evaluate free pertechnetate and Gelman ITLC-SG with distilled water to evaluate hydrolyzed reduced Tc-99m (Tc-HR). The stability of the preparations with increasing pertechnetate levels were evaluated by adding between 100-400 mCi of pertechnetate to each vial and analyzing the preparations up to 7.5 hours after formulation. In addition, the effect of air (oxygen) on the Tc-99m HDP preparations was evaluated by adding approximately 5.0 ml of air to one of two preparations, each containing approximately 250 mCi of activity, and chromatographically evaluating each preparation up to 8 hours after formulation. In general, the preparations evaluated were relatively stable up to 4 hours post-formulation. Higher levels of free pertechnetate were observed with longer time intervals (greater than 10% at 8 hours). Adding up to 400 mCi of pertechnetate to the radiopharmaceutical preparation did not significantly affect the radiochemical purity of the preparation. However with increasing pertechnetate levels, increasing instability was generally observed. The introduction of air into the preparation drastically increased the formation of free pertechnetate. Tc-HR levels were less than 2% throughout all the studies. In conclusion Tc-99m HDP preparations were relatively stable. However, careful dispensing technique must be utilized to avoid any introduction of air.

APPLICATIONS OF LOW COST DESK TOP COMPUTERS IN RADIOPHARMACEUTICAL PRODUCTION AND TESTING. R.C. Klemm and M.R. McKamey. Benedict Nuclear Pharmaceuticals, Inc., Golden, CO.

A 48K desk top computer with on-board clock, printer, disk drive and video monitor has been interfaced with conventional nuclear medicine instrumentation used in the production and quality control of radiopharmaceuticals. Software has been written to integrate the computer into a complete program of testing, calibration and analysis. Permanent radionuclidic, radiochemical purity and assay records that meet all regulatory requirements are inexpensively and efficiently generated by this system. Such a system can be easily integrated into institutions involved in radiopharmaceutical research and development.

Interfaced with a multichannel analyzer, the computer analyzes detector efficiency and radionuclidic composition. Computer comparison of measured radionuclidic impurity versus acceptable radionuclidic impurity levels results in rapid pass/fail analyses used for release of raw material and final drug product. Test data is stored on magnetic disk which allows easy retrieval.

Interfaced with a single channel analyzer and dose calibrator, the computer energy calibrates, measures dose activity and analyzes radiochromatograms. Rapid computer comparison of measured activity to regulatory and in-house limits permits real time pass/fail analysis of the drug product during production.

Finally, the computer has been integrated into drug manufacturing operations to compute dilution factors, decay correcting measured activities, and in-process testing for machine and concentration variation.

CLINICAL/COMMENTARY

8:30am-10:00am **June 16** **Room 205**

Moderator: Ronald A. Fomin

MANDIBULAR ASYMMETRY: IMPROVED DETECTION AND LOCALIZATION OF ABNORMAL GROWTH IN THE MANDIBLE WITH COMPUTERIZED SCINTIGRAPHY. R. Davis, G.J. Cisneros, S. Treves and L.B. Kaban. Children's Hospital Medical Center, Boston, MA

A computerized scintigraphic method for the diagnosis and localization of areas of abnormal growth in the mandible has been developed.

Tc-99m methylene diphosphonate (200 μCi/kg of body weight) is given intravenously three to four hours before imaging. Anterior and lateral views of the head are obtained with a high resolution collimator. Magnification with a pinhole collimator is used for greater anatomical detail. The head is held hyperextended using a specially designed holder. Another image is obtained of the posterior lumbar spine. All images are recorded on the computer on a 128x128 matrix. Regions of interest are marked on the lateral projections over the condyle, ramus and body of the mandible. A region is marked over the 4th lumbar vertebra and another over the background area. A ratio of uptake is calculated as follows:

$$\frac{\text{Counts in region - background}}{\text{Counts in vertebra-background}} = \text{Ratio of uptake}$$

Normal values of this ratio in children of all ages referred for bone scintigraphy and without facial abnormalities were obtained. Patients with mandibular asymmetry due to a hyperplastic growth center reveal increased uptake in that center.

Computerized radionuclide scintigraphy is an accurate and non-invasive technique for the detection and localization and follow-up of abnormalities associated with mandibular asymmetry.

XENON MUSCLE BLOOD FLOW - A PRACTICAL METHODOLOGY FOR THE GAMMA CAMERA. D. Grassley, D. Singer, J. Thrall, M. Tuscan, J. Cronenwett. Univ. of Mich. Medical Center, Ann Arbor, MI

Xenon muscle blood flow (MBF) studies have used probes, strip chart recorders and manual calculations for determination of MBF in patients with peripheral vascular occlu-

sive disease (PVOD). A reliable, convenient and statistically valid method has been developed for the gamma camera. To provide high count sensitivity for xenon MBF studies on the gamma camera, a special collimator was fabricated using 1/4" lead sheeting. The collimator has two 6 cm diameter holes, 22 cm apart, and a 5" vertical septum separating them to prevent crosstalk which allows simultaneous examination of both legs. Intramuscular injection of 200 uCi Xe-133 in saline is given followed by computer acquisition at 2 sec/frame for 14 min in 32 x 32 byte matrix. After acquisition is initiated, thigh blood pressure cuffs are inflated and subsequently deflated to induce stasis and hyperemia respectively. Time activity curves for each leg are generated, converted to log values and the slope (k) calculated for rest and hyperemic phases using a linear fit routine. MBF (ml/100gm of muscle/min) is given by: MBF = 100·x·k, where x is the partition coefficient of xenon between muscle and blood (x = 0.7ml/gm). Nineteen patients, 5 normal volunteers and 14 with peripheral vascular disease, were studied. The count rate in each frame improved by a factor of 15 compared to prior studies with conventional high sensitivity parallel hole collimators. The two phases of the curves (rest and hyperemia) were also better delineated. Hyperemic MBF in normals was found to be >30 ml/100gm/min. In patients with clinical PVOD, hyperemic MBF ranged from 3 to 25 ml/100 gm/min. The special collimator allows improved count sensitivity and allows simultaneous examination of both legs for determination of MBF using the gamma camera.

SIMULTANEOUS ASSESSMENT OF GASTROESOPHAGEAL REFLUX BY SCINTIGRAPHY AND ESOPHAGEAL pH PROBE. R. Davis, S. Treves, B. Smith and H. Winter. Children's Hospital Medical Center and Harvard Medical School, Boston, MA 02115

A method for simultaneous computer recording of dynamic scintigraphy and pH from an esophageal probe for the diagnosis of reflux has been developed.

Patients with pH probes in the lower esophagus for a 24-hour evaluation were kept fasting for at least four hours prior to their examination. One mCi of Tc-99m sulfur colloid was mixed in 5 to 10 ml of 5% dextrose and water and given to the patient orally. A follow-up volume of tracer free dextrose solution was given corresponding to the patient's normal feeding volume. Patients were then placed in a supine position under the gamma camera. The output of pH was connected via an analog to digital converter to the computer.

Simultaneous scintigraphic and pH recordings were collected on a computer for a period of one hour at one frame every 30 sec on a 64x64 matrix. Patients returned after three hours for a follow-up examination at which time five minute static scintigraphy was taken over the lung field to evaluate for aspiration. If activity was still present in the stomach, a 24-hour static image over the chest was obtained.

Computer analysis demonstrated scintigraphic evidence of gastroesophageal reflux in certain patients and was corroborated by a drop in pH recorded simultaneously by the probe. This supportive evidence validated the accuracy and sensitivity of radionuclide evaluation of gastroesophageal reflux. In addition, duration of reflux and gastric emptying measurements can be obtained as well as evaluation of aspiration in a well documented, non-invasive low dose examination.

THE USE OF 51Cr SODIUM CHROMATE IN DETECTING GI-GU FISTULAE. Deborah L. Honig, R.T. University of Virginia Medical Center, Charlottesville, VA

The diagnosis of GI-GU fistulae is often costly, complex and occasionally difficult. Two U.Va. Medical Center physicians have recently developed a simple and non-invasive method of detecting such fistula using orally ingested 51Cr Sodium Chromate. The procedure can be done on an outpatient basis and involves the patient drinking a 30 uCi dose of 51Cr labelled Sodium Chromate diluted in 30cc of water. All patient urine is collected for a period of 72 hours. The volumes are recorded and 3cc samples are counted in a standard gamma counter. The counts obtained from the counter printout are then entered into a computer via a BASIC language program along with background counts and dose amount. The computer processes all information and calculates the percentage of total dose and the total microcuries in each sample of 51Cr Sodium Chromate originally given. Excretion of .6 or more is considered positive or abnormal. Of the nine patients tested, five were shown to have abnormal excretions and subsequently all five were confirmed to have fistulous communications at surgery. On a cost comparison basis, the Chrome 51 test compares favorably with Roentgenologic studies such as IVP, BE and Cystogram currently employed to diagnose GI-GU fistulae and is considered to be a reliable screening procedure for patients with suspected fistulae.

INTRA-OPERATIVE SCINTIGRAPHIC PROCEDURES: PROBLEMS AND SOLUTIONS. T.F. Brown, C.R. Heinen, and B.M. Patel. Sections of Nuclear Medicine and Surgical Nursing. The University of Chicago, Chicago, IL.

The need to confirm the surgical placement of catheters feeding the hepatic arteries prompted the development of a method for performing intra-operative scintigraphic procedures. Such a procedure posed three potential problems.

First, could a gamma camera be used in an operating room by a technologist in a manner that did not interefere with the surgical procedure. Second, could the radiopharmaceutical be administered in a manner that did not compromise good radiation protection or surgical practice. Finally, surgical staff concern about the potential hazards of ionizing radiation.

The imaging procedure is performed following the injection of 5 mCi Tc-99m MAA through the catheter by the surgeon. A single anterior image is obtained with a low energy mobile camera fitted with a diverging collimator. A nuclear medicine technologist monitors the handling of the radiopharmaceutical and positions the camera to obtain images.

An educational program was initiated: Nuclear medicine personnel were instructed on operating room etiquette. Operating room staff were instructed in basic nuclear medicine technology and radiation protection. Radiation intensity from the patient was measured with a G-M tube at different locations from the patient, to be determine which members of the surgical team should be monitored with a film badge.

The problems encountered were satisfactorily resolved through good interdepartmental communications. This has enabled the successful completion of 30 intra-operative studies of hepatic perfusion to date.

RADIONUCLIDE VENOGRAPHY. B. J. Park, R. L. Luger, and P. E. Dibos. Franklin Square Hospital, Baltimore, MD.

The onset of deep venous thrombosis is insidious, with only half of those who have it exhibiting clinical symptoms. Several million individuals a year are afflicted, and if not detected and treated, deep venous thrombosis can lead to pulmonary embolism and even death. In order to detect thrombi which commonly arise in the lower extremities, Webber and others introduced radionuclide venography in 1969. Since then, there has been much written in the literature, but radionuclide venography is still not universally performed as a routine procedure. The purpose of this paper is to share an excellent technique which has been used routinely in our institution for the past 3 and one-half years. Using Tc-99m Macroaggregated Albumin, saline, tourniquets, and 25 gauge, winged infusion sets, the technique is easy and produces minimal discomfort. A lung scan is performed immediately after the leg images are recorded so that "silent" pulmonary emboli can be detected. The clinical usefulness of the procedure is evident in the increased demand for the study in our institution; we have performed over 400 radionuclide venography studies to date. Correlative information with radiographic contrast venography is available in 30 cases. We believe that the advantages of radionuclide venography far outweigh its disadvantages and strongly feel that the procedure is currently underutilized.

CLINICAL/COMMENTARY

10:20am-12:05pm **June 16** **Room 205**

Moderator: Ronald A. Fomin

GUIDELINES FOR PATIENTS AT HOME FOLLOWING TREATMENT WITH RADIOIODINE. D.A. Bozik,

U.S. Nuclear Regulatory Commission, Washington, DC.

This project was undertaken to develop a clearly written and illustrated pamphlet that lists guidelines on radiation safety for the radioiodine ablation therapy patient to use after release from the hospital. The physician has already determined that the benefits of this therapy far outweigh any small radiation risks to the patient, and that precautions should be taken at home. Precautions are necessary because the radioactive iodine medicine can pose a slight radiation risk to those around the patient.

Since the patient may forget verbal instructions, there is a need for printed material. Printed material on radiation safety that is plainly written and illustrated also provides clarification to the patient hesitant to ask questions. From the perspective of radiation safety, the more informed patients are about nuclear medicine procedures, the less apprehensive they will become. The vehicle to accomplish this is through clearly written and illustrated guidelines to supplement the physician's directions.

STYLES OF MANAGEMENT IN NUCLEAR MEDICINE TECHNOLOGY AS SEEN THROUGH A TRANSACTIONAL ANALYSIS VIEWPOINT. J.W. Fain, LAC Harbor-UCLA Medical Center, Torrance, CA.

A successful Chief Technologist or Department Manager can often be viewed as one who can appropriately move from one life position to another depending upon circumstance and need. These life positions are 1) I'm OK - so ar you, 2) I'm OK - you are not, 3) I'm not OK - you are and 4) I'm not OK - neither are you. Each of these four categories can be described in terms of objective (need), method and style Each approach can be effective when measured by appropriateness.

1. I'm OK - so are you;
objective: determine and agree on what's right,
method: inform (give ideas, fact, opinion),
style: developmental,
appropriate when: resistence is high.
- commitment is required.
- facts and information
- innovation, creativity

2. I'm OK - you are not:
: get my way,
: persuade, threaten,
: controlling,
: speed is important,
: joint commitment isn't needed,
: you control all aternatives.

3. I'm not OK - you are;
objective: go along with your way,
method: accomodate; comply,
style: relinguishing,
appropriate when: other person has the facts
- other person is emotional
- problem is not job related
- the growth of the other person is paramount.

4. I'm not OK - neither are you,
: withdraw,
: defensive,
: confusion or irritation,
: issues are outside your responsibilities,
: legal or ethical issues.

SHOULD TECHNOLOGISTS PERFORM RIA TESTS OR LET LABS TAKE OVER?
Woodrum, C.E. George Washington University Hospital

If ever a two-edged sword existed, this topic is that sword. RIA services, as far as appropriate quality control guidelines and acceptable criteria for reporting test results, are not mentioned under the "Nuclear Medicine Services" section of the 1982 JCAH guidelines, so is the RIA lab indeed part of the nuclear medicine department? I feel very strongly that the RIA lab does belong in the nuclear medicine department, if the department develops a comprehensive training program to educate and/or re-educate the tech in all facets of laboratory procedures. In my presentation, I will present a step-by-step training program designed to adequately educate nuclear medicine technologists in the proper techniques and applications of the radioimmunoassay lab, and the importance of keeping this section in the nuclear medicine department.

VARIETY IS THE SPICE OF LIFE. M.R. Boyd, M.R. Adams. Nuclear Medicine, Baptist Memorial Hospital, Memphis, TN.

Nuclear Medicine Schools currently award students with degrees or certificates. This allows a better means of meeting the individual's and health facilities' needs by allowing a greater number of individuals to enter the field. Nuclear Medicine Technologists (NMT) should not support a single type of education, but rather improve upon the two types now in existence.

Based on CAHEA information, approximately 70% of the current schools are certificate programs, 13% associate degree, and 17% baccalaureate degree. However, the allowable school capacities vary with approximately 58% of the students in certificate programs and the remaining 42% in degree programs. Requirements to enter a certificate program are flexible. 65% accept both college or allied health degreed individuals and radiologic technology (RT) graduates in the same program. The geographical distribution of degree to certificate programs is not the same throughout the country, with the West and Midwest offering fewer degree programs.

To limit the educational opportunities in Nuclear Medicine to only one type of program would suppress the profession. The individual holding a college degree with no practical use and the RT who wishes a more stimulating career should be allowed an education in NMT as well as the individual seeking a degree in the field. NMT should support the quality of the education without limiting the variety.

OUR COMMUNICATION STYLE WITH PHYSICIANS - HELPING OR HINDERING OUR PROESSION? J. W. Fain, LAC-Harbor-UCLA Medical Center, Torrance, CA.

As an Intern Marriage, Family and Child Counselor with a Graduate degree in counseling psychology and having more than eleven years experience as a professional technologist the communication pattern I have seen most often between the physician and technologist is one based upon an authoritarian style. This style mandates clear division of power and creates a dual system of "Authority" and "Dependency". These categories are pervasive throughout our culture and it is not difficult to recognize that the predominant identification a technologist makes is one of dependency upon the authority. Being and most importantly, feeling dependent upon a higher authority often generates thought processes that tend to keep us in this style. Additionally strong influences are placed upon us just so this style maintains status-quo. As a technologist status-quo may mean that we are denigrated to an unprofessional position of serving the physician and not realizing our true value to patient care. Not realizing our rightful value can build to feelings of resentment, anger and behavior that is game ridden. The games pay us back by obliquely regaining our power but since this is not done directly we may still feel like a peasant surrounded by nobility. This sense of powerlessness can be seen in the high turnover rate attrition, low pay and difficulty in recruiting new students into the field of paramedical technology. Methods of dealing with this situation are not difficult to learn and does not involve toppling the towers of established power. These include "No Lose" problem solving and value conflict negotiation. This communication is necessary if we expect to stay potent, attract and gain our fair share and feel as noble as the nobility that we so often work with.

SHOULD TECHNOLOGISTS SUPPORT COMMERCIAL, CENTRALIZED RADIOPHARMACIES? W. Thompson, St. Joseph's Hospital, Tucson, AZ.

Responding: Pro
The submitted paper addresses the significant factors influencing decisions on utilizing the services of a commercialized central radiopharmacy. The author documents these factors to justify his position of support of the use of these services. Among the topics addressed will be time savings, expediency in record keeping functions, reduction of radiation exposure to staff, the

routine performance of quality control measures otherwise unavailable, and the logistical problems of delivery, efficient material utilization, and waste disposal. The author's experience with both in-house preparation and services supplied by a centralized radiopharmacy will be reviewed. A brief review of the desirable features of the unit-dose concept in hospital-based health care delivery systems will be included, emphasizing such items as cost effectiveness and error rate reductions. The impact of centralized radiopharmacy services on the practicing technologist is most evident in the area of time utilization within the department. Time previously spent in routine pharmacy can now be allocated to the development and refinement of clinical procedures and quality assurance measures. This may become increasingly important as the implementation of computer technology continues to aid the diagnostic functions of the department.

ISSUE RESPONSE: ONE YEAR'S EXPERIENCE UTILIZING A COMMERCIAL RADIOPHARMACY. D.S. Winter. Penrose Hospital, Colorado Springs, Colorado.

Approximately one and one half years ago Penrose Hospitals reviewed the possibility of utilization of a centralized commercial radiopharmacy. As an acute care hospital with an on-site radiopharmacy, and the need to supply a smaller satellite hospital with radiopharmaceuticals, there were many factors to be reflected upon in making the change to an off-site commercial facility. Staffing, financial impact, and radiation exposure were items reviewed in the feasibility of such a change. The potential loss of specific job skills was a personal consideration for many members of our technical staff. After much deliberation, the decision to utilize a commercial radiopharmacy was made. It is my intent to relate to those considering such a change our experience after one year with this type of service. Staffing, financial, and radiation exposure factors shall be addressed in support of this decision.

INSTRUMENTATION

1:30pm-4:15pm **June 16** **Room 207**

Moderator: Elaine M. Hickman

QUALITY CONTROL IN SPECT. K.L. Greer, R.J. Jaszczak, and R.E. Coleman. Duke University Medical Center, Durham, NC.

Single photon emission computed tomography (SPECT) requires imaging with controlled, optimized conditions to obtain the goal of producing additional, accurate, and reliable information regarding radiopharmaceutical distribution within objects. Camera, electronic and software characteristics that may assume little or no significance in conventional imaging may introduce serious degradation to SPECT images. For SPECT quality control the camera should undergo the routine flood, bar, line and point source experiments as used for conventional, or planar imaging. If planar performance is satisfactory, camera to computer centering and gain adjustments should be performed and verified prior to SPECT test acquisitions. Three experiments were performed to evaluate the effects of miscalibration on line sources, the effects of attenuation and flood correction on a cylinder containing uniform activity and the effects of spatial distortions on point source shape. Mis-centering in the X dimension, perpendicular to the axis of rotation appears to introduce more artifacts and decrease resolution more than mis-centering in the Y dimension, parallel to the axis of rotation. Mis-centering tends to produce circular artifacts. Allowable error will depend on matrix size, system resolution in the planar mode and other factors including reconstruction filtering and personal preference. Flood images for non-uniformity correction must contain sufficient counts/pixel to assure statistical accuracy in order to prevent producing even more artifacts. Accurate body contour production is critical, as is the attenuation coefficient chosen. Phantoms and extensive testing will allow system characterization prior to human studies.

DESIGN AND APPLICATION OF A WHOLE BODY PHANTOM FOR SINGLE PHOTON EMISSION TOMOGRAPHY. M. DeLaney, J. Weber, S. Cochavi, A. Cool and S. J. Goldsmith. Mount Sinai Medical Center, New York, NY.

A whole body phantom (WBP) was designed to evaluate and monitor the performance of a single photon emission computed tomography (SPECT) system. An acrylic plastic cylinder (29cm diam. x 40cm length) was constructed. Removeable inserts include: A stepped cone of progressively smaller diameter acrylic tubing, a line source holder(LSH) to suspend 2 capillary tubes, 10cm. apart at a 45^{0} angle to the rotation plane, small cylinders to represent organs.

With inserts removed, activity was added to simulate clinical imaging count rates. The uniformity of the reconstructed slices was ± 12%.

Using the LSH, overall resolution(FWHM) was 2.4±0.2cm. A reconstruction artifact was observed during LSH imaging. Parallel circular sources appeared elliptical, converging toward the WBP center.

The cone was filled with activity and placed in a water filled WBP. Upon reconstruction the 2.4cm resolution limit was confirmed. Each smaller section of the cone revealed proportionally lower count densities as expected. Slices reconstructed below the cone contained a circular distribution of activity at the center, caused by the back projection of scattered photons. A water filled cone was inserted into a 12.5cm cylinder containing activity. Smallest detectable void in reconstructed images was 2.25cm. To measure the effect of an attenuating structure, a radiopaque solution was added to a 5cm cylinder, and inserted in the WBP. No attenuation artifact was observed.

The WBP is useful in assessing overall system performance, selecting clinical applications and training staff.

ARTIFACTS IN SINGLE PHOTON EMISSION TOMOGRAPHY. B.A. Harkness, W.L. Rogers, N.H. Clinthorne and J.W. Keyes, Jr. University of Michigan Medical Center, Ann Arbor, MI

The use of tomographic imaging systems requires increased precision on the part of the technologist to insure transaxial images that are free from artifact. Awareness by the technologist as to the causes and correction of these artifacts is the first step in their elimination. Artifacts that result from poor camera calibration or set up include concentric rings (bullseye artifacts), blurring and image noise. Concentric ring artifacts are a result of camera nonuniformities and can be eliminated by proper and frequent camera tuning and appropriate field-flood correction procedures. Blurring is a result of poor camera alignment and can be eliminated by making sure the camera head is parallel to the axis of rotation. Reconstructed image noise may be due to too few counts and can be eliminated by imaging for a longer period of time, using a different collimator, or administering more tracer. Artifacts can also occur as a result of a poor choice in image reconstruction parameters. Blurred images will occur as a result of using the wrong center of rotation or a reconstruction filter that is too smooth. Conversely, a filter that is too sharp for the count density will cause images that show structured noise. An intense ring at the outside edge of an organ, especially the liver, will occur when too little or no attenuation correction is used. Reconstructed image artifacts can also occur from poor patient preparation or set up. A starburst will appear in the reconstructed images when an injection site is in the field of view. Arms left in the field of view will cause attenuation shadows and decrease the readability of the scan. We will demonstrate that by careful and methodical imaging and reconstruction techniques each of these artifacts may be eliminated.

TECHNICAL CONSIDERATION OF THE GE 400T SINGLE EMISSION TOMOGRAPHY SYSTEM. M. L. Johnson, G. C. Perkins, T. R. Nelson. VA Medical Center, San Diego, California

Our institution acquired various studies with the GE 400T single photon emission tomography imaging system. Several technical difficulties were encountered in the course of acquiring these studies.

The GE 400T camera functions as a static imaging camera as well as an emission tomography system. It comes equipped with a tomographic imaging table which is narrow, hard and concave. The table is not well suited for pa-

tients who are either large; in severe pain; critically ill; or who have IV lines and tubes attached to them.

The detector head is large. In order to align the detector parallel to the axis of rotation and insure clearance of the patient and the table the detector often must be positioned a considerable distance from the source. Resolution and counting statistics then become an important technical consideration. Lengthening the acquisition time and/or the number of acquisition positions may or may not be feasible.

Cardiac blood pool images were technically the poorest studies we acquired. Head imaging gave the highest resolution and counting statistics.

In conclusion, we believe you must 1) determine an adequate compromise between study duration and counting statistics and resolution; and 2) selectively choose patients able to tolerate the study.

MAXIMIZING QUALITY OF EMISSION COMPUTED TOMOGRAPHIC IMAGES. J. C. Honeyman, and B. Y. Croft. University of Virginia, Charlottesville, VA

The development of Emission Computed Tomography promises to be a great new technique in medical imaging. Before the instrument can be put into clinical use, quality assurance must be performed on all aspects of the scanning procedure. After evaluation of the image quality, several techniques can be used to improve the resolution and clarity of the scans.

Among the important checks and adjustments that must be performed to quarantee the quality of images are; center of rotation tests, uniformity of the system, effects of object-camera distance, camera head angle, size of patient dose, and the effect of window width.

After running a series of tests on the GE-400T ECT system in our institution, we have developed a list of suggestions to improve the quality of ECT images. These suggestions and techniques will be presented along with a device we have attached to our system to maximize resolution of our studies.

A TECHNOLOGIST ORIENTED APPROACH TO DATA BASE MANAGEMENT IN THE NUCLEAR MEDICINE DEPARTMENT. C.C. Edwards, O. Tsen, and P.T. Cahill, New York Hospital-Cornell Medical Center and Polytechnic Institute of New York, New York.

The development of a computer system serving the complex needs of a nuclear medicine division in an 1100 bed hospital is described. Our information needs on equipment usage, patient scheduling and billing, and type of procedures are not readily analyzed by a simple computer algorithm.

In our approach, a small time shared computer system was introduced and all programs were written and tailored to our specific needs. The successful implementation of this system required the expanded role of the individual technologist to include not only the performance of the specific procedure but also the recording on CRT terminals of patient information, i.e. history, time per study, transport time, amount and type of radiopharmaceutical used, wet reading, and all billing information.

Results of such a system permit a more detailed statistical analysis of the equipment usage for type of procedures, average time required per procedures, and information on the scheduling of special procedures and protocol studies. Equally important the expanded role of technologists in the handling of the patient related information has generated valuable suggestions for improving not only the computer algorithms, but overall efficiency of the division also.

Although this system has been designed for the needs of our division, its special attributes are applicable to all computer-based systems. Our learning experiences may be of value to institutions considering the use of computers for patient scheduling, image archiving and communications.

THE BASIC PRINCIPLES AND TECHNIQUES OF NUCLEAR MAGNETIC RESONANCE. Kent Costen, R.T. University of Virginia Medical Center, Charlottesville, VA

Nuclear Magnetic Resonance is one of the newest medical imaging modalities introduced to the field of Nuclear Medicine. One of the most superior and attractive qualities of NMR is that it uses no ionizing radiation. NMR has been used in the chemistry lab environment for many years, for analyzing chemical properties. Now NMR will be used in the medical field as a diagnostic tool. This paper will review some of the basic principles and techniques of NMR. Due to the fact that NMR uses strong magnetic fields many considerations must be studied when one entertains the thought of installing a NMR unit in a clinical setting. This presentation will go over some of the considerations as to floor plans and actually the construction of a suitable lab for the NMR unit. It will also take a look at the images with comparison to Computerized Tomography images which are very similar. Although at this time no true hazards have been discovered with the use of NMR, some of the possible hazards will be reviewed.

AN ASSESSMENT OF THE EFFECTS OF UNIFORMITY CORRECTION IN CLINICAL SITUATIONS. S.M. Dyer, M.S. Lerner, M.L. Cianci. George Washington University Hospital, Washington, DC

Many gamma cameras utilize correction circuitry to achieve uniform flood field images. This study is an attempt to quantify changes in uniformity and resolution due to the application of these devices. In order to evaluate intrinsic uniformity, flood field images were acquired by a computer in the uncorrected and corrected modes using a 256 x 256 matrix. Three large-field-of-view scintillation cameras were examined in this procedure: a Med-X (3/8" crystal and 61 P.M. tubes); a Technicare 410S (1/2" crystal and 61 P.M. tubes); and a Picker 415 (1/2" crystal and 37 P.M. tubes). These images were then analyzed using the quality control program available through MDS' A^2 software, in which the number of acceptable pixels in each view was calculated. Acceptable pixels were defined as those within $\pm$ 10% of the mean pixel counts. Next, resolution was measured with the aid of a brain transmission phantom which contained various "lesions." Once acquition was completed for a preset number of counts, identical ROI's were placed over two of the lesions and one background area. Ratios were then established representing comparisons between the total counts contained in the background region and each of the lesions. This process was completed for each imaging system with parallel hole collimators, in the uncorrected and corrected modes. In conclusion, this study found that this analysis of uniformity did not reveal an increase in the number of acceptable pixels due to corrective flood field imaging. However, there was a slight improvement in resolution due to imaging the brain phantom in the corrected mode.

SENSITIVITY COMPARISON OF A DIGITAL TO AN ANALOG CAMERA: IS THE SINGLE CRYSTAL DIGITAL CAMERA MORE EFFICIENT? Jim Fain, Deanna Rasmussen, Ernest Garcia, Ismael Mena, LAC Harbor-UCLA Medical Center, Torrance, CA.

This paper compares the sensitivity and limiting parameters of a digital to an anlog camera. For this purpose we tested the efficiency of an Apex 415 Elscint digital camera with a Technicare 438 wide field camera.Both instruments have 3/8 in. sodium iodide crystal. The efficiency was tested by placing a Tc 99m shielded source of 7 mCi at 1.1 meter distance from the uncollimated crystal. The digital camera was set with a 30% window in digital to digital acquisition (fast) mode. A 30% window was set on the Tc 99m photopeak of the analog camera. Saturation of the digital camera was achieved at 342 kcs. A response curve was constructed by interposing sequentially a series of 1 mm thick copper filters. Count rate was recorded during 10 sec intervals. Curves were constructed from data in air and with 50 mm of water. At count rates of 10 kcs the efficiency of both instruments is not significantly different. At 30 kcs/sec the digital camera detected an 11% and 9% increase in counts in air and scatter respectively. At 50 kcs the difference in favor of the digital camera was 19% and 21% respectively. At 70 kcs the increase was 24% and 26% and at 130 kcs the increase was 39% and 37%. At the low count rate of 10 kcs the resolution of both cameras is similar.

Conclusion: The digital camera had better counting efficiency at higher count rates than the analog camera. The possible explanation of the higher efficiency is the shorter dead time of the digital instrument as both have identical efficiencies at low count rates.

CARDIAC/COMPUTER

1:30pm-4:30pm **June 16** **Room 205**

Moderator: Raymond E. Exten

AUTOMATIC INTERPOLATIVE BACKGROUND SUBTRACTION OF THALLIUM IMAGES: A UNIQUE COMPUTER PROCESS. Thomas D. Kay, Gwynne K. Neufeld, George M. McGranahan, Jr, David L. Johnson, David Romo, Mary E. Thompson, Sandy J. Riahi. USAF School of Aerospace Medicine, Brooks Air Force Base, Texas.

An interpolative background subtraction computer process has been developed that allows automatic batch processing of thallium images. The input images are searched by an edge detection algorithm which defines the boundaries of the myocardium. The program then sets a background reference zone around the myocardium that is used in developing the background subtraction variables. The subtraction algorithm also determines the contribution to the background and corrects for gastric or liver thallium uptake within the myocardial reference zone. The interpolative background program has a unique isolation and edge detection algorithm that also allows interpolative background subtraction of other organs of interest such as kidneys or liver.

The thallium interpolative background subtraction process was applied to a population known to have normal coronary arteriograms that underwent hourly serial scanning from exercise to 6 hours. Analysis of the scans by circumferential mapping and derivative image analysis showed a washout rate with a coefficient of variation of 8% versus 32.5% reported for other interpolative background subtraction processes.

The background subtraction process was also applied to scans taken after resting injections and scans of patients with severe myocardial infarction with similar benefit.

EXTENDING QUANTITATION OF Tl-201 MYOCARDIAL SCINTIGRAPHY TO ASSESS THE REVERSIBILITY OF PERFUSION DEFECTS. K Van Train, J Areeda, E Garcia, A Abdulla, A Rozanski, J Maddahi, A Waxman, D Berman, Cedars-Sinai Medical Center, Los Angeles, CA.

Although useful for detecting and localizing disease, quantitative analysis of myocardial thallium washout may not accurately differentiate reversible from nonreversible myocardial perfusion defects. Thus, we have developed a new technique which objectively quantitates myocardial thallium redistribution. Following image processing, circumferential profiles of the distribution of myocardial thallium at stress and four hours were obtained and normalized such that the normal segments superimposed. Relative change in segmental activity was computed and automatically compared to statistically derived normal limits from a group of 38 normal patients. The method was prospectively applied to 35 patients undergoing stress and 4-hour thallium imaging in whom 75 myocardial segments were interpreted by consensus, visual analysis as having unequivocally reversible (22) or nonreversible (53) perfusion defects. Quantitative myocardial thallium redistribution correctly identified 62 of the 75 segments (83%), compared to 42 of 75 (56%) by quantitative washout. This improvement by quantitative myocardial thallium redistribution was evident in both non-reversible segments (85% correct by quantitative myocardial thallium redistribution versus 58% by washout) and reversible segments (77% by quantitative myocardial thallium redistribution versus 50% by washout).

Conclusion: A quantitative method for assessing reversibility of myocardial thallium defects has been developed which correlates with visual analysis, and thereby may offer an objective means for assessment of myocardial viability.

ABSOLUTE LEFT VENTRICULAR VOLUME FROM GATED BLOOD POOL IMAGING USING AN ESOPHAGEAL TRANSMISSION MEASUREMENT. K.M. Blasius, Z.H. Travis, J.J.Reilley, A.H.Maurer, J.A.Siegel, P.S.Robbins, L.S.Malmud, Temple University Hospital, Philadelphia, PA.

We have developed a new method for measuring absolute left ventricular volumes using gated blood pool (GBP) imaging. The GBP volumes were compared with the results of biplane contrast ventriculography (BCV) for 18 patients. A point source which is used to correct for tissue attenuation was prepared by saturating a piece of filter paper with 1-2 mCi of Tc-99m sulfur colloid and placing it in a # 4 gelatin capsule. The capsule was first counted behind a phantom with a scintillation camera and then in the esophagus as it was swallowed by a patient in a supine LAO 40 degree position. The patient's red blood cells were then labeled in vivo with 20 mCi Tc-99m pertechnetate and GBP imaging was performed with the patient in the same position. A 10 cc blood sample was then drawn and counted in front of the camera. Count rates from the left ventricle were obtained at end systole and diastole using semiautomated regions of interest generated for calculation of the LV ejection fraction. A capsule count rate (CCR) was obtained as the capsule passed behind the LV. A transmission factor was then calculated using the CCR in air and behind the LV. LV volumes were then calculated by dividing the LV count rates by the transmission factor and blood sample count rate. The correlation between GBP and BCV was 0.89 (BCV = 0.95 GBP + 1.32 ml; SEE=23.4 ml) for diastole and 0.91 (BCV = 0.86 GBP + 1.04 ml; SEE=11.4 ml) for systole. This method is the first to employ a transmission measurement for calculating absolute LV volumes. It is noninvasive and can easily be performed as a part of routine GBP imaging.

COMPARISON OF QUANTITATIVE TL-201 MYOCARDIAL IMAGING PROGRAMS. J.B. Smith, M.R. Boyd, Nuclear Medicine, Baptist Memorial Hospital, Memphis, TN.

Quantitative Tl-201 software programs on two computer systems were compared on simultaneously acquired images. 13 patients were exercised on a treadmill to 85% maximum heart rate prior to injection with 2 mCi of Tl-201. 10 min. images were obtained and acquired onto a MDS A-Square and Siemens Scintiview computer system. Patients returned 3-4 hours post injection for redistribution imaging. Both software programs measured the activity in a profile through the myocardium following a background subtraction. The LAO view was used for the comparative study with the profiles through the anteroseptal, posterioseptal, and the inferoapical segments. Criteria for abnormality was based on 2 evaluations: (1) greater than 80% retention in a given segment on redistribution compared to exercise, (2) any profile peak on the post exercise image with 25% less activity than the maximum peak.

Using the first criteria, the findings in the two programs were identical in only 4 of the 13 patients. 82% of the discrepancies occured in the upper anteroseptal and posterioseptal or the inferoapical segments. Using the second criteria, identical findings were observed in 5 of the 13 patients.

Although the two programs are technically measuring the same parameters, the results do not indicate the ability to utilize the systems interchangeably.

CLINICAL COMPARISON OF Tl-201 ASYMMETRIC AND SYMMETRIC ENERGY PEAKING ON A MICROPROCESSED ENERGY CORRECTED GAMMA CAMERA. M. Ricciardone, K.M. Spicer, G.D. Frey, R.F.Curtis, M.C. Ellis, L. Gordon, and G. Hendrix. Medical University of South Carolina, Charleston, S.C. 29425.

Asymmetrically energy peaking, technically possible only on energy corrected gamma cameras, permits higher quality non-scattered photons to be detected while reducing the number of image degrading Compton photons. Asymmetric energy peaked Tl-201 images theoretically are of a higher quality than those symmetrically peaked due to greater contrast and edge delineation. This study attempted to determine whether asymmetric peaking is of benefit for Tl-201 scintigraphy.

14 patients injected with 1-2mCi of Tl-201 were imaged 4 hours after treadmill stress on a ½" crystal SFOV camera equipped with ultrafine collimation. 1500 ID images were obtained in the 45° LAO position. Both techniques used a

35% window - the symmetric directly centered and the asymmetric shifted 13% to the right of the broad 68-80 Kev photopeak. Both images were obtained without changing other camera settings or patient positioning. The 14 paired images were blindly presented to 5 nuclear medicine physicians for selection of the higher quality image.

Results show 48 asymmetrically peaked images out of the possible 70 choices (0.686) were selected revealing a significant preference for this method ($p < 0.005$) over the symmetric technique. The asymmetric image required an average of 6.5% longer to obtain.

We conclude that the asymmetric peaking procedure produces a higher quality Tl-201 image and now routinely use this technique.

A METHOD FOR ASSESSMENT OF THALLIUM-201 REDISTRIBUTION IN THE MYOCARDIUM. M. Tuscan, J. Thrall, J. Juni. The University of Michigan Medical Center, Ann Arbor, MI.

Accurate analysis and interpretation of stress and redistribution myocardial images using Thallium-201 (Tl-201) is a difficult clinical problem. The amount of Tl-201 in the myocardium at stress and during redistribution is directly related to the perfusion of the myocardial tissue and the biological half-time of the radiotracer in the heart. We are now using a method of image analysis to assist in determining the redistribution process of Tl-201 in the left ventricle.

Uptake of tracer in the heart is expressed as a circumferential profile of counts at each three degrees of radius around the left ventricle. The stress curve represents uptake prior to redistribution and is presented as a straight line with a constant value of 100 per cent. A new curve is then generated by dividing the original stress curve by the redistribution curve. This curve is then normalized to the peak value of the stress curve. The normalization factor is the result of dividing the peak value of the stress curve by the peak value of the redistribution curve. The curves now describe the segmental redistribution process.

When there is equal and uniform redistribution the two curves superimpose with only small variations due to the counting statistics. When there are segmental inequities of redistribution the two curves separate.

The algorithm is easy to use and requires minimal processing time. Data presented in this fashion may assist in the interpretation of Tl-201 imaging.

ASSESSMENT OF RIGHT VENTRICULAR FUNCTION WITH INTRAVENOUS Kr-81m. D. Koller, D. Wong, E.E. Camargo, H.N. Wagner, Jr. The Johns Hopkins Medical Institutions, Baltimore, MD

The use of Kr-81m for assessment of right ventricular function was evaluated in twenty-two pts. Pts were positioned in a 30° RAO projection, and studies acquired with a scintillation camera/digital computer system. Three types of studies were acquired; list mode first pass study (LMFP) of the passage of a 30 sec bolus of Kr through the right heart; gated first pass study (GFP) from the time activity was observed in the SVC until it reached the lungs; and a six minute gated equilibrium acquisition (KrG) during constant intravenous infusion of Kr. Representative cardiac cycles were obtained from 74% of the Kr LMFP studies. Low counting statistics, and the inability to resolve individual beats in the LMFP studies prevented reformatting into a composite beat in the other 26%. In comparison, 91% of the Kr GFP studies were considered technically adequate. Ninety-six percent of Kr gated equilibrium studies were considered technically adequate. Inadequate gating, judged by the appearance of ventricular time-activity curves and phase analysis images, was responsible for rejection of the other studies. Right ventricular ejection fraction (RVEF) was calculated with three manual regions of interest (end-diastolic, end-systolic, and background). Amplitude and phase images aided in the selection of the regions. RVEF's obtained with Kr were compared to those with Tc-99m pertechnetate list mode first pass studies. The correlation between Kr LMFP and Tc was .81; between Kr GFP and Tc was .91; and between Kr GE and Tc was .54. Gated first pass Kr studies allow assessment of right ventricular function, and are the method of choice because of ease and quickness of acquisition, short processing time, and low background.

THE IMPORTANCE OF VISUAL NON-PERFUSION ABNORMALITIES ON THALLIUM-201 MYOCARDIAL SCINTIGRAPHY. R. Slater, B. Canhasi, E. Botvinick, D. Faulkner, W. O'Connell, B. Brundage, and T. Ports. University of San Francisco, San Francisco, CA

We evaluated the importance of visual abnormalities not related to the pattern of cardiac perfusion on technically correct stress myocardial perfusion scintigrams (SMPS). Such visual abnormalities (VA) include increased lung and cardiac basal uptake and a stress related increase in left ventricular size.

These findings were assessed in 172 studies in patients (pts) with stress and where needed redistribution images. Studies were divided into 4 groups, A-D, which related to the absence of or presence of 1, 2 or 3 coronary artery disease (CAD), as judged by perfusion defects in SMPS.

VA were seen in 6 of 79 studies (8%) of group A pts, group B pts 20 of 45, (44%) with a ($p<0.05$), 32 of 42, (76%) for group C ($p<0.01$ versus group A and <0.05 versus group B), and 6 of 6 pts in group D, ($p<0.05$ versus group A).

In 39 of these pts (divided in the same fashion as before) who had coronary angiography, VA again were commonly assessed in those with 2 and 3 vessel disease. Eighteen of 21 pts (86%) with both groups showing ($p<0.05$ versus the first 2 groups). Those with single CAD, 1 of 8 (12%), pts displayed VA (p=NS) and 2 of 7 (28%), pts with absence of CAD.

Technologists should be aware of these clinically important non-perfusion, non-artifactual scintigraphic abnormalities when evaluating the technical aspects of perfusion images. Since some similar changes could result from the use of the wrong collimator, improper pt positioning, radiopharmaceutical idiosyncrasy or an improperly tuned or defected camera.

THALLIUM REDISTRIBUTION IN SERIAL STUDIES OF THE MYOCARDIUM OBSERVATIONS BASED UPON QUANTITATIVE ANALYSIS OF CIRCUMERENTIAL MAPPING, THALLIUM T-ZERO, AND DERIVATIVE IMAGE ANALYSIS. Thomas D. Kay, Paul V. Celio, Gwynne K. Neufeld, George M. McGranahan, Jr, David L. Johnson, David Romo, Mary E. Thompson, Sandy J. Riahi. USAF School of Aerospace Medicine, Brooks Air Force Base, Texas.

Thallium-201 distribution versus time was studied in asymptomatic male aircrew members with known coronary anatomy. Hourly studies were accomplished from exercise to six hours. The images were processed by an automatic interpolative background subtraction algorithm and analyzed by circumferential mapping, Thallium T-Zero, and derivative image analysis. Data showed that the washout of thallium to be multiexponential with a $T\frac{1}{2}$ varying from 2.289 hours for the exercise to 1 hour time frame to 15.590 hours for the 5-6 hour time frame. The 50% washout point was reached in 2.972 ± 0.238 hours, versus 4.0 ± 1.3 hours previously reported, by others.

Analysis of the data showed that up to 70% of coronary disease patients would be undetected if a single redistribution scan was taken earlier than 3 hours postexercise or at 6 hours postexercise. The ideal scanning protocol was found to be two scanning times of 3 and 5 hours postexercise. Using these scanning times and with computer processing by an automatic interpolative background algorithm an analysis by a Thallium T-Zero computer program, a sensitivity approaching 100% for detecting coronary artery disease was achieved in this asymptomatic group.

Author Index: Technologist Abstracts

Titles and Authors: Scientific Exhibits
29th Annual SNM Meeting—Technologist Section

Technologist Scientific Exhibits

Technologist Scientific Exhibits for the 29th Annual Meeting of the Society of Nuclear Medicine will be located in the Miami Beach Convention Center. The abstracts for them may be found in the *Scientific and Commercial Exhibits Brochure*, which will be available on site. Exhibit titles and authors are presented below; they are listed alphabetically by the last name of the first author.

AN EFFICIENT AND RELIABLE APPROACH TO MANAGEMENT OF COMPUTERIZED SCINTIGRAPHIC DATA. D. Brown, K. Van Train, J. Areeda, D. Berman, A. Waxman, and E. Garcia. Cedars-Sinai Medical Center, Los Angeles, CA.

RADIOPHARMACEUTICALS USED TODAY. W.E. Cloutet. Ochsner Medical Institutions, New Orleans, LA.

ARTIFACTS IN SINGLE PHOTON EMISSION TOMOGRAPHY. B.A. Harkness, W.L. Rogers, N.H. Clinthorne, and J.W. Keyes, Jr. University of Michigan Medical Center, Ann Arbor, MI.

TROUBLESHOOTING TECHNIQUES FOR NUCLEAR MEDICINE INSTRUMENTATION. J. Hughes, M. Aden, and M. Fernandez. University of Cincinnati Medical Center, Cincinnati, OH.

ASYMMETRIC AND SYMMETRIC ENERGY PEAKING COMPARISON OF Tl-201 ON MICROPROCESSED ENERGY CORRECTED GAMMA CAMERAS. M. Ricciardone and G.D. Frey. Medical University of South Carolina, Charleston, SC.

THE USE OF THREE-PHASE RADIONUCLIDE BONE IMAGING IN THE DIAGNOSIS AND MANAGEMENT OF TRAUMATIC BONE LESIONS IN AEROBIC DANCERS. D.A. Richardson, N.L. Kelty, L.S. Matthews, L.E. Holder, N.A. MacDonald, and H.D. Rupani. Union Memorial Hospital, Baltimore, MD.

CARDIAC PHANTOM: AN ADDITIONAL QUALITY CONTROL DEVICE. A.C. Sardina, D. Gibbons, and L. Clarke. University of Miami, Miami, FL.

COMPARISON OF SQUARE HOLE AND HEXAGONAL HOLE FOIL COLLIMATORS. M.L. Sheakley, S.M. Condon, M. Ricciardone, and G.D. Frey. Medical University of South Carolina, Charleston, SC.

INSTRUMENT OF CHOICE FOR Ga-67 IMAGING. J.B. Smith and M.R. Boyd. Baptist Memorial Hospital, Memphis, TN.

COMMERCIALLY AVAILABLE MODIFICATIONS OF GAMMA CAMERA AND COMPUTER FOR SINGLE-PASS NUCLEAR ANGIOGRAPHY. W.B. Wigger, K.M. Spicer, and G.D. Frey. Medical University of South Carolina, Charleston, SC.