Abstracts for Technologist Scientific Program

Radioimmunoassay Short Efficient Methods by Polymerized Antibody Tablet. MERRI B. BENETAZZO AND GERALD H. SPIREK. Sherman Hospital, Elgin, Ill.

Evaluation of the assay procedure in our laboratory revealed that accurate radioimmunoassay by the formerly used dextran-coated charcoal method was dependent upon a rigidly fixed time and temperature of contact with the charcoal for all samples. The substitution of a more satisfactory method of separation of the free from the bound digoxin was therefore investigated.

In the technique to assay digoxin, free antigen is separated from bound digoxin by centrifuging the insoluble polymer complex and decanting the wash containing free antigen.

The procedure employs an insoluble antibody polymer derived from guinea pig antiserum. The reacting antigen is a specific quantity of I^{125}-labeled digoxin and the serum level of the glycoside in the specimen to be tested. The ^{125}I antigen and the antigen from the sample (or standards) are mixed with the antibody polymer causing competition for the limited number of available binding sites. Uncomplexed reactants are removed by washing and decanting. The principle of the method uses a deficient quantity of antibody with a fixed number of binding sites and an excess of radioactive ^{125}I antigen. The antibody does not distinguish between labeled and nonlabeled antigen from the serum or standard. Competition occurs between labeled and nonlabeled antigen for the limited number of binding sites available, which results in a 200 decrease in the amount of radioactivity in the counting sample as nonlabeled antigen is increased. The radioactivity in the counting sampler is inversely linear to the amount of digoxin in the sampler.

Results of data fed to the computer showing normal, abnormal, and mean values of a population of over 100 proved not only to be accurate, but reproducible even if kept over long periods of time. The charcoal method was time consuming, used more sera, was more costly in terms of instruments, and was very time and temperature dependent.

Cisternography Using ^{111}In-DTPA and a Scintillation Camera. MARK J. COCHRAN AND DON R. BERNIER. Edward Mallinckrodt Institute of Radiology, St. Louis, Mo.

Many radiopharmaceuticals have been used to study cerebrospinal fluid flow with ^{131}I-iodinated human serum albumin being most commonly employed. However, the DTPA chelate of ^{111}In has many desirable properties, including its 2.8-day half-life, decay by electron capture, and a high yield of gamma photons with an energy suitable for imaging with the Anger camera. We have found ^{111}In-DTPA cisternography to give good images with the scintillation camera and images can be obtained for a 72-hr period as occasionally needed.

Adults receive between 250–500 μCi of ^{111}In-DTPA in a volume of less than 1.0 cc by a standard lumbar intrathecal injection. Anterior and lateral views are obtained at 2, 24, 48, and occasionally 72 hr after injection. More frequent images with different views are obtained in some patients, for example, those patients with suspected cerebrospinal fluid leaks. We utilize the 247 keV photopeak with a 20% window. Images are obtained for either 10 min or 100,000 counts, whichever occurs first.

Normally, activity is noted in the cisterna magna and basal cisterns at 2 hr. By 24 hr, patients with no abnormalities in cerebrospinal fluid flow have activity concentrated over the convexities in the parasagittal area. Images obtained after 24 hr are for the evaluation of slow flow over the convexities and/or the duration of ventricular reflux of the radiopharmaceutical.

Cisternography using ^{111}In-DTPA and the scintillation camera has been performed in more than

200 patients. This method of cisternography requires minimal patient cooperation and gives high-quality images. With this procedure the radiation exposure and risk of aseptic meningitis to the patient is minimal.

Evaluation of a Multi-Imaging System. RAO DASIKA, ROBERT TOKARZ, TERESA DIRIENZO, AND THEODORE STAHL. St. Peter's General Hospital, New Brunswick, N.J.

It is necessary to evaluate the capability of a multi-imaging system to provide consistent images with respect to focus, intensity, and resolution.

Sources for imaging were a bar phantom and a Hine Reference Phantom.

The 4 and 16 frame formats were used. Each of the images of the 4 frame format were focused. In the 16 frame format, 2 frames in each of 4 rows of frames were focused.

The images at the periphery of the cathode ray tube were more variable in quality than images at the center of the cathode ray tube.

In the 4 frame format the central portion of each image was of a more consistent quality than the periphery.

The focus, intensity, and resolution of the 4 central images of the 16 frame format were more consistent.

To adjust for those findings mentioned above we attempt to do all imaging in those frames of most consistent focus, intensity, and resolution.

Technologist Exposure Control. CHARLES J. DUNN. Memorial Hospital, Hollywood, Fla.

Being concerned with reducing any avoidable radiation exposure to technologists, we have been on the alert for new ideas for greater safety in handling radioactive tracer materials.

The availability of instant technetium enabled us to discontinue the use of ^{99m}Tc-technetium generators and the concomitant handling time involved in the elution process. As expected reduction of all badge readings occurred when the generators were eliminated.

Our next greatest source of technologist exposure came from the administration of 20 mCi of ^{99m}Tc-technetium pertechnetate for brain flow and scintiphotography.

Using lead syringe guards is, or should be, standard practice. It occurred to us that simply shielding the dose until it was injected for the flow study was less than optimal if we then remained in the area of that same dose of radioactivity distributed in an unshielded patient. It became necessary to determine the extent of technologist exposure from this source.

The working area at the head of an injected patient under the detector assays at less than 0.25 mrads/hr but assays at between 2.5 and 3.0 mrads/hr in the axial body area. Exposure reduction is achieved by using a shield which is placed over the patient's body during the examination. The shield is a 2 x 3 piece of rubberized lead (actually part of an old fluoroscopy apron). The unshielded body at less than 1 ft is a source of about 3 mrads/hr which the shield reduces by a factor of 10 to less than 0.25 mrads/hr at any distance.

While we do not imagine that this completely eliminates technologist exposure we feel that the reduction obtained is a benefit worth the small effort expended in use of the shield.

The RES-O-MAT E.T.R. Test for the Determination of Neonatal Thyroid Activity. GARY D. GALLAMORE, ROBERT C. SPAGNOLI, SUSAN SUJANSKY, AND JANIE FRANK. Jersey Shore Medical Center, Neptune, N.J.

The RES-O-MAT E.T.R. test was used to determine the binding capacity of circulating thyrobinding globulin in neonates between the ages of 1 and 7 days to establish a range of normal values for patients of this age group.

The RES-O-MAT E.T.R. test is a single in vitro test of thyroidal function which integrates competitive protein binding analysis with the uptake of radiolabeled hormone and the test kit was used on neonatal serum obtained from clinically normal neonates whose mothers were also clinically euthyroid.

With normal neonatal E.T.R. values established, we can now rapidly assess neonatal thyroid activity in an effort to facilitate the diagnosis and treatment of neonatal Graves' disease or hypothyroidism.

The Use of an Experimental Model in the Evaluation of Radioiodinated Autologous Fibrinogen. PAUL F. GODIN, DONALD E. TOW, DANIEL J. O'CONNELL. VA Hospital, West Roxbury, Mass.

In conjunction with the development of radiopharmaceuticals for the detection of thromboemboli, it has become necessary to produce a suitable model for testing the affinity of such agents.

We have produced clots in the lungs of dogs by inserting a double-lumen Swan-Ganz flow-directed balloon catheter through the internal maxillary vein to a specific lobar artery of the lung. The catheter is then left in situ with the balloon inflated for two days.

To date 15 dogs have been studied as described. Lung scans were performed with ^{99m}Tc-MAA immediately after the removal of the balloon catheter and at four and six days thereafter to

demonstrate perfusion defects. Radioiodinated autologous fibrinogen was injected at time of catheterization. Localization of the labeled fibrinogen was carried out by scan at two, four, and six days following clot formation.

We will present the details of this procedure and the results of using this model for studying the affinity of labeled autologous fibrinogen.

Calculation of the Radiopharmaceutical Dose for the Pediatric Patient. CHARLES A. HENRY AND EDWARD G. BELL. Crouse-Irving Memorial Hospital, Syracuse, N. Y.

The correct dose in nuclear medicine is one that gives the desired diagnostic information at the minimum radiation dose. The problem that exists in most departments of nuclear medicine is deciding in some rational fashion what fraction of the usual adult dose should be given to the child. A variety of rules for calculating drug doses have been promulgated by the physician with special interest in the young. Those methods based solely on weight or age and related to some fraction of the adult dose are of little value. They will, in general, indicate a pediatric dose inadequate for the examination.

It has been shown that the dose is not proportional to body weight but is more nearly proportional to body surface area. The dose should be administered on the basis of surface area in that this more accurately reflects metabolic activity. It has been shown that the surface area may be approximated as a power function of the body weight. The results of these calculations will be shown in tabular, graphic, and nomogram forms. The required radioactive dose of the child is simply calculated from the knowledge of the usual adult dose and the use of a multiplier obtained from the table. The multiplier is the ratio of the child's surface area with the surface area of a normal adult, weighing 65 kg. For example, if the infant weighs 6 kg and the usual adult dose for a bone scan is 15 mCi of ^{99m}Tc-diphosphonate and the multiplier is 0.19, then the infant dose equals $15 \times 0.19 = 2.85$ mCi.

Radiation Safety in Nuclear Medicine. JOHN R. HOWLEY, MICHAEL V. GREEN, MARDALEE B. DICKINSON, A. ERIC JONES, AND GERALD S. JOHNSTON. National Institutes of Health, Bethesda, Md.

Unnecessary hand and finger exposure remains an insidious radiation safety hazard in nuclear medicine. While minimum radiation exposure is the rule, half the technologists responding to a recently published survey were using no protective shielding during the injection of radiopharmaceuticals. The inevitable contamination of the hands when gloves are not worn presents an additional hazard. Calculated surface exposure (verified with the calibrated monitor film) from unshielded syringes containing ^{99m}Tc increases with decreasing volume to 45 mrads/min/mCi for 0.5 cc (900 mrads/min for a 20-mCi injection). Comparable exposures are obtained for other less-used isotopes.

The calculated beta-like surface dose from ^{99m}Tc contamination persisting on the hands can amount to 5 rads/μCi to the active skin layer. Absorption coefficients for ^{99m}Tc and ^{131}I determined with an extrapolation chamber help to confirm the degree of penetration.

Ring and wrist monitors do not adequately reflect these surface exposures to the hands. Suitable gloves and syringe shielding are essential. Commercial shields require modified welded set screw seats to make them acceptable and durable enough for the working technologist.

Blood Pool Images in Conjunction with Bone and Brain Studies. ELISABETH KILBURN AND DAVID L. GILDAY. The Hospital for Sick Children, Toronto, Ont.

Gamma camera images of the blood pool phase immediately after injection of the appropriate radiopharmaceuticals for bone and brain imaging can greatly increase the value of the study and facilitate interpretation. A blood pool image is one taken as soon as possible after the injection or after the radionuclide angiogram and within five minutes of the injection. These images take only 1–2 min to accumulate and so are not time consuming even if 3 or 4 views are required.

With these studies there is no need to reinject a patient with $^{99m}TcO_4^-$ should there be questionable findings on the late study that could be attributed to blood pool phenomena. Thus as well as being quick and simple to perform these added images may decrease the total radiation dose to the patient.

For these reasons in our department we routinely do blood pool studies with all brain scans and all bone scans where there are suspected focal lesions. Examples of areas in which these studies have proved useful are: brain scans: subdural hematomas, superficial lesions, orbit lesions, AVM's, vascular and nonvascular tumors, and unusual sinus configuration; bone scans: osteomyelitis, cellulitis, asceptic necrosis, and large primary tumors.

Cardiac Scintigraphic Imaging Using a Physiological Synchronizer. JOHN J. KOZAR III, KENNETH A. MCKUSICK, GERALD M. POHOST, AND

MAJIC S. POTSAID. Massachusetts General Hospital, Boston, Mass.

Left ventricular function was evaluated with a scintillation camera electrocardiographically gated. A physiological synchronizer for end-systolic and end-diastolic gates in the T and R waves, respectively, of the cardiac cycle provided a simple means for such studies. The synchronizer was attached to patients by two chest electrodes located at the 3rd or 4th intercostal spaces, and was interfaced to an Anger scintillation camera equipped with either a converging or high-resolution 4,000 parallel-hole collimator. Three hundred images were recorded on 35-mm high-contrast copy film at 30 deg right anterior oblique and 40–50 deg in the left anterior oblique positions in the ungated, systolic, and diastolic modes following an intravenous injection of 20 mCi of ^{99m}Tc-human serum albumin prepared by the electrolytic cell method. Sonic planimetric measurements were made of projected 35-mm images utilizing a recorded 5 cm marker as a quantitative linear standard. Computer-derived data of ejection fraction, and myocardial mass index (myocardial mass/diastolic volume) correlated well with data from cardiac catherization studies. Over 50 patients who have been studied using this noninvasive method have experienced no morbidity to the procedure, which requires less than 45 min of patient time.

Contamination and Quality Control of Radiopharmaceuticals. PETER P. LAMY AND DONALD R. HAMILTON. University of Maryland School of Pharmacy, Baltimore, Md.

With the exception of single-dose injectables reserved for cisternographic use, sterile radiopharmaceuticals are packaged for use in multiple-dose vials. Multiple punctures of the rubber closure can result in coring and foreign particles in the solution. Multiple punctures may also result in microbiological contamination of the solution.

A survey of five nuclear medicine departments was conducted to determine the extent of microbiological contamination. The survey was conducted by sampling the partially used vials and utilizing the standard United States Pharmacopoeia sterility test. When growth was found, an effort was made to subculture and identify the organism. The rate of contamination was unacceptably high and was as high as 10%.

Methods of testing are explained in detail and results are given that describe which radiopharmaceuticals became contaminated most frequently and which organisms were the most frequent contaminants. An explanation of various methods of preventing contamination in the nuclear medicine department and what the technologists can do to prevent harm to their patients.

A ^{99m}Tc-Aerosol Inhalation Technique for Lung Scintiphotography. MAX S. LIN, C. K. ERICKSON, C. L. WHITELEATHER, DAVID A. GOODWIN, AND S. L. KRUSE. VA Hospital, Palo Alto, Ca.

This paper describes a radioaerosol inhalation technique we are routinely using to evaluate whether a given perfusion abnormality is secondary to airway disease.

A DeVilbiss Model 35A ultrasonic nebulizer is modified for aerosolizing 2-ml samples of ^{99m}Tc-colloids. A 45-ml cylinder sleeve is set standing at the center of the bottom of the nebulization chamber to form a small "effective chamber." The upper end of the cylinder telescopes loosely by 0–1 mm, with the lower end of the chamber outlet arm forming a circular slit gap between the cylinder and the arm. A one-way tubing leads from the arm to the patient. As the patient inhales, room air enters the chamber via the chamber inlet, moves through the gap, picks up aerosol from the cylinder space, and carries the aerosol via the tubing to him. Proper size of the gap varies with the tidal inspiratory flow rate of each patient. The gap is adjusted by moving the arm up or down. A side arm attaches to the tubing and leads exhaled air up to the vented hood. The patient is seated and inhales the aerosol tidally for 15 min through his mouth, with his nose clamped. The patient is then placed under a scintillation camera fitted with a diverging collimator for multiple viewing of the lungs.

Pulmonary deposition and distal penetration of the aerosol vary with technical controls and with patients. About 10% of the nebulized ^{99m}Tc deposits in the lungs, and about 75% of these deposits is estimated to be in the distal nonciliated airway in patients without airway obstruction. The procedure is of relatively short duration (45 min), safe, simple, and useful for evaluating airway diseases as a cause of perfusion abnormalities.

Small-Diameter Pinholes for High-Resolution Camera Imaging. E. LING, C. DUXBURY, J. G. MCAFEE, AND F. D. THOMAS. Upstate Medical Center, Syracuse, N.Y.

Scintillation camera images of the thyroid gland obtained with a pinhole collimator following the administration of ^{99m}Tc-pertechnetate sometimes fail to reveal small thyroid nodules subsequently found at surgery. To improve spatial resolution, replaceable tungsten pinhole inserts with pinhole diameters of 1/16 in. and 2/16 in. were fabricated. Their performance was compared with a conven-

tional 3/16-in.-diam pinhole, using a Searle Radiographic HP camera.

The efficiency of counting a sheet source of ^{99m}Tc, using a 20% window, for the 2/16″ diameter pinhole was 44% of the efficiency of the 3/16″ diameter pinhole. The efficiency of the 1/16″ diameter pinhole was only 10%. As with other collimators, the sheet-source efficiency did not change at varying distances in air, but decreased exponentially with depth in Lucite (HVL-5 cm). Comparative images were obtained of a bar phantom, grid phantom, commercial thyroid phantom, and a special thyroid phantom made of a pliable plastic compound impregnated with ^{141}Ce and containing spherical plastic voids. In all instances, there was a noticeable improvement in resolution using the smaller pinholes.

Comparative thyroid images were obtained in 24 patients. The exposure times for the 1/16-in. pinhole proved excessively long. The use of the 2/16-in. pinhole aperture, however, proved practical, by either doubling the usual exposure time or the administered dose to 10 mCi. The quality of the images thereby obtained was significantly improved.

An "Instant" Kit Method for the Preparation of ^{99m}Tc-Labeled Inulin for Gamma Cisternography. BERNARD MAHER AND EDWARD G. BELL. Crouse-Irving Memorial Hospital, Syracuse, N.Y.

A kit method has been developed for the preparation of ^{99m}Tc-labeled inulin which involves only the addition of sterile ^{99m}Tc-pertechnetate ion to a presterilized reaction flask containing the sterile lyophilized reagents.

The procedure involves the addition of 4 ml of purified inulin solution (10% w/v) to 2 ml of distilled water in a 30-ml beaker containing a magnetic stirring rod and 0.5 ml of 0.1% acidified stannous chloride solution is added. The pH is adjusted to 7.5 with sodium hydroxide. The mixture is stirred at room temperature for 5 min and then passed through a Dowex 2-X8 column. The material is then passed through a Sephadex G15 $-H_2O$ gel column. The eluate is sterilized by Millipore filtration. Two-ml aliquots of the sterile eluate are added to each of 16 presterilized reaction flasks and lyophilized for 24–48 hr. Approximately 15–20 mCi of ^{99m}Tc-pertechnetate is added to the serum vial containing the sterile lyophilized reagents and the mixture is shaken thoroughly. Sufficient sterile normal saline is added to give a total volume of 3 ml.

The kits may be routinely checked for sterility, pyrogenicity, osmolarity, and chromatographic characteristics before clinical use.

The Efficacy of Administering Simultaneous Oral $NaClO_4$ and Intravenous $^{99m}TcO_4^-$ for Brain Scanning. MARY E. MAXWELL AND BONNIE BAGGENSTOSS. St. Paul–Ramsey Hospital, St. Paul, Minn.

Most nuclear medicine laboratories use a brain scan protocol that requires a 1–2 hr pretreatment dose to the patient of 250–500 mg of $KClO_4$ before the administration of the i.v. $^{99m}TcO_4^-$. Ingestion of $KClO_4$ is known to prevent the uptake of $^{99m}TcO_4^-$ in the choroid plexus and to reduce it in the parotid and salivary glands. A dose of $KClO_4$ is usually given in capsule form.

The purpose of our study was to assess the feasibility of administering an oral solution of $NaClO_4$ and simultaneously injecting the patient with i.v. $^{99m}TcO_4^-$, without decreasing the quality of the scan. We feel that our study supports the premise that perchlorate is probably a competitive inhibitor and not a blocking agent with respect to $^{99m}TcO_4^-$ (*J Nucl Med* 13: 363–366, 1972). This method will save work time and increase the overall efficiency of the brain scan study.

In a qualitative review of 2,938 scans, we found that 5% of the patients studied did not receive any perchlorate. Of this 5%, about 55% of the scans showed some increase of $^{99m}TcO_4^-$ in the choroid plexus. This uptake can often interfere with accurate scan interpretation. Of the remaining 2,791 scans, 1,558 were done using the $KClO_4$ method described above and 1,233 scans were done using the oral solution $NaClO_4$ (500 mg) method.

None of the 2,791 scans showed significant uptake of $^{99m}TcO_4^-$ in the choroid plexus. The overall scan appearances (parotid and salivary gland filling, blood/brain ratio) were similar.

Evaluation of Myocardial Scanning with ^{43}KCl. BONNIE A. MEFFERD, RICHARD W. MYERS, AND GERALD S. JOHNSTON. National Institutes of Health, Bethesda, Md.

Stress myocardial scintigraphy in patients with coronary artery disease has been diagnostically evaluated through the use of ^{43}KCl.

Each patient underwent myocardial imaging in the resting state or baseline and following maximal standard graded exercise. One week prior to the exercise study, the baseline scan was performed using 0.5–1.0 mCi of ^{43}KCl injected intravenously. For the exercise study, the dose was administered at the onset of angina, fatigue, or dyspnea and exercise was halted. Scanning was started within 5 min. Images in the anterior and left anterior oblique positions were obtained on a rectilinear scanner with a 5-in. crystal using a medium-energy collimator.

Of ten patients studied, four with no evidence

of heart disease had a uniform pattern of ^{43}KCl accumulation on both scans. Six patients with coronary artery disease had essentially normal scans at rest. After maximal exercise the scans showed decreased areas of ^{43}KCl accumulation. Four of these patients had coronary angiography which revealed significant obstruction in vessels perfusing the region of decreased uptake seen on the scan.

The feasibility of demonstrating localized ischemia as "cold areas" in ^{43}KCl myocardial scanning has been shown. A wide application of myocardial scanning for assessing coronary artery disease may be expected, as this technique would allow screening of susceptible patients as well as providing useful information in evaluating patients for more definitive techniques.

Dual-Radionuclide Myocardial Scanning Using A Scintillation Camera. LINDA L. MORROW. Ohio State University Hospital, Columbus, Ohio.

Dual-radionuclide myocardial scanning is performed to show areas of nonperfusion in the cardiac wall. The routine patient has a history of coronary disease and/or myocardial infarction. Our choice of radionuclides are ^{99m}Tc-MAA and ^{131}I-MAA. The ^{99m}Tc-MAA is prepared in our nuclear pharmacy. The ^{131}I-MAA is a commercially prepared product. Indium-113m MAA may be substituted in the place of the iodine.

The procedure is begun in the cardiac catheterization lab (hereafter noted as CCL). After normal coronary catheterization the ^{99m}Tc-MAA is injected in the left coronary artery, and the ^{131}I-MAA is injected in the right coronary artery. The patient is then transported to the nuclear medicine laboratory where scintiphotos of the myocardium are taken. Three views with each isotope are taken. These are the anterior, 45-deg LAO, and the 30-deg RAO.

By using the MAA particles and having them trapped in the small vessels of myocardium, the patient may be transported to the nuclear medicine lab without disturbing the distribution. This is a definite advantage as there may not be an Anger camera in the CCL. Another advantage to the procedure is that there have been no complications resulting from injection.

In summary, by use of this method patients can be separated into "normal" myocardial perfusion and "abnormal" groups. This provides additional information to the cardiologist about small vessel circulation in the myocardium. The coronary arteriogram is a valuable tool but fails to demonstrate small vessel circulation, which can now be evaluated by the above method.

In Vivo Distribution Studies of Technetium-Labeled Macroaggregated Albumin. JOHN H. NORRIS, PETER C. STANG, AND PINYA COHEN. Bureau of Biologics, FDA, Bethesda, Md.

Three commercially prepared macroaggregated albumin (MAA) kits to be labeled with Na ^{99m}Tc-pertechnetate and one instant preparation were tested to establish the distribution and organ uptake of radiolabeled MAA in rodents. Distribution of these products at specific times was studied. Uptake and disappearance rates in the lung, liver, kidney, spleen, thyroid, blood, and carcass were measured. Paper electrophoresis was run on each preparation to determine the bound/free ratio. Four hundred Sprague-Dawley rats weighing 150–250 gm were injected in the tail vein with 0.1–0.6 ml (400–1400 μCi) of ^{99m}Tc-labeled MAA containing 0.03 mg/ml of tin (Sn^{2+}) as chloride and 200 rats were injected with the same volume of ^{99m}Tc-labeled MAA containing 0.01 mg/ml iron as ascorbate. Groups of animals were sacrificed at 15 min, 1, 2, 4, 6, 8, 10, 12, 24, and 36 hr after injection. Organs, blood, and carcasses were counted in a dose calibrator. Organs and blood samples were counted 24 hr later in a gamma counter. Paper electrophoretic analyses of labeled MAA were run in 0.05 *M* phosphate buffer (pH 7.4) for 90 min at 380 $\pm$ 20 V. Microscopic examinations were performed on each preparation for particle count and size. Electron micrographs of prelabeled and labeled preparations were prepared. Organ uptake data were statistically analyzed and a distribution range for each organ was established. The lung uptakes of four preparations at 15 min was 88.0 $\pm$ 7.8%. Liver and kidney uptakes were less than 2% at 15 min; kidney uptake was slightly higher when tin (Sn^{2+}) ion was the reducing agent. Technetium-99m MAA prepared using tin showed a much higher kidney uptake than the liver at 12 hr; at 24 hr the liver and kidney were about the same. When iron ascorbate was the reducing agent, liver uptake was higher. Paper electrophoresis showed 96.0 $\pm$ 2.5% of the ^{99m}Tc added to the labeling vial was bound to the MAA particles. The "free" ^{99m}Tc increased from 2.0 $\pm$ 0.6% toll 0.0 $\pm$ 4.6% in 24 hr. The four preparations tested showed that MAA particles can be labeled with ^{99m}Tc using either reducing agent. Organ distribution studies indicated that reducing agent affects uptake and clearance rates, and suggest that long-term pharmacologic effects be determined.

Quality Control of Radiopharmaceuticals in the Community Hospital. WALTER L. ROBINSON. Bionucleonics, Inc., Fanwood, N.J.

With the ever-increasing number of unlabeled

kits that need to be prepared within the nuclear medicine department, the role that the community hospital should take with regard to quality control needs to be defined. Since quality control by the manufacturers and regulatory agencies is limited, the extent of commitment by the community hospital should be placed in perspective. A suggested approach is provided through a rapid, simple, inexpensive quality-control program.

The methods of quality control described encompass the pitfalls of records, storage, ordering, contamination, administration, and preparation through a program of instant thin-layer chromatography, bacterial checks, choice of agents, particle sizing, molybdenum and aluminum checks, comparative blood tests, pooled serum, and a chronological check list for suspicious scans.

With routine before and after-the-fact analysis of radiopharmaceutical preparations a safe, efficient, reproducible, high-quality product with less repeats is the result.

A rapid, simple, inexpensive program of radiopharmaceutical quality control can be initiated in the community hospital with a minimum of manpower.

A Rapid Renal Screening Procedure Using a Single Dose of ^{99m}Tc-DTPA. HERBERT D. STRAUSS, EVA C. NIKAWITZ, AND MARY JANE B. ZARZYCKI. VA Hospital, East Orange, N.J.

By the use of a bolus injection of ^{99m}Tc-DTPA and a scintillation camera equipped with data-store playback capabilities together with a multi-imaging device, a considerable amount of information regarding the urinary tract may be generated.

DTPA is easily tagged with pertechnetate. The resultant labeled chelate is excreted almost exclusively through the kidneys. A 10-mCi dose of this agent is administered. Videotape recording of the study is begun simultaneously with the injection.

The subject remains before the camera for a period of 25 min, and static scintiphotos are taken. At the end of the study, the position of the camera relative to the subject is changed so that the view includes both kidneys and urinary bladder.

The following information may be gotten from the tape. First, a 16-view renal perfusion sequence is obtained. The activity of each kidney is now plotted through a dual-ratemeter strip chart recorder system for the first minute of the study, so that the time of arrival of the tracer and its amplitude in each kidney may be determined. A DTPA renogram with characteristics similar to the classical Hippuran renogram is obtained, and a kidney/bladder ratio of activity is determined.

We will present data indicating normal values for various parameters of this study including the DTPA renogram and kidney/bladder ratio.

Scintigraphic Isotope Mammography. SYBIL J. SWANN, STEVEN D. RICHMAN, CAMILLE L. BOYCE, AND GERALD S. JOHNSTON. National Institutes of Health, Bethesda, Md.

Breast scintigraphy may afford a noninvasive imaging test for detection of breast carcinoma and discrimination between benign and malignant lesions. The dual isotopes ^{99m}Tc-pertechnetate and ^{67}Ga may prove to be of advantage in these studies.

Breast scintigraphy is performed using an intravenous injection of 15 mCi of ^{99m}Tc-pertechnetate given for a brain scan. Premedication with potassium perchlorate is routine. The gamma camera is interfaced with a minicomputer system for data collection and manipulation. The patient is placed in a sitting position and draped with a lead apron devised to allow only one breast to be exposed for scintigraphic data collection. Cobalt-57 markers are used to mark the nipple and axillary border.

Using the gamma scintillation camera with a high-performance, 140-keV, high-resolution parallel-hole collimator, lateral and medial views are obtained with 300,000-count collections. The pinhole collimator is used for a cranial–caudal view with counts up to 50,000. Forty-eight hours after the intravenous injection of 50 μCi/kg of ^{67}Ga, the patient is similarly positioned. The 1,000-hole high-energy collimator is used for lateral and medial views for 50,000 counts.

In patients with malignant lesions there was a good correlation between ^{99m}Tc-pertechnetate and mammography and clinical palpation. Most of the mass lesions were documented by ^{67}Ga.

Breast scintigraphy with ^{99m}Tc-pertechnetate and possibly gallium may be useful in the identification of malignant breast masses.

Pancreas Imaging with Computer Enhancement. SHARON M. THORP. University of California Medical Center, San Francisco, Ca.

The pancreas is one of the more difficult organs to visualize well using current radiopharmaceuticals. A method will be described by which the pancreas has been well visualized and the image enhanced by reduction of liver activity and background using a scintillation camera interfaced to a computer.

The patient is fed a high-protein meal and 15 cc of 100-proof alcohol after an overnight fast. The liver is localized with 500 μCi of ^{99m}Tc-sulfur colloid, and the patient is positioned so that the detector looks under the liver edge.

This liver image is stored in the computer. The patient is then injected with 200 μCi ^{75}Se-selenomethionine, and data collected for 60 min. Next, a rapid-sequence flow study to determine the position of the aorta is obtained by injecting 5 mCi of ^{99m}Tc-sulfur colloid. The patient is then dismissed.

Using the accumulated data the liver mass imaged with colloid can be subtracted from the selenium images of liver and pancreas. Background is also subtracted resulting in a much-improved image of the pancreas. Similarly, the frames of the flow study can be added to the pancreas image to determine if a midline defect in the pancreas is due to anatomical thinning by the aorta.

This technique has been used in 25 cases. In 19 cases the pancreas was visualized well. There was fair visualization in 3 cases, and there were 3 cases in which the pancreas did not visualize at all. Of the 22 pancreases visualized, 16 were considered normal at interpretation.

Quality Control for the Radioimmunoassay. ROBERT TOKARZ AND THEODORE STAHL. Middlesex General Hospital, New Brunswick, N.J.

The purpose of this presentation is to discuss the use of a quality-control program for the radioimmunoassay.

Duplicate determinations are performed on all patient samples. Two patient samples (high and low value) are analyzed in two consecutive runs. We obtained the difference for each pair of samples for the first and second analyses. The difference between the range for the first and second run is used as the variable. Means for the range for each pair for each run and the range between runs are calculated. With these data and statistics tables, three sigma control limits are determined.

Another variable for control is the standard curve. Percent binding for each point on the standard curve is averaged over a period of time. Control charts for the mean percent binding and three sigma control limits are used.

Oral ^{99m}Tc-Pertechnetate: An Aid in the Differentiation of Epigastric Lesions. SUSAN WEISS AND JAMES J. CONWAY. The Children's Memorial Hospital, Chicago, Ill.

Occasionally, abnormalities in the upper portion of the abdomen may be suspected by the appearance or configuration of the liver, spleen, or kidneys during radionuclide imaging. For example, during liver and spleen imaging with ^{99m}Tc-sulfide colloid, the spleen may appear separated from the liver or assume an unusual flattened configuration against the abdominal wall. The presence of an epigastric mass may be suspected. Since the stomach occupies that space between the left lobe of the liver and the spleen, the simple ingestion of ^{99m}Tc-pertechnetate following the routine liver and spleen images may resolve this problem readily by visualizing that space.

During renal imaging with ^{99m}Tc-DTPA, the presence of an avascular lesion such as a cystic duplication of the left kidney may be simulated by swallowed air in the stomach. This often is pronounced in a crying child. Ingested ^{99m}Tc-pertechnetate will eliminate this "lesion."

Oral ^{99m}Tc-pertechnetate has also been used to localize calcified abdominal masses visualized with ^{99m}Tc-polyphosphate during bone imaging.

When using the normal pediatric ^{99m}Tc doses for liver, spleen, renal, and bone imaging, approximately 500 μCi of oral ^{99m}Tc-pertechnetate given with a glass of water will provide sufficient activity in the stomach for simultaneous visualization of the upper abdominal organs.

The Technology of Imaging with ^{67}Ga-Citrate. DOUGLAS B. WIGTON. Penrose Hospital, Colorado Springs, Colo.

The purpose of the study was to define the technical factors involved in obtaining the highest quality image using ^{67}Ga-citrate.

A scan phantom was constructed which was 12 in. in diam and 2 in. deep. It was filled with a dilute solution of water and ^{67}Ga; then two line phantoms constructed from pipets were placed in the bottom of the phantom. Line-to-background ratio was chosen on the basis of tissue biopsy count information. The phantom was then imaged with a gamma camera and a rectilinear scanner. Various collimators, window settings, and information densities were tried, the results were correlated and final protocols were chosen. These protocols were then applied to actual patient imaging to evaluate practicability.

Selected case studies will be presented as slides to visually demonstrate the efficacy of our method. Our studies indicate that low-energy collimators are inadequate for imaging ^{67}Ga due to septal penetration by higher-energy photons. We found that the moderate minification of the divergent collimator caused a certain amount of data compression, which enhanced the image. We also found that the scanner was not as affected by compton scatter or septal penetration due to the greater septal length.

Special problems for the clinician and for the technologist are presented with ^{67}Ga. Our study has helped to define and delineate some of these problems and has established some basic guidelines from which to work.