ABSTRACTS FOR TECHNOLOGISTS' SCIENTIFIC PROGRAM

Quality-control Program for the Radioisotope Department BY NELLIE M. BERING, CECILIA DEFRIES AND JANIE M. REID, Oscar B. Hunter Memorial Laboratory, Washington, D.C.

This paper describes a quality-control program for the Radioisotope Department at Oscar B. Hunter Memorial Laboratory based on instrument controls and control limits set for procedures. The control program for the instruments is divided into a program for the spectrometer well and probe scintillation detectors, survey meters, rectilinear scanners and the gamma camera. Where appropriate the following procedures are performed: (1) daily high-voltage determinations using a reference source, (2) statistical checks for reliability counts, (3) regular determination of the total absorption peak of radionuclide, (4) determination of the resolution of the detector and (5) background counting. The control program established for photoscanning in addition to high voltage includes: (1) performance of calibration lines of photo intensity to view the change from gray to black at the various photo-intensity settings, (2) use of phantoms to determine the optimum isoresponse curve for the collimator and to determine what is seen by the detector and (3) determination of the "steadiness" of the CRT tube and the information density. By necessity the gamma camera has a spectrum check with each radionuclide used. The most recent picture of the spectrum is posted on the quality-control board giving the date, range and peak of the radionuclide. The photomultiplier tubes are checked by flooding the crystal with ^{99m}Tc for 300–400 K counts for 2 min using a syringe that has been used and did contain 10 mCi ^{99m}Tc. The reliability of counts is also recorded with the camera. The maintenance and service is important, but frequently the need is determined as a result of these checks and controls.

The statistical procedure used for the diagnostic tests is primarily Hoffman's "average of normals" method of quality control. The procedure is based on the use of certain patients' specimens. The daily routine of the control process consists of computing the averages of patients' values which fall within the normal range and plotting the average on a chart. The 95% confidence limits are established for the procedure by the rise of a series of normal individuals.

Details of the quality-control program will be outlined in the presentation.

Detection of Nonmalignant and Malignant Bone Disease with ^{87m}Sr BY KAREN L. BLOOMER, Tumor Institute of the Swedish Hospital Medical Center, Seattle, Wash.

Strontium-87m is a short-lived bone-seeking radionuclide that can be used for nonmalignant as well as for malignant bone diseased states. Strontium-87m is more effective than ^{85}Sr and is as easy to use as ^{99m}Tc. The what, how and why of ^{87m}Sr are explained from a technologist's point of view based on experience with over 300 bone scans.

Strontium-87m is easily obtained in generator form. It has a 2.8-hr half-life, and emits a 388-keV gamma ray. The bone dose rate of ^{87m}Sr is substantially less than that of ^{85}Sr which allows a greater dose range, yielding much better counting statistics. Strontium-87m ions are deposited on bone by physical exchange with an equal number of nonradioactive ions already present on the bone. This exchange reaches a maximum level within 1 hr which enables us to scan much sooner than with ^{85}Sr. Animal investigations in our laboratory not only show the time and rate of ^{87m}Sr exchange but also show the rate of blood clearance corresponding to this study.

Three hundred ^{87m}Sr scans were performed with a 3-in. rectilinear scanner. The results of these examinations were then compared with x-ray findings in all instances, as well as autopsy and bone biopsies when available. The findings confirmed the superiority of bone scanning over x-ray in the detection of occult disease. Exams dealing with nonmalignant diseases, such as inflammatory states, metabolic diseases, aseptic necrosis and malunion were studied with equal success.

Bone scans stand out as a valuable tool for early documentation of diseased states. Strontium-87m is an excellent scanning agent that does not limit a nuclear medicine department to studies of malignant disease but allows an effective, relatively simple study of nonmalignant bone conditions.

Utilization of ^{51}Cr Fecal Blood Loss Study to Evaluate a New Drug BY B. BORNE, Chicago Wesley Memorial Hospital, Chicago, Ill.

The purpose of this study was to use the ^{51}Cr red-cell tagging method to determine fecal blood loss to evaluate a new drug for arthritis by comparing the amount of blood loss into the gastrointestinal tract following the administration of aspirin with the amount of blood loss following the administration of the new drug.

An 8-ml sample of blood was withdrawn from the patient and added to acid citrate dextrose solution. Approximately 150 μCi ^{51}Cr ($NaCrO_4$) was added and, during 15 min of gentle mixing, erythrocyte tagging occurred. The addition of 100 mg ascorbic acid inhibited further tagging by changing the valence of the chromium ion. The tagged cells were then reinjected into the patient. Exactly 10 ml heparinized blood was withdrawn from the patient at the start of each fecal collection so that the percent of the dose in the patient's blood could be determined.

Two four-day fecal collections were obtained from each patient. The first collection was started 2 weeks after the red-cell tagging following the administration of aspirin, and the second was started 2 weeks later following the administration of the new drug. Each fecal collection was made in a paint can, which enabled the use of sodium hydroxide pellets to dissolve cheesecloth or tissue that was present. The contents of the can were diluted to the desired volume with water, and the can was put on a paint can shaker to homogenize the contents. The percent of the dose in the patient's feces was determined, and the results of those calculations and the calculations to determine the percent of the dose in the patient's blood were used to figure the fecal blood loss.

$$\text{Milliliters blood lost in feces} = \frac{\%\text{ dose in feces}}{\%\text{ dose in 1 ml blood}}$$

This method was used on 20 arthritic patients. Seven of them were within normal blood loss limits throughout the study, with six having decreased blood loss after the new drug and one having increased loss. Four patients with abnormal blood loss before the new drug went into the normal range, and four patients who were normal became abnormal. Of the patients who stayed in the abnormal range, three showed decreased blood loss, and two increased.

The data resulting from this study do not clearly demonstrate that the new drug is superior or inferior to aspirin with respect to gastrointestinal bleeding. A more extensive evaluation is indicated.

Evaluation of T^*_4 Resin Strip Uptake BY MARIAN COPPLER, BERNADINE KOVALESKI, JAMES SHERRY, HELEN SHEPPARD AND JORGE FRANCO, O'Connor Hospital Medical Center, San Jose, Calif.

Our basic thyroid workup consists of a brief history, a 24-hr ^{131}I uptake, T_3 (Triosorb) and T_4 by column.

In the Res-O-Mat T^*_4 test system, serum proteins are denatured with alcohol with the resultant release of the bound T^*_4. The supernatant is incubated with the strip which contains the resin for a period of 1 hr. The strip is then carefully removed, and the radioactivity of the sample before and after removal of the strip is determined. Serum standards of 0 and 12 μg T_4 are done with each batch, and the T^*_4 levels for any one sample are read from the graph. Technical problems observed with this method included apparent contamination of the vials by a loose cap in transit and occasional variation in the counts of the unopened vials of the same lot.

Twenty clinically euthyroid subjects were studied first. The average T^*_4 value was 7.5 μg. The normal range was from 5.0 to 12.8 μg.

Forty-two clinically euthyroid patients referred to our laboratory because of one abnormal thyroid function test had an average radioactive T^*_4 of 8.2 μg. Ten hyperthyroid patients had average values of 18 μg, and six hypothyroid patients had average values of 2.0 μg. In all these cases there was no discrepancy between T_4 by column and radioactive T^*_4. While on Itrumil one currently euthyroid patient had elevated T_4 by column and normal T_3 and T^*_4 levels. Twelve patients who had recently undergone diagnostic studies with iodinated dyes such as Hypaque, Pantopaque and Conray had normal T_4 values by column and by saturation analysis. Six

patients who had received either Telepaque, Lipiodol, Cholografin or Dionosil had elevated T_4 by column and normal T^*_4 levels. One patient who was receiving Ornade and one who had Teridax 18 years ago had markedly elevated T_4 by column levels and normal T^*_4.

Of 26 patients on contraceptive pills 19 had elevated T_4 by column and 21 had elevated T^*_4 by saturation analysis. Two euthyroid patients had unexplained elevations of T_4 by column or the strip method.

T^*_4 by saturation analysis entirely circumvents the problems of iodinated contamination which have impaired the reliability of the colorimetric procedures. However, misleading results are likely to occur in patients with drug-induced changes in thyrobinding globulin levels. The method has appealing simplicity.

Radioisotope Measurement of Urinary Bladder Residual BY FAUNO CORDES AND KENNETH MCCORMACK, Mt. Zion Hospital and Medical Center, San Francisco, Calif.

A method of measuring the urinary bladder residual with ^{131}I-Hippuran is being re-evaluated. The technique is essentially that of making prevoiding and postvoiding counts over the bladder and mathematically correlating them to the volume voided. The results are then confirmed by catheterization as soon as possible. This method has been found to be simple, well tolerated by the patient and highly reliable.

Radiation Exposure to Personnel Handling ^{99m}Tc BY DENNIS WAYNE DAMM AND JOHN WOLFF, Univ. of Minnesota Health Sciences Center, Minneapolis, Minn.

The frequent use of ^{99m}Tc as a multipurpose radionuclide may constitute a significant radiation hazard to personnel handling this material. Because of the decay characteristics, large doses can be administered to patients to obtain desirable counting statistics without significant radiation hazard to the patient. However, these large quantities when handled repeatedly by personnel may constitute a significant radiation hazard.

To evaluate radiation to the hands at contact and at distance, the following instruments were used: a G-M counter, a Cutie Pie, a Victoreen r-meter, film badges and a thermoluminescent dosimeter. Of particular interest was dose at contact with syringes containing 15 mCi ^{99m}Tc. Shielded and unshielded syringes were measured and results expressed as rads/surface area/mCi/hr.

Syringe shields were cylindrical to accommodate syringe barrel, 3 mm thick, with a window slit to allow visual inspection of syringe content.

Values from unshielded syringes were 200 times that of shielded syringes. Measurements at window slit were approximately ½ those of unshielded syringes.

If all factors are taken into account, the radiation hazard may be considerable for personnel handling this material. Although much of the assay data are within established limits of radiation exposure, those for skin at contact appear startling.

Quality-Control Program in the Nuclear Medicine Laboratory BY SISTER AUSTIN MARIE DONNELLAN, St. Francis Hospital, Miami Beach, Fla.

A quality-control program gives the clinician, laboratory director and technologists the only assurance that tests performed are accurate. Diagnostic *in vitro* routine procedures can readily be subjected to a quality-control program. The two most widely used procedures are blood volume and T_3 determinations.

The blood volume method used in this institution is a simultaneous double tag using radioactive labeled sodium chromate and ^{125}I-human serum albumin. Weekly controls of the methodology are performed using outdated blood units; either whole blood or packed cells reconstituted to a predetermined volume with saline. Since the red-cell mass can be physically measured and the total volume is also known (in the case of packed cells by measuring the amount of saline added), one can calculate the percentage error (deviation) of the actual results from the true values. Over an 18-month period our error for the red-cell mass averaged 3.7%; for the plasma volume it was 4.8%. As long as percent deviation from true values is within acceptable limits, the procedure is assumed to be functioning correctly. Results outside acceptable limits are investigated to determine the cause. IHSA plasma tag alone can be controlled in similar manner by using a measured quantity of water as the "test patient."

The T_3 determinations are monitored daily by running a pooled serum control simultaneously with the patient samples. This pool is collected in sufficient quantity to last 4 months. Aliquot amounts for daily use are dispensed from the pool into stoppered tubes and frozen. One tube is used daily. The frozen serum is stable up to 4 months. The T_4 tests can be controlled in a similar manner.

We evaluated six of the available T_3 systems using two commercial control serums and our own pooled-serum control. Two of the kits give consistently satisfactory reproducible results with our control serum and are now used interchangeably. Without a con-

trol method it would be a great problem deciding which of the many commercial T_3 kits to use.

Advantages of Producing a Minified Scan Image BY JAMES W. DOWELL, FRED S. MISHKIN AND ISAAC C. REESE, Indiana Univ. Medical Center and the Indianapolis V.A. Hospital, Indianapolis, Ind.

The purpose of this study was to evaluate the validity and clinical advantage of image minification in rectilinear scanning.

An Ohio Nuclear rectilinear scanner (Model 54HD) with dual 8-in. crystals was used. Changing the gear ratio in the synchro motors coupling the detector head with the x-y plotter and changing the light mask slit were the only modifications required to achieve a 5:1 reduction of the scan image.

A Picker thyroid phantom and a homemade phantom with known defects of 1, 2 and 3 cm were scanned, and the counts were varied by increments of 1,000 cpm from 2,000 to 100,000 cpm to insure no perceptible loss of resolution with the minified scanning system compared with the life-sized image. The results showed that good images were produced using maximum scanning speed except when counting rates dropped below 4,000 cpm when the defects in the thyroid phantom could not be seen although the outline of the gland could be seen.

Clinical results of all organ images have been satisfactory for interpretation. In five patients with skeletal lesions the miniscans requiring 20–30 min were judged as interpretable as the life-size scans which required approximately 4–6 times as long to obtain.

Our conclusions are (1) Scanning time for any organ is remarkably shortened; (2) Five-to-one linear reduction of the image is roughly equivalent to increasing the counting rate by a factor of 25; (3) Since density gradients of the mini-image are projected over a smaller area of the retina than the life-sized image viewed at the same distance, density differences are readily perceived; (4) Reduction of film size from 14 × 7 in. to 8 × 10 in. or 70-mm film if desired represents a significant savings; for example, using 8 × 10-in. film saves approximately $2,000 per year in film cost at this institution.

Photography on 35-mm Film of the Persistence Scope of a Gamma Camera as a Routine Imaging Procedure BY PIERRETTE FILLION, LORRAINE PICARD-DAOUST AND ROGER GHYS, Hopital du Sacré-Coeur, Montréal, P.Q., Canada

The usual imaging procedure for the Anger camera consists of taking Polaroid pictures of an oscilloscope with a three-objective photographic camera. This is a convenient method, but it suffers from two drawbacks: (1) Polaroid film is expensive, it has a poor definition and it does not lend itself to subsequent reproduction by standard photographic techniques and (2) although the picture can be seen immediately *after* the exposure, there is little that can be done to improve or correct it *during* the exposure.

Nuclear-Chicago now supplies as an accessory for its gamma camera a system consisting of a persistence scope and a Super-8 movie camera, for the specific purpose of facilitating radioisotopic flow studies. In our laboratory, as in many others, flow studies only represent a small percentage of the total number of examinations done, and we have tried to make the best use of the unique properties of the persistence scope for routine cases.

A single-lens reflex 35-mm camera with an 80-mm focal length objective and extension tube has been installed on the pedestal of the Super-8 camera (which can be put back in a matter of seconds). The technician watches the image build up on the persistence scope and takes a picture when enough information has accumulated. The films are developed each day.

This method has several advantages: (1) the picture is taken when the right amount of dots have accumulated. Actually, in most cases, this takes much less time than with the conventional Polaroid system; (2) the picture is about the same size as on the Polaroid print and can be examined directly, but it is also a fine-grain negative, which lends itself much better to reproduction and enlargement; (3) sequential pictures can be taken at about the same speed as by pulling Polaroid films, but there is no need for stopping after eight pictures; and (4) the cost of a picture is only a small fraction of the cost of a Polaroid print.

We are very satisfied with this technique, which we now use for all our patients.

Pitfalls in Peaking the Pho/Gamma Scintillation Camera BY JUDIE FOSTER, Univ. of Chicago, Chicago, Ill.

Optimum peaking is of great importance in obtaining correct results from the Pho/Gamma Camera.

Optimum peaking depends on the configuration, distance and activity of the source, use of collimation and proper adjustment of the isotope range and isotope peak dials.

Using the Nuclear-Chicago Pho/Gamma III, peaking without a collimator, a point source, syringe or sheet source may be used at any distance *providing the counts per minute do not exceed* 3×10^6 *cpm.*

Choice of an improper isotope range setting can decrease efficiency by as much as 6%. Once the

camera is peaked, the isotope range setting should not be changed.

With ^{99m}Tc, the isotope peak is so broad that a variance in peak setting can be observed depending upon whether the window is set from the "high" or "low" side. This variance can be as great as 80 divisions. Until complete familiarity with "setting the peak" is achieved, we recommend a photograph of the final setting (taken by opening the scope camera shutter and manually turning the master power switch from "standby" to "on" to "standby" as rapidly as possible) to confirm proper window placement.

Blood Volume BY REBECCA HECHT, Nuclear Medicine Institute, Cleveland, Ohio

A test which has, in many cases, been simplified in explanation and practice to a point of misunderstanding and inaccuracy by a great number of nuclear medicine technologists is the determination of blood volume. Since the circulatory system is only part of a greater system (the body), neither of which is in a static state, the common tank dilution explanation can be considered only partially correct.

The purpose of this paper is to point out the factors which must be considered to obtain an accurate blood-volume determination of value to the physician. These considerations include physical condition, statistics (height, sex, etc.) and activity of the patient. All of these factors must be considered before a radioactive tracer can be properly chosen.

One of the greatest factors to be considered is the proper use of the hematocrit and its fluctuations due to various locations and conditions in the body. It is my intent that by exploring the many varied aspects influencing the blood-volume determination, it may assume the important role in the field of medicine of which it is capable.

Dual Radioisotope Technique for the Diagnosis of Subdiaphragmatic Abscess BY CAROL J. IMBORNONE AND DAVID A. GOODWIN, V.A. Hospital and Stanford School of Medicine, Palo Alto, Calif.

In questionable cases of subdiaphragmatic abscess it is important to determine whether the abnormality seen on the x-ray is above the diaphragm in the lung or below the diaphragm in the liver. We have devised a technique with which we can visualize both organs separately and together.

An intravenous injection of 3.5 mCi of ^{99m}Tc-sulfur colloid for liver scanning is followed immediately by a 4 mCi dose of ^{113m}In $Fe(OH)_3$ macroaggregates for lung scanning. The Anger gamma scintillation camera with the diverging collimator is used to image the organs. The diaphragmatic area can be evaluated by superimposing both the liver and lung images on the same photograph, performing each exposure with the spectrometer peaked at its proper setting. Standard anterior, posterior and right lateral views are taken. Next, the same views are obtained for the liver and lungs separately. Because the peaks of the two isotopes are far enough apart (140 keV and 390 keV) visualization of the liver can be accomplished without interference from the lung. The total study can be performed in 1–1½ hr.

By this means a clear view of the subdiaphragmatic area, lower lung zone and dome of the liver are obtained singly and together.

Technique for Performing Lung Ventilation Studies with Pressurized ^{133}Xe Gas BY BARBARA J. JUMP, SUSAN J. LITRENTA AND THEODORE T. NIZNIK, North Charles General Hospital, Baltimore, Md.

The purpose of the study is to visualize and record the distribution of ^{133}Xe gas in the lungs during inhalation, equilibration and subsequent washout. Using the newly available cylinder of meterable xenon gas and an Anger camera equipped with the low-energy collimator, the study is quickly and easily performed.

The cylinder contains a 50-liter mixture of 200 mCi xenon gas and breathing air under 500 psi. A special valve with a flow meter and a pressure gage, supplied by the company, is attached to the cylinder. The breathing apparatus consists of a 6-liter anesthesia bag with a mask attached to one end and tubing connecting the other end to the xenon valve outlet.

Preparatory to the study, the bag is first partially filled with oxygen and then approximately 6 mCi of xenon gas is metered into it. The patient is seated and positioned for a posterior view of the lungs. Transmission images are viewed on a long persistence oscilloscope to insure exact placement of lung fields on each side of the split crystal. When the patient has been given breathing instructions, the study is begun by placing the mask over the patient's face. Scintiphotos are made at 15-sec intervals during inhalation and breath holding, during equilibrium and during washout. Left and right scaler counts are recorded as each picture is pulled, and the strip-chart recorder is used to graph the left and right activity levels during the entire procedure.

At the present time two to eight patients daily undergo this study in our laboratory. The average time per study, including preparation is only 8 min. The procedure graphically depicts ventilatory function of the lungs in preparation for general anesthesia and for the evaluation of chronic lung disease.

The Knowledgeable Technician: A Good Brain Scanning Agent BY BARBARA J. KLAASSEN, Tumor Institute of the Swedish Hospital Medical Center, Seattle, Wash.

A quality radioisotope scan depends on many factors, one of the most important being the technical ability to obtain a good study. Since the nuclear medicine physician cannot be present at all times, a knowledgeable technician is necessary to obtain the best information possible from every radioactive test.

Technetium brain scans are the most commonly performed procedure in the nuclear medicine department today. Even in this familiar test, questions of procedure arise with each new patient, and the advantages of having a technician who is aware of these problems and can solve them are numerous. Certain questions that every technician should answer each time he performs a technetium brain scan on the gamma scintillation camera include: (1) Could there be any extrinsic interference with this brain scan leading to false positive or false negative results, i.e. previous tests, drugs? (2) Would a cerebral blood flow be of value, as in the case of suspected arterial occlusion or vascular defect? (3) How much time should elapse between injection of the radiopharmaceutical and start of the scanning procedure for sufficient isotope localization? (4) How many views are needed, what are the best ways of positioning and how many counts are necessary for each picture for the required information? and (5) Should a blocking agent be used with ^{99m}Tc-pertechnetate?

Various technical approaches and solutions to these problems based on experience with over 2,500 Pho/Gamma Camera brain scans will be discussed.

Combined Isotopic and Ultrasonic Studies in Selected Patients with Unusual Liver Disease BY BERNADINE KOVALESKI, MARIAN COPPLER AND JORGE FRANCO, O'Connor Hospital, San Jose, Calif.

Most of the time, in the appropriate clinical setting the isotopic liver scan is all that is necessary to actually diagnose liver masses. However, in a number of cases this information does not suffice and the differentiation between cyst and abscess or a tumor can be difficult.

During the past year we had six such instances of patients with liver pathology where the use of isotopic scanning and arteriography did not result in an unequivocal differentiation between cyst, abscess or neoplasm. In such cases we have used the A-mode ultrasonic study as outlined by Ostrum *et al* (*Radiology* **88**:745, 1967). The first case was a 32-year-old female patient with right upper quadrant pain. The gold liver scan demonstrated a large 5.0-cm defect superiorly in the right lobe. The ultrasonic pattern was one of a cystic tissue. Aspiration and subsequent clinical course were consistent with amoebic abscess.

The second case was a 67-year-old male who was found to have a pronounced hepatomegaly. There was no history of known malignancy. The liver scan demonstrated what appeared to be a large circular defect in the left lobe of the liver. The arteriogram was interpreted to be consistent with a cyst although tumor could not be ruled out. The A-mode ultrasonic pattern was that of a solid tissue. At laparotomy there were a number of orange-sized metastatic nodules which partially overlapped each other.

The next patient was a 56-year-old male with a long standing history of alcoholism and a rapidly developing epigastric mass. The isotopic scan demonstrated a large defect in the left lobe of the liver. G.I. series and selective arteriography suggested a pancreatic lesion, probably a cyst although a neoplasm couldn't be ruled out. The ultrasonic A pattern was that of a cystic lesion. At laparotomy this was a large pancreatic pseudocyst.

Three additional patients had what appeared to be large single defects in the liver scan but with a history of previous colonic carcinoma. The ultrasonic A study demonstrated the pattern of solid tissue, and the eventual course of events demonstrated that there was indeed metastatic disease in the liver to a greater extent than anticipated by the isotopic liver scan.

In summary, when dealing with large defects in the isotopic liver scan the use of ultrasound to distinguish between cystic lesions, abscesses and solid tumors is a relatively simple and apparently a reliable diagnostic modality.

Comparable Films on Rectilinear Scanners BY DONALD E. KUNDEY, Baylor Univ. Medical Center, Dallas, Tex.

This paper shows that comparable scans (density range of contrast, etc.) can be obtained using a simple setup and one variable control setting (window width) on rectilinear scanners (except Dynapix) of different makes and models.

The basic setup was originally a technique used in Miami, Florida, adapted for a 5-in. Magnascanner (low-energy collimator). The settings are: speed 200, time constant 0.01, range 30 K $\times$ 2, density 50, range differential 50, windows set at 130–150 keV. Using a modified light-pipe opening rectangle in shape, line spacing was 0.29 cm. The probe is placed over the coldest part of the brain. The count-

ing rate is adjusted by opening or closing windows to obtain 20 K over the coldest area. The light source is set at 650–700 (varies from week to week as machine ages).

Using a low-energy collimator on the Magnascanner 500 which has a different light output than the 5-in. scanner, a different group of settings is needed. As before, the probe is placed over the cold spot and adjusted to 20 K. (The 5-in. Magnascanner has a short gray scale, and the Magnascanner 500 has a long gray scale and tends to be quite contrasty.) The light source in this case is adjusted to read 300 and the other settings are: line spacing 0.3 cm, time constant 0.01, range 30 K $\times$ 2, density 25, range differential 60, windows as before, speed 250 and modified light pipe.

This technique can be used even on a 3-in. scanner. The speed is somewhat slower so wide windows have to be used. Films tend to be flat with a bit more background in the cold area. If the method is expanded slightly, it can be used for 10-crystal Dynapix. The settings are: density 48; suppression 5–10; windows at manufacturer's recommendation; Channel 8—anterior view above bridge of nose, lateral view slightly posterior to outer canthus; Channel 9—posterior view at base of skull; speed—anterior set to obtain 40 counts Channel 8, lateral set to obtain 35 counts Channel 8, posterior set to average 50 counts between Channel 8 and 9.

Note: This technique gives films comparable to single probe scanner on "negative film." The Polaroid paper print, however, is a "positive" (white on black). This method provides a practical and simple technique for insuring consistent scan film cosmetics.

Tools for Survival BY MICHAEL M. KUSCH, Muskegon General Hospital, Muskegon, Mich.

The growth and development of nuclear medicine has been unbelievable during the years that I have been acquainted with it. Where it will go in the coming years is anyone's guess. One thing is sure; nuclear medicine is here to stay and is grabbing a firm hold on the distinction of being a separate medical specialty.

This rapid growth has put a great deal of weight on the shoulders of both the physician and technologist. They are now constantly being asked the five W's about their work: . . Who? . . What? . . When? . . Where? . . and Why? . . Personally I am finding it increasingly difficult to answer these questions.

Today's technologist for his own self-protection has to keep abreast of new developments in procedures, instrumentation, radiopharmaceuticals and education. If he doesn't—like "Jonah and the Whale"—he will be swallowed up. Unlike Jonah though, he will never be seen again.

Some years ago I realized that the greater majority of technologists were in a situation where they did not have the people or resources available to answer their problems and keep them abreast of new developments.

During the past few years I have solved this problem for myself by collecting all the literature that is available concerning nuclear medicine. This includes texts, pamphlets, journals, etc. I did this not necessarily to read and digest all the materials contained within their covers (although this would be most ideal), but to have them available as a ready reference when problems or questions arise.

It is true that text books are relatively expensive, but when you place this expense alongside the idea of being left in the "dark ages," the expense is well justified.

Plumbers, carpenters and mechanics have their "Tools for Survival" as do most all professions. I feel the average nuclear medical technologist's "Tools for Survival" are contained within the covers of today's vast array of nuclear medical texts.

The various types of literature currently avaliable and their usefulness will be shown and discussed. A current up-to-date list of available materials giving the title, author, publisher, date of publication, breakdown of contents by chapter and price will also be shown and will be made available for handout.

This will be done with no commercial overtones to any author or publisher, but simply to show the technologist what is available and where it can be obtained.

New Method for Making Heat-Treated, ^{51}Cr-Tagged RBCs for Spleen Scanning BY RALPH W. KYLE AND GERALD S. JOHNSTON, Walter Reed General Hospital, Washington, D.C. and Letterman General Hospital, San Francisco, Calif.

Spleen scanning has not been extensively used because of the time required for preparing the red cells and the lack of reproducible results. A rapid, easy method of preparation was developed in which the RBCs were simultaneously heat-denatured and tagged with ^{51}Cr. Twenty milliliters of patient's blood, 4 ml of ACD solution and 200–300 μCi of $Na_2{}^{51}CrO_4$ are mixed in a sterile bottle and then incubated for 10 min in a 56°C water bath. The mixture is removed from the water bath, 100 mg of ascorbic acid is added, and it is allowed to cool to body temperature. Twenty milliliters of the mixture is then injected intravenously and spleen imaging is begun 15 min post dose. The resultant scans were

of a superior diagnostic quality to those obtained by the usual prolonged RBC preparation. This method has become standard for splenic scanning in the authors' home institutions.

On the Use of a Small Digital Computer in Every-Day Practice for Calculating Radiopharmaceutical Injections BY YOLANDE LAFONTAINE, RENÉ ROBILLARD AND ROGER MATHIEU, Hopital Maisonneuve, Montreal, P.Q., Canada

This study intends to show the usefulness of a digital computer in a nuclear medicine department, notably in precalculating volumes of radiopharmaceutical injections for scanning and other procedures.

This paper compares and describes methods used to calculate the activity of an isotope at a specific time to determine volumes to be injected for a given dose. The method of longhand calculations referring to decay tables normally used in laboratories is compared with the computer, namely the PDP-8/I, programmed to calculate the information required.

The study describes how an interactive type of program can be set up easily for a variety of isotopes with a computer using Focal, an easy-to-learn interpretive language.

The presentation will illustrate in more details how the program is executed, the structure of the hard copy obtained and its use in every day practice.

Use of a Cinescintigraphy System in Clinical Imaging Studies BY J. MCFARLAND, E. V. STAAB AND A. B. BRILL, Vanderbilt Univ. School of Medicine, Nashville, Tenn.

The Intertechnique digital cinescintigraphy system has been in clinical operation in our laboratory for over 1 year. The use of a digital data-acquisition system in routine nuclear medicine studies provides useful information not available from cameras or scanners alone.

Examples of the use of this system in evaluating regional and temporal distribution of radiopharmaceuticals will be presented. Hippuran renograms will be shown in which counting rates from the whole kidney, portions of either kidney, urinary bladder and blood background are obtained. Other examples will include the use of ^{133}Xe for lung ventilation-perfusion studies, pertechnetate for bolus flow. Early thyroid uptake and placental localization studies will be presented.

The usefulness of nondestructive readout systems, temporal kinetic presentations and image subtraction techniques, along with the ability to vary display factors such as contrast, intensity and size will be demonstrated.

Measurement of Oral Calcium Absorption by External Isotope Counting: Studies in Renal Failure BY L. RENERTS AND SAUL M. GENUTH, The Mt. Sinai Hospital of Cleveland, Cleveland, Ohio

The factors which regulate normal gastrointestinal calcium absorption are thought to include calcium intake, vitamin D and parathyroid hormone. It is well documented that gastrointestinal calcium absorption is reduced in states of malabsorption and hypoparathyroidism and is markedly reduced in patients with chronic renal failure. Difficulties inherent in classic calcium-balance techniques have prompted investigators to search for more practical and reliable means of detecting the onset and measuring the degree of impairment of calcium absorption. This paper reports our studies of intestinal absorption of ^{47}Ca by external radioisotope counting using the method of Curtis, Fellows and Rich (*J. Lab. Clin. Med.* **69:**1036, 1967). The subjects received an intravenous injection of 10 μCi of ^{47}Ca on Day 1 and an oral dose of 25 μCi on Day 2 with 200 mg of carrier calcium as the gluconate. Arm counting was performed in a liquid scintillation counter (Packard Armac) before the intravenous dose, 24 hr after the intravenous dose and 24 hr after the oral dose. After correction for background and radioactive decay, the fractional rate of oral calcium absorption was calculated.

The mean semifractional absorption in 10 normal males and eight normal females was 0.27 ± 0.023 and 0.25 ± 0.022, respectively. The group mean was $0.26 \pm .016$. The preceding dietary calcium intake in the 18 normal subjects was calculated from three-day diet records. No significant correlation was noted with fractional rate of absorption ($r = 0.02$, pNs). Nine subjects with renal failure undergoing chronic hemodialysis had a mean calcium absorption of 0.13 ± 0.017 differing significantly from normal ($p < 0.001$). In three patients with successful renal transplants the mean was 0.20 ± 0.023. One subject with osteomalacia secondary to malabsorption had a value of 0.08 which rose to 0.15 with vitamin D treatment.

It is concluded that this technique successfully measures the degree of impairment of gastrointestinal calcium absorption in patients with renal failure and its restoration to normal by renal transplant. Further applications of this method to clinical situations is expected.

Error in Radiation Counting BY HELEN ROJEK, Royal Victoria Hospital, Montreal, P.Q., Canada

In the measurement of radioactivity, statistics are of primary importance. It can be established how accurately precise results are after recognizing the

types of errors and the extent that are acceptable for the particular examination.

The most obvious error in the measurement of radioactivity is introduced by the random pattern of disintegration of nuclides. Where variations of observed results are governed by chance, the magnitude of an error is established by application of the law of probability. The less obvious, systematic or constant error, cannot be neglected in considering the accuracy of the results. Various factors may contribute to a positive or negative tendency in introducing an error which renders precise results inaccurate.

The number of events counted is the only variable in establishing the limits of an error. By means of standard deviation of the observed counts, the confidence limits for the precision of the result is established. In each detector, where the pulses observed by it are transformed into electrical signals, the degree of sensitivity and efficiency of the detector indicates how close to the true value otherwise precise results are. The ratio of the output to the input events in a theoretically optimum performance of a detector should be one.

A characteristic resolving time for a G-M tube will introduce a coincidence error which will be more significant in establishing the sensitivity of the G-M detector than the same error of a gamma scintillation counter with a hundred times shorter resolving time. Sensitivity of a well counter will be affected by the volume of the sample. A wrong selection of the pulse-height analyzer window width may result in a statistically invalid response of the detector. An operator aware of the factors affecting the statistics of counting will use them to his advantage. If spatial resolution is not of primary concern, an increase in the efficiency of the detector by widening the window may be beneficial.

Consequently, a systematic record of the response of the detectors using accurate standards is imperative. An absolute elimination of an error is impossible due to the multitude of known and unknown factors contributing to it.

Effects of Overnight Refrigeration on the Dried Thyroxine in the Competitive Protein-Binding Analysis BY SARA L. SEKSO, GONZALO UVELTA AND FUAD S. ASHKAR, Univ. of Miami School of Medicine, Miami, Fla.

The use of competitive protein-binding analysis for the measurement of serum thyroxine has been a very valuable tool in the evaluation of functional disorders of the thyroid gland. The method is based on the *in vitro* competition between the alcohol extracted and then dried serum thyroxine and tracer ^{125}I-thyroxine for the binding sites ot the thyroxine-binding globulin.

A modification of the procedure in which the alcohol extracted and then dried serum thyroxine was refrigerated at 4°C overnight and then dissolve in the ^{125}I-TBG solution, instead of dissolving it in ^{125}I-TBG solution instantly after alcohol evaporation.

The refrigeration lets one handle bigger numbers of samples over a 2-day procedure period, which otherwise would have been impossible in the continuous 1-day procedure because of the limited technician time and manpower.

Serum thyroxine values in euthyroid, hypothyroid and hyperthyroid patients were compared after overnight refrigeration with the continuous procedure; the values correlated very well with a variation of a maximum of $+1.6$ to -1.9, which is within the acceptable ± 2 point variation.

Serum thyroxine values after overnight waiting without refrigeration resulted in poor correlation with a variation from $+3.7$ to -0.7.

Overnight refrigeration of the extracted and dried serum thyroxine correlates well with the continuous technique and allows one to handle more samples with limited technician time and manpower without altering the accuracy of the procedure.

Method for Measuring Individual Patient Doses with a Commercially Available Isotope Calibrator BY E. LISETTE SESTER AND F. R. GYDESEN, Penrose Hospital, Colorado Springs, Colo.

The purpose of the study is to produce a reliable method for the calibration of administered patient doses using an isotope calibrator. The geometry of the system as well as temperature and barometric pressure effects must be considered since the chamber is not sealed and must be calibrated at the altitude where it is used.

A Picker 632-500 isotope calibrator was fitted with a special jig to permit centering of syringes in the calibrator chamber. After the instrument was standardized, syringes were filled to various volumes with carefully calibrated isotopic solutions. One-, 5-, 10- and 20-cc plastic syringes were measured. By adjusting the isotope factor control, the instrument was made to give a direct true reading for various volumes. Isotope factors were plotted against the syringe size and volume. A "geometry correction factor" monograph was constructed.

Small isotopic volumes in the calibrator chamber resulted in considerable inverse-square attenuation at the top of the ionization chamber and significant geometry correction. An almost linear relationship between volume and isotope factor was seen at large syringe volumes. Using different isotopes in the same

syringe volume resulted in a family of similar curves, suggesting that the geometry correction was independent of the energy of ionization. Measurements made with volumes less than 10% of the total syringe volume gave inconstant results. Duplicate determinations made with different technicians agreed within <10%. A monograph using a variable curve parameter set by the selected isotope has proven quite satisfactory.

Placental Localization Prior to Amniocentesis using ^{99m}Tc-Albumin and the Gamma Camera BY VIOLET STARK, Argonne Cancer Research Hospital, Chicago, Ill.

The placental localization scan has proven to be of great value in the diagnosis of placenta previa. A very recent application of placental imaging consists of mapping the organ on the patient's abdomen in preparation for amniocentesis. The obstetrician is therefore provided with an exact picture of the position of the placenta.

The short-lived radionuclide ^{99m}Tc-albumin is used for the examination after pretreatment with Lugol's solution to block both maternal and fetal thyroid glands. The radiation dose to the mother and fetus is minimal.

The imaging device used to carry out the examination consists of the Nucelar-Chicago Pho/Gamma III scintillation camera equipped with a persistence scope. The patient is placed in supine position under the camera, and the nuclide is injected intravenously. Radioactivity from the patient is recorded both on the persistence scope and on Polaroid film. The placental image is drawn on the scope. A ^{57}Co marker source is placed on the abdomen in a position that coincides with one point on the outline of the placenta seen on the scope image. A mark is then made on the abdomen with ink. This process is repeated until the entire placenta is mapped out. The entire procedure takes about 15 min.

A complete description of the technique with examples will be presented.

Reuse of the T_3 Resin Sponge BY JANE ZIELINSKI AND LINDA DULOCK, Memorial Baptist Hospital System, Houston, Tex.

Experiments were performed to determine whether reuse of the T_3 resin sponge was feasible, and, if so, the degree of accuracy compared with the values obtained on unused (new) sponges. The advantages of reuse are quite obvious.

Over a 5-year period, the same sponges were used 28 times. We found that the T_3 anion exchange resin sponge remained stable over a long period of time and with repeated reuse.

	Condition of resin sponge				
	Unused (New)		Used 27 times (Old)		Conversion factor
	Average	s.d.	Average	s.d.	
Euthyroid Pt. #1	36.8%	±2.8	39.2%	±1.08	0.9388
Euthyroid Pt. #2	35.8%	±2.2	35.3%	±2.50	1.0142
Ambulatory T_3 normal pooled serum	37.3%	±1.5	39.9%	±1.11	0.9348

For example, the T_3 pooled serum for normal ambulatory patients using new and used resin sponges increased only slightly by the 28th time of use. This represents an actual 6.9% increase over a 5-year period or a 0.25% increase with each time of use. This slight increase can be corrected using the same system as the company supplying the commercial sponges and applying a conversion factor. Reuse of T_3 resin sponge has been proven to produce as accurate results as the new unused sponge.