Abstracts in this section pertain to papers presented at The Society of Nuclear Medicine, 6th Conjoint Winter Meeting, "Perfusion Imaging," February 2–4, 1987, San Antonio, TX. Program Chairperson: Michael M. Graham, PhD, MD. This meeting was supported by the Department of Energy.

A Comparison of a Technetium-Labeled Isonitrile Analog with Thallium as a Myocardial Perfusion Imaging Agent. J.A. Leppo and D.J. Meerdink. *University of Massachusetts Medical Center, Worcester, MA.*

Technetium-99m- (Tc) labeled compounds have been proposed as an alternative to thallium-201 (Tl) perfusion imaging. Accordingly, we compared the myocardial transcapillary exchange of Tl and [Tc] hexakis (2-methoxy-2-methylpropylisonitrile) (RP-30 E. I. DuPont) and Tl during variable flow levels in eight blood perfused isolated rabbit hearts. Multiple indicator-dilution experiments (n = 16) were performed using radiolabeled albumin, ethylenetriaminotetraacetic acid, RP-30 and Tl. When coronary blood flow was varied from 0.52 to 3.19 ml/min/g, myocardial extraction (Emax) of RP-30 averaged 0.38 ± 0.09 (s.d.), while Tl Emax averaged 0.73 ± 0.10 ($p < 0.001$). Emax for both RP-30 and Tl was inversely related to blood flow with a correlation (r) of −0.80 and −0.85, respectively. The mean capillary permeability surface area product (PS; ml/g/min) for RP-30 (0.43 ± 0.14) was one-third lower than Tl (1.30 ± 0.45, $p < 0.001$). However, parenchymal cell PS for RP-30 (48.3 ± 24.9) was much higher than Tl (6.4 ± 5.5, $p < 0.0001$) and apparent cellular volume distribution for RP-30 (14.9 ± 3.3 ml/g) was also higher than Tl (10.7 ± 4.3, $p < 0.01$). We have concluded that myocardial RP-30 and Tl extraction are inversely related to flow, but RP-30 uptake is less efficient. In addition, cellular volume distribution of RP-30 is larger than Tl and, therefore, has a longer tissue residence time. These data suggest that RP-30 is a useful perfusion agent and merits further clinical testing.

Quantification of the Organ Distribution of Perfusion by Texture Analysis of SPECT Images. E.A. Velasco, F.A. Garcia, H.F. Corbus, W.W. Wooten, and J.J. Touya. *St. Agnes Medical Center, Fresno CSU and School of Medicine, UC San Francisco, Fresno, CA.*

Texture is the global impression offered by image elements with a repetitive pattern. Texture in lung, liver, and myocardium single photon emission computed tomography (SPECT) slices is a function of the organ distribution of the functional or effective plasma flow. Three different texture analysis methods were implemented and tested. One depended on the total variance, corrected for stochastic variance and system variance. The second depended on identifying local extrema along one-dimensional profiles. The run length and intensity difference between extrema were used to estimate texture. The third method depended on Fourier frequency components after a two-dimensional Fourier transform. All methods required correction for noise contribution to texture and system MTF. Two methods to correct for noise were compared: the first relied on an internal standard, (for instance, liver texture normalized by texture in the spleen); the second attempted to predict stochastic noise and correct intrinsically in the texture calculation.

Algorithms were tested on SPECT images of the Jaszczak phantom and they showed approximate linear relations between texture and rod diameter. They were further tested by assessing the texture in radiocolloid liver SPECTs from normals and cirrhotic patients with known degree of disease.

Two-Dimensional Mapping of Three-Dimensional SPECT Data: A Preliminary Step to the Quantitation of Thallium Myocardial Perfusion Single Photon Emission Tomography. M.L. Goris. *Stanford University School of Medicine, Stanford, CA.*

A method is presented by which tomographic myocardial perfusion data are prepared for quantitative analysis. The method is characterized by an interrogation of the original data which results in a size and shape normalization. The method is analogous to the circumferential profile methods used in planar scintigraphy, but requires a polar to cartesian transformation from three to two dimensions. As was the case in the planar situation, centering and reorientation are explicit. The degree of data reduction is evaluated by reconstructing "idealized" three-dimensional data from the two-dimensional sampling vectors.

The method differs from previously described approaches, by the absence in the resulting vector of a coordinate reflecting cartesian coordinate in the original data (slice number).

This approach overcomes the problem of size and shape variation and has been shown useful for the generation of "normal" perfusion maps.

Renal Blood Flow in ml/min by First-Pass Analysis Using Aorta as Supply Conduit. J.M. Arnold, J. Arnold, and J.S. Arnold, *Nuclear Medicine Service, VA Medical Center, Iron Mountain, MI.*

A method for semiquantitative measurement of renal blood flow is described using posterior camera viewing of the upper aorta and kidneys in first-pass technetium-99m 0.5-sec image perfusion studies. The advantage of the procedure is that values are independent of dose size, blood dilution, and cardiac output. No special measurement of administered dose is required.

Curves of the upper abdominal aorta, both kidneys and background were generated from AOIs and net curves of the former derived. Analysis of renal blood flow assumed that the diameter of the aorta was known and the length of the monitored segment was defined by its AOI such that the volume of arterial blood being monitored was known. The aortic arterial blood activity could thus be expressed as counts/ml of blood. The blood flowing into the kidneys has the same counts/ml as the aortic blood when shifted forward in time by the aorta to kidney transit time. The curve of the rapid rise of activity in the kidney corresponds to the integral of the aortic activity per ml multiplied by a scaling factor whose units are in ml of blood per unit time. Renal blood flow

calculated in normal 30–40-yr-old males was 1,200 ± 200 ml and ~ 500 ml/min above 70 yr of age, when the diameter of the aorta was assumed to be 2.0 cm. Duplicability was ~ 10%, however, absolute accuracy is yet undetermined. The principal error is perceived to be the variation in ratio of kidney to aorta mass absorption values as a function of changing bone density with age.

Revascularization Therapy in Renovascular Hypertension. Poor Prognosis when Exercise Mediated Renal Perfusion Disturbance is Demonstrated. J.H. Clorius, L.G. Strauss, J. Allenberg, TH. Hupp, and P. Schmidlin. *German Cancer Res. Ctr., University of Heidelberg, FRG.*

Exercise was recently shown to be a potent trigger of a transitory hippurate transport disturbance, in the majority of hypertensives. The known kinetics of iodine-123 (^{123}I) hippurate implicates a cortical perfusion disturbance. The abnormality was seen in either essential or renal hypertension. We tested the hypothesis that patients with renovascular hypertension and the exercise induced renal cortical perfusion disturbance would not be helped by revascularization. Eighteen patients with angiographically verified renovascular stenosis were studied. Patients were scintigraphed in prone position and during upright ergometric exercise. Six microcuries ^{123}I or 7 μCi iodine-131 hippurate per kg body weight were used for each gamma camera sequential scintigram. Renograms were generated. Ten of 18 hypertensives developed evidence of a bilateral renal perfusion disturbance during exercise. In eight, exercise failed to influence the results of scintigraphy. All patients were re-examined clinically 6 mo after surgery. Nine of ten exercise positives continued to be hypertensive after surgery. Hypertension was cured in seven of eight patients who had no evidence of the renal perfusion disturbance. The results suggest that the maintenance phase of renovascular hypertension is characterized by presence of a bilateral cortical perfusion abnormality.

Tissue Blood Flow from Bolus First-Pass Data Applied to Renal Transplants and the Penis. M.M. Graham, H.W. Vea, and A.N. Schwartz. *University of Washington, Seattle, WA and University of Oregon, Portland, OR.*

Bolus technetium-99m radiotracer first-pass studies of transplant renal blood flow (RBF) have been used to assess vascular integrity and to assist in differentiating transplant rejection from acute tubular necrosis. Several empirical indices of RBF have been developed such as kidney/aorta (K/A) slope ratios, transit time, washout rates, and peak to plateau ratios. All of these techniques depend upon the quality of the bolus injection, and on region-of-interest (ROI) placement. We have derived a physiologically valid index of RBF from mass-balance considerations, and applied it to renal transplant studies. For a short time following bolus injection of radiotracer, activity is entering the K via the renal artery but has not yet reached the renal vein. During this time the activity in the K equals the RBF times the concentration of activity in the renal artery. From this concept we have derived an estimate of RBF from the aortic and renal time-activity curves during the upslope of activity over the K. Correction factors were derived to account for the size of the A ROI, different depths of A and K, and time delay between A and K. This approach was compared with peak-height normalized K/A ratio and effective renal plasma flow (ERPF) by the 44-min technique in 22 unselected patients. The correlation of the normalized K/A ratio with ERPF was poor (R = 0.18), while the correlation of the renal plasma flow (RBF index times (1 − Hct)) with the ERPF was better (R = 0.66). This technique is proposed as an improvement over empirical methods for serially following adequacy of RBF in individual patients. The same technique was used to evaluate penile blood flow (PBF) in 30 patients as part of their evaluation for impotence. The PBF index correlated well with other measurements of PBF including arteriography, pressure measurements, and outcome after corrective surgery.

Phosphonate Complexes of Gadolinium: Potential Contrast Agents for Magnetic Resonance Imaging of Myocardium. P.V. Kulkarni, S. Schaefer, R.M. Peshock, J. Katz, and R.W. Parkey. *The University Texas Health Science Center, at Dallas, TX.*

Paramagnetic contrast agents have increased the ability of magnetic resonance images (MRI) to identify ischemic or infarcted myocardium. The primary agent gadolinium diethylenetriaminepentaacetic acid ([Gd]DTPA) employed to date is limited by its nonspecificity. Since metal complexes of phosphonate are known to localize in damaged myocardium, we developed and investigated a new agent, gadolinium diethyl triamine pentamethylene phosphonate ([Gd]PMP), as a potential MRI contrast agent. The relaxation times, T1 and T2 were measured for saline solutions of [Gd]PMP, Gd-DTPA, $MnCl_2$ in concentration range of 0.1 to 0.85 mM/L using an IBM 20 MHz spectrometer. S-D rats (250–300 g) were injected i.v. with [Gd]PMP, [Gd]DTPA or $MnCl_2$ at doses of 0.01 to 0.34 mM/kg. The hearts were excised 5 min after injection. A sample of left ventricular myocardium was measured for T1 and T2 as above. Measurements of in vitro relaxation rates (R1 = 1/T1) as a function of concentration showed that the relaxitivity (R/conc.) of [Gd]PMP is greater than either [Gd]DTPA or $MnCl_2$ with $\Delta R1/\Delta C$ of [Gd]PMP = 9.1 sec^{-1} mM^{-1} compared with [Gd]DTPA = 5.1 sec^{1} mM^{1}. The myocardial T1 and T2 relaxation times of the animals given [Gd]DTPA but not as short as those given $MnCl_2$. Gadolinium-153 PMP localized in injured zones of myocardium in dogs undergoing temporary ligation of left anterior descending coronary artery. The infarct zones in the excised canine hearts were better visualized in dogs administered with 0.034 mM/kg compared to those injected with [Gd]DTPA. Gadolinium-PMP shows promise for improved MR imaging of the myocardium. Its specificity for injured myocardium and its toxicity remain to be established.

Caudate Hyperperfusion and Cortical Atrophy in Huntington's Disease as Shown by ^{99m}Tc-HMPAO Brain Scintigraphy Using SPECT. H. Botsch, G. Oepen, and G. Deuschl. *St. Josefskrankenhaus and Psychiatrische Universitätsklinik, Freiburg, FRG.*

Huntington's disease is an inherited degenerative disorder with progressive increase of chorea and dementia and atrophy of the striatum.

Technetium-99m HMPAO SPECT was used to evaluate cerebral blood flow in six patients with HD. All patients showed regional perfusion defects in the cortex or a diminished cortical tracer uptake, whereas computed tomography

and magnetic resonance imaging were normal. Moreover in four patients the uptake in the caudate was increased strongly.

The increased caudate uptake may be due to a compensatory mechanism to reduced caudate hypometabolism, as shown by PET-studies.

The results suggest the possibility, that SPECT may show increased caudate uptake in some asymptomatic subjects, who are autosomal dominant for HD.

Potential Copper Radiopharmaceuticals for PET Imaging of the Brain and Heart. M.A. Green, D.L. Klippenstein, M.K. Loken, R.J. Boudreau, R.P. duCret, and J.R. Tennison. *University of Minnesota, Minneapolis, MN.*

The zinc-62/copper-62 radionuclide generator has received relatively little attention as a source of radiopharmaceuticals, despite a daughter half-life (10 min) well suited to perfusion imaging by positron emission tomography (PET). An investigation of a series of lipophilic copper-67 (^{67}Cu) complexes has been initiated in order to screen potential tracers that could be used to measure regional cerebral and/or myocardial blood flow when labeled with copper-62.

The copper-67 complexes of pyruvaldehyde bis(thiosemicarbazone), PTS; pyruvaldehyde bis(N^4-methylthiosemicarbazone), PTSM; and pyruvaldehyde bis(N^4-dimethylthiosemicarbazone), PTSM2; have been prepared and found to be lipophilic (log P values of 0.75; 1.97; and 2.7; respectively). Biodistribution studies have been carried out following i.v. injection of each of these tracers into rats. [Cu-67]-Cu (PTSM) and [^{67}Cu]-Cu(PTSM2) are both rapidly cleared from the blood and show excellent uptake in the brain. At 1 min postinjection, ~ 3.2% of the injected dose is found in the brain with both of these tracers. These two tracers differ in that the brain uptake of [^{67}Cu]-Cu(PTSM2) drops to 1% of the injected dose at 15 min postinjection, while the brain uptake of [^{67}Cu]-Cu(PTSM) remains constant over the period of 1 min. to 2 hr postinjection. This difference between Cu(PTSM) and Cu(PTSM2) is consistent with the reported differences in the rates of their reaction with cellular sulfhydryl groups. [^{67}Cu]-Cu(PTSM) provides gamma images in the rat and monkey that clearly show both the brain and heart.

Technetium-99m HMPAO as a Tracer of Cerebral Blood Flow N.A. Lassen, A.R. Andersen, H. Friberg, and R.D. Neirinckx. *Rigshospitalet, Denmark and Amersham Laboratories, England.*

d,l-Hexamethyl-propyleneamine-oxime labeled with technetium-99m has been developed for imaging cerebral blood flow distribution using single photon emission computed tomography.

The unidirectional fractional extraction E of HMPAO over the blood-brain barrier was 0.8 to 0.9 at low to normal cerebral blood flow f, but at high flow E fell reaching 0.50 at a flow of 1.8 ml/g/min corresponding to a PS product = -f ln(1-E) of 1.25 ml/g/min.

External counting over the human brain (three cases) after internal carotid bolus injection showed an exponential decrease over 2 min to a constant fractional residue R averaging 0.47 at f = 0.78 and E = 0.80. These studies show, that the lipophilic tracer is not instantly converted to the hydrophilic form, that is retained in the brain. Using the classical three-compartment model the fractional conversion rate k is related to R by the equation $R = k/f/\lambda + k/E)$ with λ being the brain: blood partition coefficient; assuming λ = 1.0 ml/g gave k = 0.90 min^{-1}. If E is the same in all regions, then the HMPAO tomograms can be linearized with respect to relative CBF, f/f, where f_s is flow in a "standard" or "reference" region.

This linearization results in a moderate enhancement of HMPAO image contrast, so that it closely matches that of CBF distribution as shown by xenon-133 tomography in 35 clinical cases comprising normal brain, brain infarcts, brain tumors, various dementia syndromes, and focal epilepsy.

The model predicts that absolute CBF values can be calculated provided arterial sampling with rapid octanol partitioning is used and a series of tomograms are taken over the first 10 min.

Characterizing the Kanno-Lassen Algorithm for Estimating Regional Cerebral Blood Flow from Tomographic Diffusible Tracer Clearance Curves by a Dynamic Flow Phantom. G.D. Arora, M.D. Devous, Sr., E.M. Stokely, F.J. Bonte. *Nuclear Medicine Center, The University of Texas Health Science Center, Dallas, TX.*

Regional cerebral blood flow (rCBF) can be measured from xenon-133 gas clearance data using Kanno-Lassen algorithm (KLA) employed in our dynamic single photon computer assisted tomograph (DSPECT). To date, only computer simulation studies of DSPECT have been performed to study KLA. A dynamic flow phantom (multi-chambers) has been developed which mimics Kety-Schmidt single compartment model. Perfusions ranging from 10–160 ml/min/100 g of tissue have been measured with our phantom by using a technetium-99m DTPA radiopharmaceutical. There is a non-linear relationship between KLA estimated perfusion (KLA P) and real perfusion (RP) so that low flows (up to 20 ml/min/100 g) are overestimated and high flows ranging from 80–160 ml/min/100 g are underestimated. For average values of RP ranging from 20–60 ml/min/100 g, KLA estimates a constant value of 40 ml/min/100 g. Effect of image reconstruction threshold on computing different perfusion values has been studied. Perfusion values progressively increase (up to 150%) when threshold is lowered. Low perfusions are more sensitive to threshold than higher perfusions. KLA does not correct for background contamination from previous study and hence KLA P are higher in second study if performed immediately.

Testing Vasoreactivity in Patients with Dementias. F.J. Bonte, M.D. Devous, Sr., A.K. Ajmani, M.F. Weiner, J. Hom, and R. Tintner. *The University of Texas Health Science Center, Dallas, TX.*

Vasoreactivity as an index of brain tissue viability was tested in normal controls (NC) and patients (pts) with dementias by determining regional cerebral blood flow (rCBF) with a single photon computer tomographic scanner (SPECT), and inhaled xenon-133 from a tomographic section (SEC) 6 cm above the cantho-meatal line before and 15 m after the administration of a cerebral vasodilator, Diamox (DIA). RCBF values were derived from left (L) and right (R) frontal (F), parietal, temporal (T), and occipital regions of interest (ROI), and from the entire SEC in ml/min/100 g. Ratios of rCBF values in various L and R ROI to the SEC mean flow (ROI/SEC) were calculated for all ROI in 16 NC and nine pts with dementias

(seven Alzheimer's, one Pick's, 1 unclassified). In NC SEC flow was 30 ± 16% higher after DIA than in resting studies, and rCBF increase was uniform and symmetrical. In PTS, by visual inspection of images and comparison of patient's ROI/SEC ratios with NC mean ratios, a total of 16 ROI (ten T, six F) were found to have significantly low flow at rest. After DIA, ROI/SEC rose in 12 ROI, was unchanged in two, and declined in two. These results were then compared with similar studies done in 6 pts with chronic, CT-proven stroke (STR). In STR pts, eight low-flow areas were demonstrated at rest in areas matching CT infarct images. ROI/SEC declined in seven after DIA, and in 1 other remained unchanged, although ROI/SEC value of 0.6 is >5 s.d. below mean for NC group. Preservation of vasoreactivity may prove useful in differential diagnosis between primary dementias and multiple infarct dementia.

Cerebral Vascular Reactivity in Patients with Partial Complex Epilepsy. M.D. Devous, Sr., R.W. Homan, and F.J. Bonte. Nuclear Medicine Center, and Neurology Service on VAMC. *University of Texas Health Science Center, Dallas, TX.*

Patients (pts) with partial complex epilepsy have impaired regional cerebral blood flow (rCBF). We used dynamic single-photon emission computed tomography (DSPECT) of the cerebral transit of Xe-133 to examine the effect of the cerebral vasodilator acetazolamide (ACZ) on rCBF in ten controls and 7 pts with partial seizures. DSPECT was performed prior to and following i.v. injection of 1 g ACZ. Images were interpreted by visual inspection and quantitative rCBF was obtained for frontal, temporal, parietal, and occipital regions of interest (ROI) bilaterally. Six of 7 pts had abnormal DSPECT images in the resting state. Following ACZ, 4 pts had rCBF images indicating increased severity of relative focal hypoperfusion. Two showed improvements in focal hypoperfusion, and one showed no change. Quantitative rCBF values in controls showed a uniform 28% increase compared to resting studies, while pts had a mean increase of 37%. Areas with focal hypoperfusion at rest increased less than ROI's in controls, or normal ROI's in the patient group. Regions of more severe relative focal hypoperfusion after ACZ had quantitative rCBF increases ranging from 10–20%. Pts also had greater interhemispheric variability in the response to ACZ than controls. Thus, pts with partial complex epilepsy demonstrating relative hypoperfusion at rest increase rCBF following cerebral vasodilator administration more than controls for normal areas, but are less responsive than controls in areas of relative hypoperfusion.

Do Heart Rate and Contractility Affect LV Mass Measured by Thallium-201 SPECT? J. Machac, R. Vaquer, H. Levin, E. Balk, and S.F. Horowitz. *Mount Sinai Medical Center, New York, NY.*

Viable left ventricular myocardial mass has been successfully measured by thallium-201 (^{201}Tl) single photon emission computed tomography (SPECT). However, the effect of changes in heart rate (HR) and contractility has not been determined. We constructed a dynamic computer model, simulating the contracting left ventricle in 32 views in a 180° arc of acquisition from the RAO to the LPO views. Parallel slices through the heart in each position were convolved with the point spread functions of ^{201}Tl at corresponding depths of water to simulate attenuation and scatter, and summed. Multiple volumes derived from gated blood-pool time-activity curves at three HRs and three ejection fractions (EF)s commonly encountered clinically were summed to produce static views of a moving heart. Each image set underwent standard SPECT reconstruction, producing 48 short axis cuts. LV myocardial mass was measured at a fixed percentage of maximal counts threshold in each slice. Total mass was normalized to the highest value and compared for the different HRs and EFs.

EF	HR (bpm)		
	60	80	100
30%	1.00	0.995	0.993
55%	0.999	0.967	0.960
80%	0.958	0.934	0.923

LV Mass varied little (4%) as a function of HR between 60 to 100 beats/minute and slightly more (7%) for changes in EF between 30% to 80%. Thus, in the normal clinical setting LV mass measurements by SPECT are minimally affected by the dynamic state of heart.

SPECT Perfusion Imaging in Patients with Colorectal Tumors and Treated with Radiation and Intraarterial Chemotherapy. L.G. Strauss, J.H. Clorius, T. Fleiner, and E. Wetzel. *German Cancer Research Center, Heidelberg And Klinikum Mannheim, Mannheim, West-Germany.*

SPECT perfusion imaging was assessed in 17 studies on six patients. All patients suffered from recurrent colorectal tumors and received intraarterial chemotherapy via the internal iliac artery. The therapeutic protocol included continuous FU-infusions for 5 days, and simultaneous radiation therapy. SPECT imaging followed intraarterial injection of Tc-99m-MAA on the first, and last, day of i.a. chemotherapy. The tumor perfusion was determined using SPECT cross sections and a ROI-technique. Furthermore, posterior lung images were used in order to estimate the shunting fraction.

In spite of the selective radionuclide application only 8% of the total activity was found in the tumor region. Ten percent of the total radionuclide was shunted. Angiograms provided dynamic images of the tumor blood supply, while SPECT perfusion imaging permitted a quantitative assessment of tumor blood flow.

Thallium Myocardial SPECT Following Dipyridamole Infusion for the Assessment of Coronary Artery Disease. S.M. Spies, W.G. Spies, D. Fintel, E.A. Silverstein, and A.M. Zimmer. *Northwestern Memorial Hospital, Chicago, IL.*

The purpose of this study was to evaluate the use of SPECT in conjunction with dipyridamole infusion to evaluate the presence or extent of coronary artery disease.

Planar and single photon emission computed tomography (SPECT) thallium-201 imaging was performed in 85 patients immediately after intravenous infusion of dipyridamole and after a 4-hr delay. Planar imaging in three projections was performed using a low energy all purpose collimator on a large field-of-view gamma camera. Circumferential profile analysis was performed on all three projections. SPECT imaging was performed using a large field-of-view SPECT system. Images were acquired over 180° for a total of 64 angular samples.

Imaging time was 20 sec per projection. SPECT images were preprocessed with a spatial smoothing filter and reconstructed by the convolution backprojection technique. Horizontal long axis, vertical long axis, and short axis views were interpreted, and concentric quantitation maps were crested from short axis images. The results of planar imaging were generally corroborated by SPECT images. Some patients with relatively normal appearing planar views had significant abnormalities on SPECT. A few patients displayed planar abnormalities, which were not appreciated on tomographic images.

The data suggest that SPECT imaging following dipyridamole infusion is a practical and useful adjunct to conventional planar imaging in patients who cannot undergo conventional treadmill exercise.

Is the Localization of N-Isopropyl-p-Iodine-123-Iodoamphetamine in the Adrenal Gland Due to Perfusion or Specific Uptake? G. Demonceau, C. Brihaye, R. Cantineau, A. Palmer, and G. Merchie. *University of Liege and Cyclotron Research Centre, Liege, Belgium.*

We describe the kinetics and high uptake of *N*-isopropyl-*p*-I-iodoamphetamine [^{123}I]IMP in adrenal adenoma secreting cortisol (Cushing's disease). 185 MBq were injected and a dynamic acquisition was performed over 100 min. After surgery, the whole adrenal activity was counted in an ionisation chamber. Uptake of [^{123}I]IMP was high and relatively stable after 20 min, reaching a maximum (1.36% of the injected dose) ~70 min after injection. The signal/noise ratio is 1.13 at 15 min, 1.26 at 30 min, 1.43 at 60 min and 1.47 at 90 min due chiefly to the decrease of the splenic, renal and, after a later time, hepatic activity.

The evaluation of blood pool by Tc-99m labeled red blood cells shows a whole organ/blood pool ratio of about 400 at 30 min and 600 at 90 min, which suggests that most of this activity is not vascular in origin.

As compared to [^{131}I]iodocholesterol, [^{123}I]IMP has a more suitable energy, an earlier uptake, a higher availability and a lower cost. Because pheochromocytoma does not show such an uptake, [^{123}I]IMP appears to be a promising tracer for the adrenal cortex.

Critical Comparison of LCBF Measurements with Technetium-99m Hexamethylpropyleneamine Oxime, Tl-201 Diethyldithiocarbamate, and Carbon-14 Iodoantipyrine Using Triple Label Quantitative Digital Autoradiography. J.L. Lear, *University of Colorado Medical Center, Denver, CO.*

We compared local cerebral blood flow (LCBF) measurements obtained with HMPAO, DDC, and IAP in a series of 12 awake rats using double and triple label quantitative digital autoradiography. The rats were given terminal 45-sec i.v. infusions of a mixture of ~15 mCi of HMPAO, 500 μCi of DDC, and 70 μCi IAP. The brains were removed and microtomed into 20-μ sections. Three autoradiographic images were produced from each section using exposure durations of 8 hr, 3 days, and 10 days, respectively. The images were digitized and LCBF images were created and compared for the three tracers.

LCBF values were similar for IAP and DDC while values obtained with HMPAO averaged 60% those of the other tracers. Ratio images demonstrated subtle and consistent differences in uptake patterns which helped explain the quantitative differences in LCBF values. The HMPAO underestimation of LCBF was not caused by diffusion limitation, but rather, by rapid conversion to a nonextracted compound and/or binding to blood constituents. High proximal extraction of HMPAO and DDC caused relative underestimation of LCBF in "downstream" structures.

Brain Scintigraphy with Iodine-123-Labeled N-Isopropyl IMP in the Differential Diagnosis of Ischemia versus Infarction. T. Higa, K. Toyonaga, T. Nishihira, and T. Shimoji. *Okinawa Chubu Hospital, Okinawa, Japan.*

The role of planar brain scintigraphy in the detection and differential diagnosis of ischemia versus infarction was evaluated in 13 patients with angiographically documented occlusive cerebrovascular diseases using iodine-123(p,5n)-labeled IMP of excellent radionuclide purity.

Five-minute planar images of the brain in vertex, anterior, posterior and two lateral views were obtained with a gamma camera (Siemens ZLC 750) equipped with a medium-energy collimator at 15–45 min (early scan) and 210–240 min (delayed scan) after an i.v. injection of 3 mCi of [^{123}I]IMP. The data was stored on a computer, and background subtraction was performed using data obtained from soft tissue uptake of the posterior neck. Identified were reversible abnormalities, defined as reduced radiotracer uptake on early images with good equilibration on delayed images, and nonreversible abnormalities, defined as fixed defects on both early and delayed images.

Seven cases showed reversible abnormalities, none of which were identified on CT. Seven cases showed nonreversible abnormalities, all of which were identified on CT. Correlation to CT and follow-up studies revealed the reversible abnormality to be a reliable finding for viable ischemia. Rapidly changing radioactivity was observed over the brain increasing up to 20–30% during the early scan in every patient; the phenomenon, however, did not cause difficulty in detection of abnormalities.

Improvement in radionuclide purity in [^{123}I]IMP made it possible to produce high quality planar brain scintigram suited for detecting viable ischemia. The procedure may provide a help in selecting patients for bypass surgery.

Design Considerations and Performances of a High Sensitivity and High Resolution SPECT. Y. Higashi, Y. Hirose, and S. Nakanishi. *Shimadzu Corp. Kyoto, and* K. Uemura, and I. Kanno. *Research Inst. of Brain & Blood Vessels, Akita, Akita, Japan.*

The ring detector ECT, the "HEADTOME-II" was originally designed for both positron and single photon ECT, and has been used at Research Institute of Brain and Blood Vessels, Akita and several other hospitals.

It has been redesigned as a single photon dedicated system for routine brain perfusion study with inhaled Xe-133, I-123 IMP, Tc-99m HM-PAO etc. It has three (3) layers of stationary detector ring, 64 detectors in each ring. The detectors surround the innovative "turbo-fan" revolving collimator, which forms a bank of converging collimator and offers excellent spatial resolution and sensitivity. The collimator can easily be changed from high resolution (H.R.) to high sensitivity (H.S.) and vice versa within 10 sec.

The measured performances are shown below.

	H. R. collimator	H. S. collimator
Spatial resolution at the center.	9.6 mm FWHM	20 mm FWHM
Slice thickness	16 mm FWHM	24 mm FWHM
Slice intervals	35 mm	35 mm
Sensitivity	6 kcps/μCi/ml	31 kcps/μCi/ml
Number of slices	3	3

The minimum time required for obtaining data for reconstructing an image is 12 sec in H.S. mode, and 48 sec in H.R. mode. The data aquisition time for routine examinations is, for example, 15 min with H.R. collimator, when 3 mCi of I-123 IMP was administered.

Perfusion Imaging by Positron Emission Tomography: Scintillation Well-Counting of Blood Samples. C.C. Harris, L.P. Warren, M.C. Estrada, and R.E. Coleman. *Duke University Medical Center, Durham, NC.*

The required operating conditions for accurate well-counter assay of blood samples containing oxygen-15 and rubidium-82 (^{82}Rb) were studied. The short half-life of these positron emitters present practical problems in well-counting. High activity levels can cause counting system nonlinearities (i.e., variable apparent resolving time) due to random coincidence summing of single annihilation photons as well as true coincidences enabled by well counter geometry. Freshly withdrawn blood samples frequently exhibit levels of activity that require correction for deadtime losses. Such samples may be set aside to decay until activity levels diminish, but in the case of ^{82}Rb, the usefulness of this is limited by strontium-85 breakthrough. The ability to count accurately at over 10,000 counts per sec is desirable. This requires accurate determination of deadtime losses over a wide range of counting rates. However, apparent deadtime losses will vary with the energy window chosen. Analyses of spectra of gallium-68 and ^{82}Rb from a 3-in. NaI(Tl) well crystal over a potentially useful range of activities show that narrow-window counting with a single 511-keV window causes highly nonlinear operation, with large variations of apparent deadtime. A wide, 400-keV threshold window, however, yields apparent dead-times with only small variations and which can be easily determined from a single experiment. Thus use of expensive instrumentation designed for high counting rates is useful but not necessary with the wide window. The use of smaller well crystals also reduces the coincidence summing problem.

Impact of Filtering and Scatter Correction on Quantitative SPECT Data. L.G. Strauss, J.H. Clorius, T. Fleiner, and E. Wetzel. *German Cancer Research Center, Heidelberg and Klinikum Mannheim, Mannheim, West-Germany.*

The suitability of SPECT for the quantification of radionuclide concentrations was assessed in phantom studies. Double energy studies of the Alderson Remcal phantom were acquired with different radionuclide concentrations (1.76–552.3 MBq/l). Cross sections were reconstructed using two different filters (RampHanning, Butterworth) and three cut-off frequencies (0.25, 0.5, 1.0 pixel). Furthermore, scatter correction was performed using the compton subtraction method as described by Jaszczak et al. ROIs were placed in the cross sections and the mean values of the ROIs were compared to the true radionuclide concentrations. Both values were logarithmically transformed and corrected for count rate loss. We noted a high correlation ($r = 0.976$) and low standard error of estimate (1.18–1.37 MBq/l) for nonscatter corrected studies. Butterworth filtering with a cut-off frequency of 0.5–1.0 gave best results. The error of estimate increased by 15.9% when Ramp-Hanning filtering and a cutoff of 0.25 was used. Scatter correction improved the accuracy when the Ramp-Hanning filter was used.

The reproducibility of the regression function was verified using a second phantom with different shape and two different target areas. The deviation of the predicted from the true radionuclide concentrations was +6.18 to +17.51% for the Butterworth filter and without scatter correction. The error of estimate was −6.60 to +15.37% when scatter correction was used.

SPECT can be used for quantitative analysis of radionuclide concentrations using a regression function. Theoretically a ten percent error requires radionuclide concentrations exceeding 14 MBq/l. Additional errors such as ROI mispositioning and decay must be considered. The prospective phantom studies showed that the overall error of estimate is below 20%.

Intravenous Radionuclide Total-Body Arteriography: Introducing a New Technique. D.C. Yang, D. Patel, W. Yee, L. Gould, and J. Giovanniello. *The Methodist Hospital, Brooklyn, NY.*

We have developed a technique using a blood-pool agent and a moving detector head set at a high speed to obtain total-body arterial and tissue perfusion images with only a single i.v. injection.

The equipment employed was the Siemens ZLC 7500 total body gamma camera imaging system with IRIS (improved resolution and improved sensitivity) electronic accessories.

Twenty minutes after an i.v. injection of "cold" pyrophosphate (Sn), the patient was placed supine on a whole-body imaging table with the detector centered at the top of the patient's head. Speed was set at 150 cm/min and intensity at 800. A tourniquet was fastened around the patient's arm. Tc-99m pertechnetate (20 mCi in <1 cc) was injected into an antecubital vein. Simultaneously, the tourniquet was released and the camera started. The detector moved from head to foot completing the arterial image in ~90 sec. Immediately afterwards another total-body image was obtained to assess tissue perfusion.

Out of 250 cases, more than 90% were of good diagnostic quality, clearly demonstrating aorta, iliac, femoral, and (to a lesser extent) the more distal arteries. The perfusion images showed the anatomic/physiologic status of organs (e.g., thyroid, liver, spleen, etc.) and soft tissues. Done as part of MUGA studies, this technique provided valuable data regarding the whole cardiovascular system, including unexpected arterial stenoses and aneurysms.

Previously with one i.v. injection, radionuclide arteriography could only show arteries in a limited body area. Now, with this simple and noninvasive technique we can evaluate the major arterial system, organs, and soft tissues in the whole body with just one small i.v. injection.

Technetium-99M MAA Perfusion Imaging as a Prognostic Indicator in Hepatic Arterial Infusion Chemotherapy. C. Divgi, K. Jackson, N. Kemeny, P. Oderman, and R. Benua. *Memorial Sloan-Kettering Cancer Center, New York, NY.*

An evaluation of the utility of radionuclide perfusion imaging in hepatic arterial infusion chemotherapy was undertaken. Hepatic arterial infusion devices implanted in the abdomen in patients with colon carcinoma metastatic to the liver were studied with 3 mCi (111MBq) of technetium-99m macroaggregated albumin (MAA) injected as a bolus into the side-port of the infusion device.

Baseline studies were reviewed for 46 patients who subsequently received only selective hepatic intra-arterial chemotherapy. Scans were considered "positive" if there was evidence of tracer concentration within, and/or a rim of hyperperfusion around, the lesion(s) seen in colloid liver/spleen images. A significant correlation was noted between scan positivity and response to chemotherapy: 14 of 16 patients with negative scans showed failure of or minimal response to chemotherapy, while 24 of 30 positive scans showed partial or complete response.

We conclude that perfusion imaging is a valuable prognostic indicator in the evaluation of hepatic intra-arterial infusion chemotherapy. It is also useful in determining baseline perfusion through the infusion device including possible extrahepatic perfusion.