

**Comparison of  $^{85}\text{Kr}$  and  $^{133}\text{Xe}$  Cerebral Blood Flow Measurements Before, During, and Following Focal, Incomplete Ischemia in the Squirrel Monkey.** Jerome Hanson, Jr., Robert E. Anderson, and Thoralf M. Sundt, Jr. *Circ Res* 36:18-26, 1975.

This study was undertaken in a proved model of focal, incomplete ischemia to determine if the reported discrepancies on the severity of reduction of regional blood flow and the influence of altered arterial  $\text{pCO}_2$  on regional blood flow in areas of infarction were due to spatial resolution inherent in techniques that depend on a gamma emitter (errors from the "look-through" phenomenon and Compton's scatter). One group of monkeys was studied with  $^{85}\text{Kr}$  and the other with  $^{133}\text{Xe}$ . In the Krypton group a right temporoparietal craniectomy and dural resection was performed and the brain protected with Saran Wrap. In the  $^{133}\text{Xe}$  group craniotomy was not necessary. Cerebral blood flow with both isotopes was determined at variable levels of arterial  $\text{pCO}_2$  for 90 min prior to occlusion of the right middle cerebral artery, for 70 min during occlusion, and for 30 min after release. Radioactive gases were injected into the internal carotid arterial system. Regional cerebral blood flow was determined by the initial slope technique and kinetic analysis. After middle cerebral artery occlusion at normocephnia there was a 65% reduction in regional cerebral blood flow from 1.40 to 0.40 ml/gm-min<sup>-1</sup> in monkeys studied with  $^{85}\text{Kr}$  but only a 27% reduction in regional cerebral blood flow from 0.8 to 0.61 ml/gm-min<sup>-1</sup> in monkeys studied with  $^{133}\text{Xe}$ . The lack of correlation in the areas of incomplete ischemia was attributed to an impairment of isotope delivery to the area of ischemia coupled with the inherent lack of spatial resolution of determinations made with  $^{133}\text{Xe}$ . The authors felt that this may partly explain the numerous discrepancies in experimental and clinical studies of the effects of alterations in the partial arterial  $\text{pCO}_2$  on regional cerebral blood flow in areas of ischemia. They also postulated that the failure of such studies to reflect the true severity of focal ischemia was due to the same deficiencies.

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**Dynamic Scintigraphy of Primary and Secondary Malignant Intracranial Neoplasms.** Jerome J. Sheldon, William M. Smoak, Aldo N. Serafini, and Michael M. Raskin. *Radiology* 114:373-380, 1975.

During a period of 3 years 98 patients with intracranial neoplasms were studied by means of brain scintigraphy and carotid arteriography, with confirmation available in 49 cases. The patient population was composed of 25 glioblastoma multiformes, 11 astrocytomas, and 13 metastatic lesions. Eleven of the patients with glioblastoma multiformes had positive dynamic images and the contrast arteriography showed tumor circulation in each of these. In 14 patients with glioblastoma and negative dynamic images, tumor circulation was found in 10 on arteriography. None of the 11 patients with astrocytomas had a positive dynamic image and only 10 of the 11 demonstrated tumor circulation by arteriography. Of those patients with metastasis, 3 had positive dynamic images and all had tumor circulation by arteriography, but of 10 with negative dynamic images 8 showed positive arteriography. Of the total 49 patients, 14 demon-

strated a positive dynamic image and tumor circulation by arteriography and 35 had negative dynamic images with 20 demonstrating tumor circulation on arteriogram. When shunting on the contrast arteriograms was correlated with the dynamic scintigraphic findings, all 14 patients with positive dynamic studies did show shunting by arteriography but only 1 of the 35 patients with a negative dynamic image had shunting on the arteriogram. It appears that the detection of primary or secondary malignant intracranial neoplasms by dynamic scintigraphy probably depends on the presence of shunting within the tumors. The authors concluded that the size and location of lesions were not major factors in determining whether the dynamic study would be positive. They observed relatively small lesions with arterial venous shunting in patients with positive dynamic images.

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**Sequential Brain Scanning as an Adjunctive Scanning Procedure.** James H. Christie, Raymundo T. Go, Yutaka Suzuki, Norihisa Tomami, and Rolf L. Schapiro. *Radiology* 114:381-387, 1975.

Sequential brain scans were performed at various, arbitrarily chosen time periods immediately after intravenous administration of  $^{99\text{m}}\text{Tc}$ -pertechnetate, at 10, 20, and 30 min, and at 1, 2, 3, and 4 hr. The study was composed of 108 patients who had had a previous routine 1-hr brain scan that was either normal or equivocal. Final diagnoses were confirmed by angiography, pneumoencephalography, surgery, autopsy, or by the clinical course in nonsurgical diseases. In 62 of the 108 patients, the ultimate disposition did not suggest a discrete morphologic brain lesion. The other 46 did indicate the presence of a definite lesion. In 27 of these 46 patients, the lesion was detectable on at least one of the sequential scans. In 13 patients, the whole sequential scan series was necessary for a definitive diagnosis since the lesion was not definitely detectable on any one single scan or in the whole sequential series. In 6 cases, the lesion was not detectable on the sequential brain scan and these were classified as false negatives. It must be emphasized that, in nearly a third of the 46 patients, careful observations of the progressive and subtle changes in radioactivity in the whole sequential scan series were necessary for the detection of the lesions and they could not be appreciated on any single static scan when viewed independently. In many instances, the authors found that the temporal variations and activity of normal anatomic structures were predictable and that the image patterns varied from similar changes in pathologic processes. Normal anatomic structures exhibited the tendency to accumulate radioactivity at a more rapid rate than lesions and tend to rise to a peak activity early, which is followed by gradual and progressive reduction in activity. The sequential scanning permitted firmer identification of the normal anatomic structures and the more gradual and progressive accumulation of radioactivity permitted the identification of pathologic tissue. The sequential images presented in the article are quite instructive.

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**Neonatal Craniopharyngioma: Case Report.** Behrooz Azar-Kia, Uttamapalayam R. Krishnan, and Mannie M. Schechter. *J Neurosurg* 42:91-93, 1975.

The authors reported on a newborn child weighing 4,250 gm at birth who had a huge head and wide open fontanelles and separated cranial sutures. At the age of 2 days a ventriculogram demonstrated markedly enlarged ventricles, a large third ventricle, and a normal-sized aqueduct in the fourth ventricle. The calcified mass projected predominantly into the floor of the right lateral ventricle. The supratentorial vessels were stretched and there was elevation of the right middle cerebral artery. Tumor stain was present. At the age of 6 days the baby demonstrated movements resembling a seizure. At this time the head measured 51.1 cm in diameter. The brain scan demonstrated a massive lesion that spanned from the anterior to the posterior fossa located predominantly on the right side. Approximately 80% of the tumor was removed surgically and was interpreted histologically as a solid craniopharyngioma. This was the first neonatal craniopharyngioma demonstrated by radionuclide imaging.

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**Dural Fluid Collections in Infants and Children.** David I. Gilday, Judith Ash, and Norah Milne. *Radiology* 114:367-372, 1975.

The authors describe their experience with 94 cases of dural fluid collections that included 5 dural hematomas, 14 subdural hydromas, and 75 subdural hematomas. The causes of the dural fluid collections were injury at birth, meningitic inflammation, acute head trauma, and treated hydrocephalus. Radionuclide angiography was performed predominantly in the posterior projection and static images were obtained immediately and after a delay of 2-4 hr. Criteria for the diagnosis of a dural fluid collection were a peripheral rim of accentuated activity on the delayed scan, a superficial defect on the radionuclide angiogram, and a diagonal line or an extra rim of activity in the blood pool area. Twenty-one subdural hematomas were detected in 29 infants with no false negatives and 35 subdural hematomas were detected in children with 4 false negatives. Eighteen bilateral subdural hematomas were correctly diagnosed in infants with 3 false negatives and 58 in children with 8 false negatives. The total false negatives in infants was 8% and in children 14% and the total false-positive detection rate was 10%. The authors felt that the technique of routine cerebral radionuclide angiography followed immediately by a blood pool scan plus a delayed scan 2-4 hr later was the key to their high success rate. The cerebral radionuclide angiogram was valuable in correlating the abnormal scan in 42 cases and in detecting fluid collections when the delayed scan was normal in 5 cases. In toto the radionuclide angiogram was necessary to establish the correct diagnosis in 23 of the 75 cases, nearly one-third. The radionuclide angiogram was normal, however, in 29 patients with a subdural hematoma that was less than 1 cm thick. They also concluded that the probable reason for nondetection of sterile subdural effusions that had old and collagenous membranes is the lack of meningeal inflammation. The images presented in the article are well worth reviewing.

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**Renal Localization of Gallium-67 Citrate.** Robert S. Frankel, Steven D. Richman, Stanley M. Levenson, and Gerald S. Johnston. *Radiology* 114:393-397, 1975.

The authors observed renal localization of <sup>67</sup>Ga-citrate in 34 patients from a total of approximately 2,000 gallium whole-body studies. The renal findings were observed principally in three diseases: lymphoreticular neoplasm, leukemia, and malignant melanoma, and to a lesser extent in breast carcinoma. Real concentration was not observed in lung carcinoma, primary bone tumor, head and neck carcinoma, and uterine and ovarian neoplasms. Thirteen of the 34 patients were examined at autopsy and in 9 of these patients with lymphomas and leukemias, bilateral renal tumor was found in two-thirds of them. In 3 patients with malignant melanoma, tumor was found bilaterally but not in 1 patient with breast carcinoma. The authors concluded that gallium localization in kidneys might be the first indicator of real involvement with either tumor or inflammation.

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**The Temporal and Pathological Significance of Perfusion Failure Following Renal Transplant.** Gerald S. Freedman, Martin Schiff, Phil Dager, DeWitt Jones, and Michael Hausman. *Radiology* 114:649-654, 1975.

The authors report on more than 200 <sup>99m</sup>Tc-DTPA studies performed in 55 renal transplant recipients. They found that in 21 patients the transplants became avascular and required removal for the following reasons: 5 transplanted kidneys were removed 0-2 days after surgery because of hyperacute rejection or vascular ischemia due to vascular occlusion or kinking, or renal vein thrombosis; the kidneys were removed 3-10 days after surgery in 4 patients because of progressive loss of renal perfusion because of accelerated or second-set rejection. Seven patients demonstrated renal pathology characteristic of acute rejection during a period of 20-40 days following surgery and in 5 patients a more chronic form of rejection dictated removal at 60-360 days after surgery. The authors provide an excellent description of their radionuclide findings for the different periods of time when removal of the transplanted kidney was necessary.

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**The Uses and Limitations of Radioisotopes in the Investigation of Gastrointestinal Diseases.** Phillip Braunstein and Chull S. Song. *Am J Digest Dis* 20:53-90, 1975.

The authors review the state of the art of using radioisotopes in gastrointestinal diseases and include static imaging for anatomic information and dynamic imaging for functional information in diseases of the liver. The use of specifically oriented radiopharmaceuticals such as <sup>75</sup>Se-selenomethionine and <sup>67</sup>Ga-citrate are discussed both with respect to the liver and the pancreas. The last part of the article contains information on nonimaging procedures including some of the later developments in the use of <sup>14</sup>C-labeled compounds and radioimmunoassay. The bibliography is quite extensive, and the authors' presentation is well-organized.

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**Experience with <sup>111</sup>In-Chloride Scanning in Patients with Focal Defects on <sup>99m</sup>Tc-Sulfur Colloid Liver Scan.** Hussein M. Abdel-Dayam, Adel M. Elkousy, Eugene B. Leslie, and Victor A. Panaro. *Radiology* 114:403-406, 1975.

The authors studied 39 patients with focal abnormalities revealed by <sup>99m</sup>Tc-sulfur colloid liver scans by means of 1.5-2 mCi <sup>111</sup>In-Cl administered intravenously. Whole-body scans were obtained in anterior and posterior projections, plus additional area scintillation camera images. In 20 patients with hepatic malignancy, 11 had subsequent positive indium chloride scans. None of the 19 with focal sclerotic fibrosis had positive indium scans although 2 of the 5 demonstrated indium chloride uptake in extrahepatic tumors. The authors concluded that a positive indium scan suggested that the defect was malignant but the indium study was less helpful in the negative scan and failed to distinguish between neoplasm and focal cirrhosis. If a positive concentration of <sup>111</sup>In was found in an extrahepatic primary neoplasm, and the uptake in the liver was found in an extrahepatic primary neoplasm and the uptake in the liver was negative, the evidence suggested that the hepatic lesion was not neoplastic.

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**Screening for Bone Metastases.** D. A. Pistenma, I. R. McDougall, and J. P. Kriss. *JAMA* 231:46-50, 1975.

The authors reported the results of total skeletal scintigraphy with <sup>99m</sup>Tc-labeled diphosphonate in 200 patients with biopsy-proven primary cancer. The sites of the primary tumors included all of the major organ systems except brain. They found both the scans and the roentgenograms positive in 52 of their patients (26%), and both were negative in 76 patients (38%). In 28.5% (57 patients) the scans were positive and the roentgenograms negative and the reverse was found in only 3 patients (1.5%). In addition, 9 patients had positive scans and 3 patients had negative scans without concomitant roentgenograms. In nearly two-thirds of the patients there was agreement between the scans and the x-rays. The primary tumors in which only the scan was positive were lung (54%), gastrointestinal (43%), non-Hodgkins lymphoma (35%), urinary tract (33%), prostate (27%), breast (26%), and Hodgkins (25%). Of the potential 2,400 anatomic regions available for concomitant analysis (200 patients with 12 regions each), 1,307 were included on the roentgenograms. There was correlation between the two procedures in only 84 regions (6%) whereas there were positive images in 160 regions. Only 5 of 17 regions that were abnormal on roentgenograms but not on scans were unexplained false-negative findings. The authors concluded that skeletal scintigraphy with <sup>99m</sup>Tc-labeled diphosphonate is the more reliable and simple screening examination for skeletal metastases than a roentgenographic metastatic survey and should replace the latter as the primary investigation for such lesions. The authors also found poor correlation between scan findings and serum calcium alkaline phosphatase levels or acid phosphatase levels that were normal, and thus these clinical chemical procedures should not be used as criteria to decide whether or not a bone scan should be obtained.

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**Serum Digoxin Levels Using an <sup>125</sup>I-Labeled Antigen: Validation of Method and Observations on Cardiac Patients.** Kathryn Taubert and William Shapiro. *Am Heart J* 89:79-86, 1975.

The purpose of this study was the evaluation of a new prepackaged method of digoxin radioimmunoassay and to explore the effects of maintenance dose, postalimentary absorption with or without an orally administered diuretic, and maximal exercise on serum digoxin levels. The kits contained digoxin-specific antibodies and either <sup>3</sup>H-digoxin or <sup>125</sup>I-3-O-succinyl digoxigenin tyrosine. Standard curves were prepared from healthy volunteers. In order to correlate serum levels, an analysis was done of the venous blood digoxin determinations and relevant clinical data on 356 patients who were taking various daily doses of digoxin. Postabsorptive studies were also carried out in two groups of nine male patient volunteers. In one group the patients were taking 0.25 mg digoxin/day and blood samples were obtained prior to the morning ingestion of digoxin and hourly after injection for 6 hr and again at 24 hr. In the second group of patients on a similar dosage, but who also required a thiazide diuretic daily, the same samplings were obtained. The effect of bicycle exercise tests on serum digoxin levels was studied in 16 male patients who had been maintained on 0.25 mg digoxin/day orally. Venous blood samples were obtained immediately before and at the conclusion of maximal exercise efforts. The authors found that the results obtained from commercially available kits with <sup>125</sup>I-labeled antigen were essentially the same as the results obtained with a <sup>3</sup>H-labeled antigen. For those patients on digoxin medication, blood samples should be drawn either before administration of the digoxin or at least 6 hr following administration of the oral tablet in order to obtain the best approximate steady state level. In those patients on thiazide diuretics, no changes were noted, indicating that the diuretic did not interfere with the absorption of the digoxin tablet. Maximal exercise testing did not significantly alter serum digoxin levels.

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**Massive Pulmonary Emboli Diagnosed and Followed in Progress by Lung Imaging and Radionuclide Pulmonary Angiography.** E. W. Klein, Kathleen McCarten, D. G. Dimcheff, and J. T. Colvin. *Circulation* 50:1260-1263, 1974.

This article points out that radionuclide pulmonary angiography can be utilized in the diagnosis of massive pulmonary embolism. In the case presented, the radionuclide pulmonary angiogram clearly demonstrated complete obstruction of the right main pulmonary artery. They suggested that the more central large type pulmonary emboli could be diagnosed by radionuclide procedures without associated contrast angiography and that the postembolic progress is easily followed without the necessity of the more hazardous contrast angiography. In the case presented, perfusion lung scans revealed almost complete absence of blood flow to the right lung and a followup radionuclide pulmonary angiogram did demonstrate complete obstruction of the right pulmonary artery. Followup by repeated lung scans demonstrated an appreciable improvement in perfusion both by particle and flow procedures.

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**Radioimmunoassay of  $\alpha$ -Fetoprotein in Human Serum: Clinical Value in Patients with Liver Diseases.** J. A. P. Chayvialle, C. Touillon, C. Crozier, and R. Lambert. *Am J Digest Dis* 19:1102-1110, 1974.

This article reports the development of a radioimmunoassay for human  $\alpha$ -fetoprotein (AFP). The serum AFP levels were measured in healthy adults and in patients with malignant hepatoma, liver metastases, and various non-neoplastic liver diseases. The study involved 304 subjects, 136 controls, and 168 patients with various liver diseases. In the 136 controls the mean serum AFP level was  $3.8 \pm 1.3$  ng/ml (mean  $\pm$  s.d.). The mean values in males and females did not differ significantly. No correlation was observed between age and serum AFP level. In patients with primarily hepatocellular carcinoma (34) serum levels were all above the upper limits of normal (3 s.d.). In 19 subjects with liver metastases, 4 had elevated serum levels. Of 33 patients with cirrhosis, 21 had normal serum levels and 12 were elevated at lower concentrations of 8.2-43.6 mg/ml. One of 10 patients with obstructive jaundice and 1 of 16 with hydatid cysts of the liver had slightly elevated AFP levels. Abnormal serum AFP concentrations were found in 17 of 28 patients with viral hepatitis, the highest value being 538 mg/ml. No correlation was found between the serum AFP level and the presence of Australian antigen as detected by electroimmuno-diffusion. The authors concluded that a moderately elevated serum AFP level is not decisive for the diagnosis of malignant hepatoma.

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**The Effective Thyroxine Ratio as a Test of Thyroid Function.** James S. Powers, Christopher J. Roach, and Thomas A. Verdon. *Obstet Gynecol* 44:806-810, 1974.

Presently the most satisfactory test of thyroid function in pregnancy and in those patients on estrogen therapy or oral contraceptives is the free thyroxine index (FTI) (resin  $T_4$  uptake  $\times$  serum  $T_4 \times 100$ ). The problems with the determination of the  $T_4$  test alone arise due to increased thyroid binding protein production. Determination of free unbound  $T_4$  would be a better test, but this is not routinely available. The effective thyroxine ratio (ETR) involves ethanol extraction of  $T_4$  from the patient's serum and a reference serum. Incubation with a labeled  $T_4$ -TBP reagent and a small amount of the patient's serum is performed and resin extraction of excess  $T_4$  is made. The residual count rate for the patient's serum is compared to the residual count rate for the reference serum and the ratio is the ETR.

A study comparing the ETR with the FTI in 253 clinically euthyroid patients was performed. Ninety patients were in the third trimester of pregnancy, 58 were on estrogen replacement, 71 were on oral contraceptives, and 34 were on no specific therapy. Values were obtained for the ETR, FTI, resin  $T_4$ , and resin  $T_3$  uptake using commercial kits. Statistical analysis of the ETR compared with the FTI showed good correlation of the two tests.

The authors feel that further studies will prove the value of the test and that it will replace the  $T_4$  and resin  $T_3$  uptake studies. Current studies with hyperthyroid and hypothyroid patients are under way.

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**Validated with Tetracycline Labeling.** Robert C. Stadalnik, Richard L. Riggins, Robert D'Ambrosia, and Gerald L. DeNardo. *Radiology* 114:663-666, 1975.

Fluorine-18 positron scintigraphy and tetracycline labeling were performed in 17 randomly selected patients in whom the femoral head was subsequently removed. Thirteen of the patients had an acute fracture of the femoral neck and four had painful arthritis following earlier fracture. Acute fractures were defined as those that had occurred within 2 months of the study. The ages of the patients varied from 13 to 91 years but only two were less than 55. Prior to surgery the patients were studied with  $^{18}F$  scintigraphy and in addition were given tetracycline for several days before surgery. Following removal, the femoral head was sectioned and examined with long-wave ultraviolet light. The radionuclide images suggested absent radioactivity in the femoral head in ten patients, normal radioactivity in five, and increased in two patients. The results of the  $^{18}F$  scintigraphy correlated with the tetracycline labeling, indicating that the radionuclide procedure is a reliable method for assessing blood flow to the femoral head. The authors concluded that when scintigraphy demonstrated absence of blood flow to the femoral head, avascular necrosis would most likely develop, but in those patients with normal scintigraphy of the femoral head it could not be determined with certainty if some degree of avascular necrosis had not developed earlier.

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**Effect of Collimator Motion on Image Quality in Nuclear Medicine.** J. Edward Dowdey, Robert C. Murry, and Frederick J. Bonte. *Radiology* 114:411-414, 1975.

The authors evaluated the quality of scintillation camera images and those obtained by means of moving collimators. A group of collimators was constructed that could be rotated or oscillated sinusoidally in two dimensions. It was found that an increase in the width of a point source occurred in the direction of the collimator motion. In the case of a thyroid phantom with a cold void, the area of decreased activity was nearly lost by either a linear or rotary collimator motion. Collimator motion during imaging will reduce septal aberration but will not increase the resolution of the imaging system. This is specifically true of collimators with fine septae. In collimators with thick septae a more faithful representation of a source will be provided by means of collimator motion.

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