

Computerized Transverse Tomography of Vascular Lesions of the Brain. Part I. B. D. Pressman, J. Kirkwood, and D. O. Davis. *Am J Roentgenol Radium Ther Nucl Med* 124: 208-214, 1975.

This report discusses the application of computerized transverse tomography (CTT) in the diagnosis and evaluation of intracranial arteriovenous malformation. The authors present eight cases in which an absorption coefficient abnormality was noted. In five cases brain scans were performed and all were positive. In the majority of the arteriovenous malformations studied, an increased density, compared to surrounding normal brain tissue, was present. In three cases, however, there was a relative radiolucency and in two of these there were also focal areas of increased density. The reasons for the increased density of the arteriovenous malformation could include a mural thrombosis or calcification, an associated hematoma, calcification or gliosis of intervening brain tissue, or a highly absorptive large blood pool. The reasons for the lucencies or decreased densities are not clear. In three cases the arteriovenous malformation was difficult to recognize on the computerized scan before the injection of contrast material. The authors recommend that all patients with the clinical suspicion of an arteriovenous malformation or a history of subarachnoid hemorrhage should have a repeat computerized scan after intravenous administration of a contrast agent. From their data the sensitivity of the routine CTT (without iodine injection) for detecting arteriovenous malformations is not as high as would be desirable for a simple noninvasive screening examination. They recommend static and dynamic radionuclide brain scanning on all patients in whom the routine CTT performed for suspected intracranial lesions is negative.

Computerized Transverse Tomography of Vascular Lesions of the Brain. Part II: Aneurysms. B. D. Pressman, G. E. Gilbert, and D. O. Davis. *Am J Roentgenol Radium Ther Nucl Med* 124: 215-219, 1975.

The authors present five cases in which intracranial aneurysms were studied by computerized transverse tomography. The location and size of these aneurysms were as follows: (A) junction of the right posterior cerebral and posterior communicating artery, 12 × 20 mm; (B) genu of the left middle cerebral artery, 12 × 20 mm; (C) left supraclinoid carotid artery, 16 × 20 mm; (D) left middle cerebral artery from origin to genu, 20 × 49 mm; and (E) basilar artery, 20 × 23 mm. Each of the aneurysms visualized by CTT was relatively large and each had absorption coefficients greater than +20. These high coefficients can be explained by the presence of mural thrombus and calcification, which surgical findings corroborated in two cases. The authors were not aware of any false-negative CTT scans in patients with aneurysms as large as the ones presented; however, they had not visualized small aneurysms at the base of the brain. They assert that CTT will not satisfactorily call attention to small aneurysms in any location unless there is an associated hematoma or edema. The authors also conclude that CTT may offer valuable complementary information to the angiogram when a more accurate indication of the size of the aneurysms with mural thrombus is required, when a

hematoma is suspected, and when numerous aneurysms are present and angiography does not indicate which one is responsible for a subarachnoid hemorrhage.

Computerized Axial Tomography of the Cerebral Ventricle and Subarachnoid Spaces. S. H. Cornell, J. H. Christie, C. L. Chiu, and C. W. Lyon. *Am J Roentgenol Radium Ther Nucl Med* 124: 186-194, 1975.

From more than 500 case studies the authors selected 12 examples that included hydrocephalus, arachnoid and porencephalic cysts, cerebral atrophy, cerebral neoplasms, and congenital anomalies. The purpose of this article was to present the pictorial evidence of these conditions as shown by computerized axial tomography. The illustrations are excellent and well worth reviewing in the original article.

An Investigation for Extracting More Information from Computerized Tomography Scans. D. F. Reese, P. C. O'Brien, G. W. Beeler, P. R. Gerding, and E. C. McCullough. *Am J Roentgenol Radium Ther Nucl Med* 124: 177-185, 1975.

Although the standard display mode for computerized tomography scans is two-dimensional, such other formats as a three-dimensional display of individual brain slices and a combined display of several sections simultaneously in both sagittal and frontal projections have been developed. The authors' approach was directed toward statistical analysis and redisplay in the form of histograms. They analyzed 20 normal scans and five proven abnormal scans generated by the EMI brain scanner. Only data within the region of the spherical hemispheres were utilized; these were divided into left and right halves. The 2A slice was chosen for each subject because this level is anatomically quite complex, including portions of such structures as the frontoparietal and occipital lobes, the lateral and third ventricles, and the basal ganglia. Certain statistical tests were felt to be useful in detecting an abnormal scan: (A) the difference in mean attenuation coefficient between the right and left hemispheres; (B) the ratio of standard deviations; and (C) the difference between skewness coefficients. The authors found their earlier results to be encouraging but equivocal. The method did not appear to work in those lesions whose average x-ray attenuation was equal to that of normal tissue. Midline symmetric lesions such as pontine and corpus callosum tumors and third ventricle masses were thought to be undetectable, at least by comparison means. They conclude that further refinement and experience are necessary before the method might be clinically applicable.

Increased Intracranial Pressure: Evaluation by Computerized Tomography. W. E. Lightfoot and B. D. Pressman. *Am J. Roentgenol Radium Ther Nucl Med* 124: 195-198, 1975.

Increased intracranial pressure is a disorder without focal neurologic symptoms or signs and with normal cerebrospinal fluid analysis. Symptoms are due solely to the elevated increased intracranial pressure and frequently manifest by headaches, visual blurring, diplopia, occasional tinnitus, and less frequently, nausea and vomiting. Papilledema, and occasionally palsies of the abducens nerve, are present. A cautious but expeditious evaluation must be promptly initiated.

The possibility of neoplasm, either supratentorial or infratentorial, must be eliminated. If small or normally sized ventricles show no evidence of mass lesions and spinal fluid findings are normal except for elevated pressure, idiopathic intracranial hypertension may be logically concluded and appropriate therapy instituted. If there is evidence of hydrocephalus, a mass lesion, or both, cerebral air studies or surgery may be indicated. If computerized tomography shows small or normally sized ventricles without evidence of a mass lesion and the radionuclide brain scan is normal in a patient with suspected idiopathic intracranial hypertension, a lumbar puncture may then be cautiously performed. Investigations by computerized tomography of three patients with suspected idiopathic intracranial hypertension were reported. Each case showed normally sized ventricles without evidence of mass lesions. Each was treated accordingly and were found to have improved on followup studies several months later. For the early diagnosis of increased intracranial pressure, the value of computerized tomography in conjunction with other studies is evident.

Experimental Studies to Determine Application of CAT Scanning to the Human Body. R. J. Alfdi, W. J. MacIntyre, T. F. Meaney, E. S. Chernak, P. Janicki, R. Tarar, and H. Levin. *Am J Roentgenol Radium Ther Nucl Med* 124: 199-207, 1975.

The application of computerized axial tomography (CAT) to portions of the body besides the head is of considerable medical interest. Basic to such investigations is the determination of the attenuation characteristics of organs other than the brain, in both normal and diseased states. This the authors accordingly undertook. In order to study isolated portions of tissue, an acrylic-plastic basin was constructed which permitted access to the scanner for single or multiple studies. The size of the organ study was limited to 17 cm. Scanning of canine organs immediately after death and 24 hr later showed no significance differences in attenuation. The heart and the majority of intra-abdominal organs were found to have overlapping tissue characteristics. The authors also found considerable variation in the density of animal organs as compared to the same human organs: in general, the smaller the animal, the less the attenuation. Organs containing considerable fat appeared to be most amenable to CAT scanning. The studies on the plasma of fresh and banked blood yielded considerably increased values, with a range of 9-17 EMI scale. Values for whole blood likewise varied and were shown to be hematocrit-dependent. Bone structures showed a variety of attenuations ranging from EMI values of 25 in osteoporotic ribs to 925 in human tibial cortex. Osteolytic metastatic tumors involving various bones showed marked diminution in bone absorption, as expected. Normal and abnormal tissues in the same organs showed only minor variation in absorption. The organs were studied under ideal circumstances without respiratory or cardiac motion; the latter will most probably introduce significant artifacts under clinical conditions. Fat planes showed excellent definition and provided information concerning the size and shape of organs. The absorption characteristics of the pancreas and adrenal gland were sufficiently different to determine size and shape. The authors conclude that anatomic cross sections of the body will provide considerable information on size, location, and configuration of various intra-abdominal and intrathoracic organs. However, CAT scanning is not effective in intraorgan pathology, with the exception of cystic lesions, in such solid organs as liver, spleen, or kidney. A conclusive study utilizing contrast agents and whole-body scanning will be required to answer this question.

An Investigation of the Plutonium Content in Fission-Product ^{99m}Tc Generators. V. J. Sodd, R. J. Grant, and D. M. Montgomery. *Health Phys* 29: 425-426, 1975.

The eluates from 12 fission-product ⁹⁹Mo-^{99m}Tc generators were analyzed for plutonium contamination. The generators, nominally rated to contain 200-400 mCi of ⁹⁹Mo, were obtained from two distributors during the months of July, August, and October of 1974. Samples from eight generators were collected from the eluates only, and in four cases eluates from unused generators that had decayed beyond their useful lifetimes were examined. The eluates were "spiked" with 11.5 pCi of ²³⁹Pu for the determination of plutonium recovery. The plutonium was electrodeposited on stainless-steel disks and counted by alpha spectrometry by means of a 400 × 400-mm silicon surface barrier detector and a 12-channel analyzer. The maximum possible concentrations of ²³⁸Pu, ²³⁹Pu, and ²⁴⁰Pu found in this study ranged from 0.004 to 0.1 pCi per curie of ^{99m}Tc. These concentrations are 4-5 orders of magnitude below the AEC criterion for gross alpha contamination. The authors conclude that if the fission-product ⁹⁹Mo is produced and processed in the manner described in their studies, then plutonium is not present in the ^{99m}Tc in detectable or significant amounts and does not represent a health hazard.

A Radioreceptor Assay for Evaluation of the Plasma Glucocorticoid Activity of Natural and Synthetic Steroids in Man. P. L. Ballard and J. P. Carter. *J Clin Endocrinol Metab* 41: 290-304, 1975.

The authors report on the development of an assay for plasma glucocorticoid activity by means of specific glucocorticoid receptors. In contrast to other assays, the radioreceptor assay measures the glucocorticoid activity of all natural and synthetic steroids. After extraction the steroids are incubated with ³H-dexamethasone and cytosol receptors from cultured rat hepatoma cells. From 0.5 to 50 ng of cortisol are detected accurately, and the glucocorticoid activity of adult plasma determined by the assay correlates closely with corticoid levels obtained by the CBG-isotope and fluorometric assays. Other steroids are measured in proportion to both concentrations and potency as glucocorticoids. The assay has been useful in detecting glucocorticoid activity in unidentified medications and in measuring plasma and glucocorticoid levels after administration of synthetic corticosteroids. The authors also developed a modification of the assay for estimating the level of free (unbound) glucocorticoid activity in plasma. The assays were performed before and after the removal of steroids by charcoal not bound to the plasma transcortin. This consideration is particularly important with prednisolone where the unbound steroid level is much less than the total. The radioreceptor assay offers a relatively simple technique for measuring the total or free-plasma glucocorticoid activity in man due to any natural or synthetic steroid or combination of steroids.

Regional Cerebral Blood Flow Measured by the Gamma Camera after Direct Injection of ¹³³Xe into the Distal Stump of the Occluded Middle Cerebral Artery. E. O. Ott, J. Abraham, J. S. Meyer, C. A. F. Tulleken, N. T. Matthew, A. N. Achari, M. Aoyagi, and R. F. Dodson. *Stroke* 6: 376-381, 1975.

The investigation was designed to compare regional blood-flow values (measured by the scintillation camera) in the region of an occluded middle cerebral artery in a baboon after (A) injection of ¹³³Xe into the internal carotid artery, and (B) injection of a small bolus of ¹³³Xe into the distal stump of the middle cerebral artery. Changes of regional cerebral blood flow in the ischemic region induced by changing arterial carbon dioxide tension or induced hypertension

were measured using both methods of ^{133}Xe injection and results compared. Although manipulation and cannulation of an artery can result in spasm, no such spasm was observed in the cases studied. The authors found that the flow values in ischemic regions that were obtained by direct injection of the ^{133}Xe into the middle cerebral artery were 15–20% lower than the values obtained by internal carotid injection of ^{133}Xe . In ischemic regions due to occlusion of the middle cerebral artery, some flow was still preserved, presumably from collateral circulation. After lowering the carbon dioxide tension by hyperventilation, the authors found that an increase of local cerebral blood flow in the ischemic zone occurred because of the displacement of blood into the ischemic zone due to regional pressure changes. During induced hypertension, dysautoregulation in the ischemic zone was present, so that local cerebral blood flow passively showed changes in cerebral perfusion pressure.

Some Experimental Errors in Calculating Regional Cerebral Blood Flow from the Intracarotid ^{133}Xe Clearance Curve. A Quantitative Evaluation Employing a Digital Model. I. Kanno and K. Urmura. *Stroke* 6: 370–375, 1975.

The authors describe a digital model developed for the quantitative assessment of experimental errors in the analysis of ^{133}Xe clearance curves from the brain. A small computer synthesized model clearance curves with varying combinations of fast and slow components. The curves were convoluted with Poisson random digits to simulate statistical fluctuations. Identical curves with varying injection intervals were overlapped to study the influence of the remaining activity. The height-over-area method for 10-min wash-out overestimated cerebral blood flow by 10–15% with a slow component of 20 ml/100 gm per min. The overestimation was increased with a lower slow-flow component. The initial slope was shown to have a close relationship with the fast-flow component when the latter was less than 100 ml/100 gm per min. The remaining activity gave errors of 1–3% in the initial-slope method with an injection interval of 15 min. The influence of the remaining activity could be eliminated with an injection interval of more than 25–30 min in the initial-slope method and of more than 40 min in the height-over-area method. *Note:* This article is relatively technical, involving an appreciable amount of mathematical calculation. Those interested should refer to the original publication.

Alpha-Fetoprotein in Non-Neoplastic Hepatic Disorders. J. R. Bloomer, T. A. Waldemann, K. R. McIntire, and G. Klatskin. *JAMA* 233: 38–41, 1975.

The authors studied 473 patients with non-neoplastic hepatic disorders by means of a serum alpha-fetoprotein radioimmunoassay. In each case the diagnosis was biopsy-proven. The ages ranged from 3 to 80 years and, except for five patients, all were more than 15 years of age. Serum levels of alpha-fetoprotein were below 30 ng/ml in 130 healthy controls and were below 40 ng/ml in 349 of 350 patients with chronic nonhepatic non-neoplastic diseases. Therefore, values greater than 40 ng/ml were considered to be elevated for the purpose of these studies. Of the 473 patients with biopsy-proved non-neoplastic hepatic disorders, 22% had serum alpha-fetoprotein concentrations that exceeded 40 ng/ml. The alpha-fetoprotein level was greater in those hepatic disorders in which liver biopsy specimens showed prominent cirrhosis and inflammation. Thus, elevated levels were found in more than 30% of the patients with chronic hepatitis and viral hepatitis, but in less than 15% of patients with cholestasis or portal inflammation. In patients with alcoholic liver disease increased levels of serum alpha-

fetoprotein were found only in those patients with alcoholic hepatitis. Only those patients with postnecrotic cirrhosis in whom active hepatitis was also present had increased levels. In drug hepatitis increased levels were found in five patients with hepatocellular necrosis and inflammation. The highest values of serum alpha-fetoprotein were found in patients with viral subacute hepatic necrosis, 12% of whom had levels exceeding 500 ng/ml. In none of the other hepatic diseases, including classical viral hepatitis, did serum concentrations exceed 500 ng/ml. In 75 American patients with hepatoma the serum alpha-fetoprotein levels ranged between 40 and 500 ng/ml in nine of these patients, between 500 and 3,000 ng/ml in seven, and exceeded 3,000 ng/ml in 36. The authors state that serum alpha-fetoprotein levels were found to be elevated in several non-neoplastic hepatic disorders when a sensitive assay was used; this phenomenon may reflect hepatic regeneration.

Nuclear Medicine in the Evaluation of the Patient with Jaundice. H. Handmaker. *JAMA* 231: 1172–1176, 1975.

This article attempts to present the state of the art in the evaluation of jaundice by means of nuclear medicine. The uses of functioning radionuclides, i.e., parenchymal radiopharmaceuticals (^{131}I -rose bengal) and RES radiopharmaceuticals (radiolabeled sulfur colloid preparations), are presented with their respective contributions to the diagnosis of liver disease in patients with jaundice. Patients who have markedly abnormal clearance curves (greater than 86% retention) are considered to have liver failure, whether or not they have excretion into the gut. These patients may show either prompt excretion into the gastrointestinal tract or delayed passage, and therefore they should be observed again at 48 and 72 hr, or later if necessary. Occasionally, patients with severe hepatocellular disease may have simulated obstruction on both scan and urinary excretion studies. Patients with drug-induced toxic hepatitis may show urinary excretion and scintiscan studies identical to those in patients with partial or complete mechanical obstruction. Patients with complete obstructive biliary tract disease ("surgical" jaundice) may show any degree of abnormal clearance of ^{131}I -rose bengal but will show no evidence of excretion into the bowel at intervals of 72 hr or more. Such patients show the highest values on urinary excretion studies. Patients with good bowel excretion of ^{131}I -rose bengal and 60–86% retention of the radionuclide on a clearance study fall into the class with indeterminant etiology, which may include acute hepatitis and varying degrees of obstruction. The value of $^{99\text{m}}\text{Tc}$ -sulfur colloid liver scanning in the diagnosis of metastatic disease, cirrhosis, pyogenic and parasitic abscess, and in the evaluation of subphrenic masses is well substantiated. Recent attention has reemphasized the value of the liver scintiscans in the diagnosis of obstructive jaundice. The pattern of dilated biliary radicals can be discerned on the routine liver scan. In a recent series, 43% of patients with pyogenic hepatic abscess were first seen with jaundice. In this series, colloidal liver scintigraphy was found to be the most definitive diagnostic tool. The use of ^{67}Ga -citrate imaging techniques or combined liver-lung scanning techniques have further improved the accuracy in detecting these abnormalities. Intelligent selection of agents, well-planned studies, and recognition of characteristic patterns should lead to accurate diagnosis in most patients and should be feasible in most nuclear medicine laboratories without the use of extraordinary techniques.

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