Noninvasive Visualization of Acute Myocardial Infarction in Man with Thallium-201. F. J. Th. Wackers, J. B. v. d. Schoot, E. B. Sokole, G. Samson, G. J. C. v. Niftrik, K. I. Lie, D. Durrer, and J. J. J. Wellens. *Br Heart J* 37: 741–744, 1975.

This investigation sought to evaluate thallium-201 as an imaging agent for normal myocardium and acute myocardial infarction in humans. Studies were performed in 21 patients, of whom 10 had no clinical or electrocardiographic evidence of coronary artery disease and 11 had a diagnosis of acute myocardial infarction based on clinical history, serum enzyme levels, and electrocardiographic changes. Images were obtained by scintillation camera using a high-resolution collimator with the energy window set for 69–82 keV. The data were converted to a digital form by means of a 4096 multichannel analyzer and stored on magnetic tape. A transmission scintiscan was made with ^{99m}Tc. After ^{201}Tl injection, anterior serial scintiscans were made at 5-min intervals for approximately 25 min. A left lateral scintiscan was then obtained with the patient lying on his right side. In two patients several whole-body scans were obtained over the period of examination and in four patients ^{201}Tl excretion in urine and feces were measured. In ten patients with apparently normal myocardial perfusion the images presented a horseshoe or ovoid pattern. The right ventricular mass was not visualized. All frontal and lateral scans of patients with acute myocardial infarction showed an area of decreased radioactivity corresponding to the electrocardiographic localization of the infarction. The optimal scintiscans were obtained about 20 min after ^{201}Tl injection. Thallium-201 accumulates in all organs of the body. Increased uptake is seen in the myocardium, liver, kidneys, and in variable amounts in the digestive tract. About 12% of the administered activity is excreted in the urine and 6% in the feces. The authors concluded that thallium-201 appears to be of diagnostic value for recognizing acute myocardial infarction in the very first hours after its onset and for visualizing infarction in those patients with pre-existing electrocardiographic abnormalities.

Radioisotope Scintigraphy in Head-Injured Patients. R. Ballani, F. S. Gaini, P. Paoletti, T. Barmballa, S. Canenschi, and G. Frigeni. *Acta Neurochir* 32: 25–33, 1975.

A group of 140 patients with head injuries were studied using cisternography with radioiodinated human serum albumin. Of the 88 patients with head injuries who did not undergo surgery, 44 had had transient loss of consciousness and 44 were in prolonged coma. The remaining 52 patients underwent surgery: five had skull fractures with dural lesions, seven had extradural hematomas, 19 had subdural hematomas, and 21 had brain contusions. The authors sought to determine, first, the scope of radionuclide scintigraphy in evaluating abnormalities of CSF absorption and, second, the incidence and clinical significance for recovery of CSF abnormalities in these patients. The radionuclide cisternograms were classified as (A) normal, (B) asymmetric diffusion and absorption of tracer, (C) accumulation of tracer in the operative cavity with a clear defect in reabsorption, and (D) penetration of the ventricular system with a more or less delayed clearance. Of the 88 patients who did not have surgery, 14 had unsuccessful injections, 39 had normal scintigrams, 17 asymmetric scintigrams, and 17 showed ventricular penetration. Of the 52 patients who received surgery, four had unsuccessful injections, nine had normal scintigrams, 16 had asymmetric findings, eight had operative cavity stagnation, and five showed ventricular penetration. The authors found a satisfactory correlation between the radionuclide scintigram and the air studies. Two patients with asymmetric perfusion and ventricular enlargement received cerebral spinal fluid shunts; one did not improve clinically. The largest number of patients who had CSF shunts was in the group who presented with loss of consciousness and neurologic deficits. The authors point out that ventricular reflux may coexist with the normally sized ventricles associated with rapid clearance of the tracer. The authors observed that 50% (73) of the brain-injured patients in this study had alterations of cerebral spinal fluid circulation and that radionuclide cisternography was the preferred clinical test. They also concluded that ventricular reflux shown by cisternography was the abnormality which most clearly gave evidence of alterations in cerebral spinal fluid dynamics.

Cerebral Blood Flow in Dementia. V. C. Hackinski, L. D. Liffi, M. Phil, E. Zilhka, G. H. DuBoulay, L. McAllister, J. Marshall, R. W. Russell, and L. Symon. *Arch Neurol* 32: 532–537, 1975.

This study sought to correlate the clinical types and severity of dementia to total hemisphere and regional cerebral blood flow and to study the reactivity of the cerebral blood flow in this condition. Twenty-four patients (13 men and 11 women) who had evidence of dementia were studied. Trauma, tumor, syphilis, vitamin B_{12} deficiency, and Huntington chorea were first excluded by history and other evidence. Based on clinical features the degree of dementia was classified by an "ischemic score" as either "multiple infarct" or "primary degenerative" dementia. Regional cerebral blood flow was measured by the intracarotid ^{133}Xe method. Those patients with multi-infarct dementia showed a significant decrease in flow. In both groups areas of high flow were observed, particularly over the primary motor and sensory regions. The proportion of fast-clearing brain tissue was significantly reduced in both groups. There was no relationship between the degree of dementia and cerebral blood flow in the primary degenerative group. However, an inverse relationship existed in the multi-infarct group. Reactivity of blood vessels to the reduction of arterial carbon dioxide pressure was normal in both groups. The authors conclude that the blood flow is adequate for the brain's metabolic needs in those patients with primary degenerative dementia but inadequate in those with multi-infarct dementia.

Generalized Pulmonary Hyperinflation and Fallot's Tetralogy in a Neonate Investigated by Pulmonary Physiological and Radioisotopic Methods. S. Godfrey, R. Ronchetti, J. Stocks, and K. Hallidie-Smith. *Thorax* 30: 452–460, 1975.

The authors report an infant who presented a complex cardiopulmonary problem which was elucidated with the aid of physiologic and radioisotopic methods. The child was born at term by emergency Cesarian section because of fetal distress. Examination revealed that the infant had

aspirated meconium. Despite high ambiant oxygen he remained tachypneic and hypoxic. Shortly after birth the chest radiograph indicated septic lesions at the base of the lungs, and pulmonary function tests confirmed hyperinflation with delayed nitrogen washout. Physical signs raised the suspicion of Fallot's tetralogy, subsequently confirmed by cardiac catheterization. Although the cardiac condition was serious, the amount and persistency of hypoxia and tachypneia were disproportionately severe and the possibility of localized lung disease was entertained. During the neonatal period reasonable lung function tests were obtained; these were repeated at 6 months of age with ^{13}N administered by injection and inhalation. These radionuclide procedures revealed gross ventilation/perfusion imbalance in the lungs, most marked at the bases. However, the abnormalities were too generalized to permit surgical correction. The authors outlined the principles of measurement of lung mechanics in the newborn child by means of regional radioisotopic spirometry nitrogen washout and whole-body plethysmography. Results from the simple nitrogen washout measurement of functionable residual competency indicated poor gas mixing within the infant's lungs. The rebreathing washout study gave an overall estimate of lung function but was unable to distinguish localized from generalized disease. Full analysis of regional lung function and confirmation of the generalized nature of the gas trapping and the very poorly ventilated areas could only be obtained by means of ^{13}N and the scintillation camera.

Uptake of ^{125}I Albumin by the Endothelial Surface of the Isolated Dog Common Carotid Artery: Effect of Certain Physical Factors and Metabolic Inhibitors. A. Siflinger, K. Parker, and C. G. Caro. *Cardiovasc Res* 9: 478–489, 1975.

The total process of macromolecule transport between the arterial lumen and wall has been determined to be primarily mass diffusion in the blood phase, rather than bulk (hemodynamic) flow. The rate-controlling step appears to be located at the blood–wall interface and to be intimately associated with the endothelial cells. This investigation sought to characterize this process in greater detail. The common carotid arteries were dissected from 47 dogs. Blood serum was obtained from the dogs before dissection. After excision, the arteries were generally flushed with saline to remove blood and then stored in the animal's own serum at room temperature. The delay between excision and incubation was 30–90 min. The radionuclide-labeled incubation fluid was prepared from either the animal's own serum or a solution of sodium chloride containing a tracer amount of ^{125}I-serum albumin. Three preparations of ^{125}I-albumin were used. Each artery was divided into 3–4 segments about 3 cm long and each segment was mounted in an individual rig. The labeled incubating fluid was flushed through the segments at a rate of about 1 ml/sec, corresponding to a wall shear rate of about 1000/sec. Transmural hydrostatic pressure was 0. Isotonic saline was used as the external incubating fluid. At the end of a run the labeled internal fluid was drained into a vial for counting and the internal and external surfaces of the segment flushed with saline. The sections were removed, cut into 2–4 sections, and placed into separate vials for counting. Damage to the segment was evaluated by means of Evans' Blue dye. There was approximately a linear increase in wall concentration of ^{125}I-albumin in segments incubated for periods up to 90 min. The rate of change of wall concentration is determined by the wall permeability, which varies considerably with incubation temperature, being greater at 25–37°C than at 1–18°C. Labeled uptake in the wall was not significantly altered by the presence of potassium cyanide or iodoacetate in the incubating medium or by the absence of substrate from the incubating medium, indicating that the process was primarily passive rather than active. The presence of hyaluronidase had no effect on uptake in the wall. Wall permeability was increased twofold with 5% ethyl alcohol and threefold with 20% ethyl alcohol. Osmotic pressure influences appeared to be negative in the absence of a change in the external incubating fluid. In order to damage the endothelium, pipe cleaners were passed through arterial segments which were mounted in the rigs. During an incubation period of 5 min the increased uptake was approximately fourfold, and in 10–15 min studies about twofold. The authors conclude that the label entered the wall mainly by routes other than the endothelial intercell clefts.

Carotid Endarterectomy. A Review of 104 Operations. B. Lindberg, B. Norback, P. Svendsen, and V. Synek. *J Cardiovasc Surg* 16: 161–170, 1975.

To determine the treatment of choice in patients with occlusive disease of the internal carotid artery (i.e., surgery or conservative treatments), the authors reviewed the results of carotid endarterectomy. Over the previous 10 years, there were 104 surgical procedures on 90 patients with atherosclerosis of the internal carotid artery. Sixty-five percent of the patients were men, and the ages varied between 41 and 79 years with a mean of 63 years. Thirteen patients had endarterectomies on both sides, 37 on the right side only, and 40 on the left side only. The patients were divided into four groups depending on their preoperative symptoms: Group 1) five patients with no neurologic symptoms; Group 2) 48 patients with transitory ischemic attacks; Group 3) 34 patients with neurologic deficits; and Group 4) three patients with cerebrolesional symptoms. Of those patients with transitory ischemic attacks, 81% had one or more symptoms related to carotid artery stenosis: contralateral motor, contralateral sensory, aphasia, eye signs, and dizziness. In those patients with neurologic deficits, four had hemiplegia, 27 hemiparesis, one facial palsy, and two dysphasia. In 90% of the patients in whom the artery was opened, a bruit was heard over the common carotid artery bifurcation. Eight patients died within 1 month after the surgery, six from causes related to surgery. Six patients suffered permanent exacerbations of the symptoms and in five of these the arterial reconstruction was closed. The immediate postoperative course was uneventful in 79 of the 104 operations. The patency of the reconstruction was objectively verified after 53 operations on 46 patients. Of the five Group 1 patients, one died from a myocardial infarction and the other four were free from symptoms 6 months to 4½ years after surgery. Of the 48 patients with transitory ischemic attacks, three died from causes related to the surgery and one from myocardial infarction. Five patients developed permanent neurologic symptoms after surgery. The remaining 39 patients were free from symptoms after surgery. Of the 34 patients with neurologic symptoms (Group 3), 12 were alive at followup and all but one were either asymptomatic or improved. Seven of the Group 3 patients died following surgery at different intervals from cerebro-related causes. Of the three patients with cerebrolesional symptoms, two have died (one from cardiac problems and the other from a stroke) and a third patient, although alive, has not improved. (*This abstract was included in view of the increasing emphasis on cerebral dynamic perfusion studies.—Editor.*)

Bone Scintiscanning in the Initial Assessment of Carcinoma of the Breast. B. C. Lentle, P. E. Burns, H. Dierich, and F. I. Jackson. *Surg Gynecol Obstet* 141: 43–47, 1975.

This investigation involved unselected patients (examined during a period of 1 year) who had not been previously treated and who presented with newly diagnosed carcinoma of the breast. The patients were examined, staged, and investigated by radiographic skeletal survey and bone scintiscan. The patients' ages ranged from 28 to 87 years (average 59.6 years). The bone scintiscans were obtained with the 5-in. dual-probe rectilinear scanner operated in the 5:1 minification mode, with an information density of 400 counts per square centimeter. When necessary, supplementary scans were obtained. The patients received 12–14 mCi of ^{99m}Tc-polyphosphate. The scintiscans were obtained 4 hr after administration of the tracer. Of the 174 patients 67 were scanned before biopsy or operation, and the remainder with a mean delay of 23 days after operation. The patients were examined clinically and radiologically to determine the accuracy of the scintiscan findings. Nine patients had both scintigraphic and radiographic evidence of metastatic bone disease. An additional eight patients had scintiscans suggestive of skeletal metastases while the radiograms were considered normal. Followup data in five survivors of this group yielded clear radiographic evidence of bone destruction at precisely the site indicated by the abnormal bone scan. Thus, the scintiscan was recognized as being definitely abnormal in 17 patients, nearly twice that observed with radiographic examination. In one of two patients where the scintiscan was interpreted as equivocal, followup studies eventually gave evidence of metastatic bone disease. No false-positive findings were encountered in this series. Four of the patients showed increased uptake of the radiotracer in the tumor itself. In ten patients with normal bone scans at the time of the initial diagnosis, eight have shown metastasis on followup scans 1 year later. The authors explored the possibility of the direct quantitative assessment of the sensitivity of bone scintiscanning by means of followup studies for 12–24 months. Their data suggested that possibly 18 of 26 patients did show positive scan findings at the beginning of the study.

The Kinetics of Copper Uptake by the Liver in Wilson's Disease Studied by a Whole-Body Counter and a Double Labelling Technique. K. Günther, V. Lossner, J. Lossner, and D. Biesold. *Eur Neurol* 13: 385–394, 1975.

Since it had been suggested that external counting techniques could not differentiate between the ^{64}Cu content of the vascular pool circulation through the liver and that within the hepatic parenchymal cell, the authors investigated the copper uptake in the liver with simultaneous correction for the copper content of the blood by means of ^{51}Cr-labeled erythrocytes. The procedure was performed in normal subjects, homozygotes, and heterozygotes of Wilson's disease. Each subject received 40–80 mCi of ^{64}Cu and 30 mCi of ^{51}Cr. The body was scanned by means of a NaI(Tl) detector (10 in. diameter by 4 in. thick) with a lead-slick collimator at a speed of 1 cm/sec. Approximately 3 min were needed for a whole-body scan. In the normal individual and the heterozygous patients, the uptakes of copper within the liver were similar and rapid. In patients with Wilson's disease (homozygous), there was only a slight increase of uptake within the liver. During the first hour after ^{64}Cu injection the heterozygotes stored 70–90% of the blood copper content of the liver region at the time of injection, whereas the normal persons concentrated about 50% and the patients suffering from Wilson's disease (homozygotes) only 15–30%.

Intestinal Blood Flow: An Evaluation by Clearance of Xenon Xe-133 From Canine Jejunum. S. E. Wilson, J. Hiatt, M. Winston, and E. Passaro, Jr. *Arch Surg* 110: 797–801, 1975.

The authors wished (A) to elucidate the washout characteristics of xenon from the small bowel, (B) to measure tissue perfusion by determining the half-time of Xe clearance, and (C) to correlate the rate of Xe clearance with controlled reduction of arterial inflow. Five male dogs were fasted for 24 hr before anesthesia. By means of a midline abdominal incision the superior mesenteric artery was fitted with a 4-mm flow probe connected to a blood flowmeter, and a Blalock clamp was placed around the aorta above the superior mesenteric artery in order to occlude arterial inflow as desired. Collateral circulation at the distal duodenum and the ileocecal junction was interrupted by division of the mesentery and marginal arcade. The segment of midjejunum was selected for Xe injection. A 0.95-ml dose of ^{133}Xe (10 mCi/ml) dissolved in 0.09% NaCl was injected into the submucosa in five dogs and the muscularis in two dogs. A scintillation probe connected to a scaler spectrometer was positioned 5 cm above the injection site and counts were recorded at 30-sec intervals for 5 min, after which the washout curves were relatively flat. The administration of xenon was repeated several times with varying degrees of aortic occlusion. Xenon clearances from the submucosa and the muscularis were similar and reproducible. The biexponential function of Xe clearance exhibited a rapid initial component which represented a mean flow. Calculated Xe clearance rates, expressed as half-times for disappearance, were characteristically rapid for a broad range of superior mesenteric artery flows (90–600 ml/min). With reduction of superior mesenteric artery flow below 80 ± 10 ml/min, tissue clearance of xenon was markedly prolonged. Accurate perfusion of the vascular compartments of the small bowel, as measured by xenon clearance, was maintained until the reduction of superior mesenteric flow was 80%.

Adaptive Changes in Vitamin B_{12} Absorption in Celiac Disease and after Proximal Small-Bowel Resection in Man. A. M. Mackinnon, M. D. Short, E. Elias, and R. H. Dowling. *Am J Dig Dis* 20: 835–840, 1975.

Resection of the proximal small bowel is known to cause mucosal hyperplasia and enhanced absorption in the ileum of experimental animals, but similar adaptive changes had not previously been studied in man. Since intrinsic-factor-bound vitamin B_{12} (IF-B_{12}) absorption is confined to the ileum, whole-body ^{58}Co-IF-B_{12} absorption was measured as an index of ileal adaptation in 24 control subjects, in four patients after proximal small-bowel resection, and in nine patients with adult celiac disease (where mucosal damage is often limited to the proximal intestine and spares the ileum). Control subjects absorbed 20.4% (±6.2%) of the administered 5-μg dose of vitamin B_{12}, while the corresponding 7-day retention values in patients with proximal resection (mean 42.3%, range 32–61%) and in two of the nine celiac patients (44.1% and 54%, respectively) were above the normal range. The increased B_{12} absorption in these patients suggests that functional adaptation also occurs in the ileum in man. This study illustrates the application of a newly developed whole-body counting technique to study vitamin B_{12} in man.

Comparative Metabolism of Radionuclides in Mammals. IX. Retention of ^{75}Se in the Mouse, Rat, Monkey and Dog. J. E. Furchner, J. E. London, and J. S. Wilson. *Health Phys* 29: 641–648, 1975.

This paper is one of a series comparing radionuclide metabolism in a few mammalian species. Selenium-75, in the form of H_2SeO_3, was studied in the four species given in the title. Whole-body retention measurements were made using 4π liquid scintillation counters after oral and intravenous injection in all species and after intraperitoneal injection in mice and rats. Individual organs were assayed for ^{75}Se content in the mice. Except for the monkeys, selenium retention was relatively unaffected by the route of administration. More than 90% was absorbed from the gut in all species but monkeys, in which much less was absorbed. Retention was described by the sum of three exponential functions in all species. In general, effective half-times increased with body size. The kidney was the most important emunctory for ^{75}Se after the first 3 days. The authors conclude that the MPC of ^{75}Se in water is lower by factors of 3–10 than those proposed by the International Commission on Radiological Protection in 1959.

Carcinomaembryonic Antigen in an Unselected Elderly Population: A Four Year Follow Up. D. P. Stephens, I. R. Mackay, and K. J. Cullen. *Br J Cancer* 32: 147–151, 1975.

The authors feel that there are two major areas of uncertainty in the application of testing for carcinomaembryonic antigen (CEA): first, is it useful for the routine diagnosis of cancer in the clinic and, second, will population screening be rewarding? The authors report the results of studies to determine, first, the incidence of CEA in serum of the elderly segment of population in an Australian town and, second, the relevance of a positive test for CEA to the occurrence of cancer in the subsequent 4 years. Serum from 956 unselected elderly persons was tested for carcinomaembryonic antigen by a "double antibody" microradioimmunoassay. Forty-four (4.5%) were positive for CEA (5 ng/ml or greater). During the following 4 years six of the 44 persons that had a positive CEA test died of CEA-associated cancers. In this group of 44 patients, 15 were heavy smokers, two had colonic diverticula, and one a peptic ulcer. However, 18 of the 912 persons with a negative CEA test developed CEA-associated cancers. In 21 persons who had a positive CEA test in 1969 but were clinically well 4 years later, examination revealed that two patients had occult cancer of the lung and colon, respectively. The relatively low yield of diagnosis of cancer from this population survey led the authors to the conclusion that, if screening for cancer were to be solely dependent on testing for CEA, sensitivity and specificity would have to be greatly increased.

Evaluation of Visceral Larva Migrans by Radioimmunoassay Systems. R. Patterson, M. Roberts, R. J. Hart, and C. C. Hundley. *Pediatrics* 56: 417–420, 1975.

The authors report the case of a 9-year-old child with miliary pulmonary infiltrates, eosinophilia, and hyperimmunoglobulinemia E who recovered rapidly over a 4-week period. Subsequent analysis of serum samples by solid-phase radioimmunoassay techniques showed that IgM, IgE, and IgG antibodies to Ascaris suum antigen declined after the acute phase of the illness and that this decline was paralleled by that of the serum IgM, IgE, and IgG concentrations. Antibodies against the Ascaris antigen could be demonstrated. The diagnosis was considered to be toxiocariasis or ascariasis. The authors found that the application of this radioimmunoassay technique provided earlier diagnoses and a measure of rapidly changing antibody levels needed to confirm the diagnosis of parasitic disease.

A Non-linear Programming Method for Optimizing Parallel-Hole Collimator Design. G. H. Simmons, J. M. Christenson, J. G. Kereiakes, and G. K. Bahr. *Phys Med Biol* 20: 771–788, 1975.

A new method for optimizing the design of multiaperture parallel-hole collimators for the scintillation camera is presented. The method takes into account the frequency spectrum of a plane source object distribution as well as the radiation energy. A frequency-dependent statistical figure of merit is calculated and combined with a weighted object distribution frequency spectrum to obtain an objective function which, when maximized, yields the optimum collimator design according to the chosen criteria. The optimization is performed by means of a sequential pattern search technique. The results show a positive correlation between the objective function and an experimental performance index evaluated for existing collimators. The optimal designs obtained by maximizing the objective function, under the assumption of no scatter within the source, exhibit somewhat higher sensitivity and lower resolution than the commercial low-energy collimators tested. The authors conclude that much of the resolution capability of very-high-resolution collimators is unused because of the limitation imposed by the intrinsic resolution of the detector assembly, and that for rapid-frame dynamic studies, the optimum collimator is one in which the frequency response most closely matches that of the detector component.

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