ABSTRACTS OF CURRENT LITERATURE

Minimisation of Data Transfer Losses in the Display of Digitied Scintigraphic Images. J. Cormack, B. Hutton; Royal Prince Alfred Hospital, Camperdown, NSW, Australia. *Phys Med Biol* 25: 271–282, 1980

The transfer of data from the acquisition device, such as a gamma camera, to any type of display results in the loss of significant amounts of information. Much of the loss is due to assigning available gray levels to equal portions of the range of values to be displayed. This paper discusses the use of information theory to maximize information transfer. To calculate pixel uncertainty (or entropy), a computer program was developed based upon two components of uncertainty, data compression and noise involved in transmitting the data. From this, a value for mean pixel uncertainty for a given image can be calculated, thereby measuring how well the perceived image matches the transmitted image and allowing quantification of the effect of various display parameters. Several types of simulated and clinical phantom images have been investigated. The initial results appear promising and present the possibility of integrating a routine display optimizer into a software package using the mean pixel uncertainty as an indicator of display efficiency.

The Need to Estimate Risks. E. E. Pochin; National Radiological Protection Board, Oxfordshire England. *Phys Med Biol* 25: 1–12, 1980

This paper argues for the need to establish a numerical estimate for the variety of risks involved in alternate sources of action. Although public health consideration of harm is not the only factor involved, nevertheless, it provides a basis for decision beyond arbitrary or emotional parameters.

One area appropriate to risk estimates, where the risks are similar, is whether radiological screening of healthy people for disease, such as breast or stomach cancer, causes more deaths than it prevents. Since better risk estimates are now known, it is possible to decide the age at which screening should start based on the increased natural incidence of cancer with age contrasted to the reduced risk of cancer induction with age.

It is also important to determine the risks involved in power production from different primary fuel sources; however, in this example the risks are dissimiliar, involving chemical carcinogens, accidental injury, or death as well as radiological risks. There is clear evidence of substantial differences in the biological cost of different fuel sources, by as much as a factor of 50, though the number of deaths is very small compared with the deaths from natural causes in the involved population.

The Question of Radiation Causation of Cancer in Hanford Workers. J. W. Gofman; University of California at Berkeley. *Health Physics* 37: 617–639, 1979

An independent examination of the raw data for accumulated radiation exposures, employment history, and causes of death in the deceased Hanford workers which was performed by the author, differed in the method of analysis from that used by Mancuso, Stewart, and Kneale (*Health Physics* 35: 369–384, 1977). The issue considered was whether ionizing radiation at the dose rates and for the total doses experienced by the workers is responsible for cancer induction in those workers. This study was restricted to male workers and contrasted those receiving 10 or more rads of penetrating radiation to those receiving less. The calculated doubling dose for cancers overall was found to be 43 rads at a mean exposure age of 45 years, which is consistent with the value of 33.7 rads reported by Mancuso et al. However, the confidence limits are very broad. The authors ruled out chemical or environmental influences as possible causes of cancer induction and did not concur with Mancuso that certain tissues are unusually radiosensitive for cancer induction. They concluded that to determine the effect of low dose rates for low total doses will require a large increment in cases.

Differentiating Hepatic Abscess from Tumor: Combined In-111 White Blood Cell and Tc-99m Liver Scans. H. D. Fawcett, R. L. Lantieri, A. Frankel, I. R. Mcdougal; Stanford Univ. Med. Ctr, Stanford, CA. *Am J Roentgenol* 135: 53–57, 1980

Three patients presenting with mass lesions in the liver were studied by scintigraphic scanning following the intravenous administration of Tc-99m sulfur colloid and In-111-labeled white blood cells. In one patient the Tc-99m sulfur colloid scan demonstrated that the lesion had decreased tracer uptake, whereas the In-111-labeled white blood cells showed an increase in tracer activity in the same area. A diagnosis of abscess was made and confirmed by biopsy. Two patients were similarly studied, and in each an area of decreased tracer activity was identified in the region of the mass by both techniques. A diagnosis of liver cancer was made and confirmed by biopsy. In two of the cases, one of proven abscess and the other of proven neoplasm, the clinical impression strongly favored the other entity. Tc-99m sulfur colloid imaging and In-111 white blood cell imaging of hepatic masses may enable the differentiation of hepatic abscess from neoplasm. Citing previous work, the authors stress that because the normal liver takes up In-111-labeled white cells, small abscesses or neoplasms ("probably less than 2 cm") will not demonstrate the scintigraphic abnormalities seen with larger lesions.

Development of a Dual Label Schilling Test for Pancreatic Exocrine Function Based on the Differential Absorption of Cobalamin Bound to Intrinsic Factor and R. Protein. W. R. Brugge, J. S. Goff, N. C. Allen, E. R. Podell, R. H. Allen; Univ. of Colorado, Denver, CO. *Gastroenterology* 78: 937–949, 1980

Cobalamin (vitamin B_{12}) binds preferentially to R protein in acid gastric juice and is not transferred to intrinsic factor until the R protein moiety is partially degraded by pancreatic proteases. Aware of this phenomenon, the authors administered to adult humans orally the following mixture: (a) human intrinsic factor-^{57}Co-cobalamin, (b) hog R protein-^{58}Co-cobalamin, (c) free human intrinsic factor, and (d) cobinamide (a cobalamin analogue binding only to R protein that prevents endogenous R protein from dissociating complex (a), just mentioned). Urine was collected for the following 24 hr, and its radioactivity was assayed in a dual-channel gamma counter and expressed as a ratio of R protein-cobalamin/intrinsic factor-cobalamin. In 26 normal subjects, a

mean ratio of 0.76 occurred (observed range 0.52–1.00). In 11 patients with nonpancreatic gastrointestinal diseases, a mean ratio of 0.65 with range of 0.45–0.86 was seen. All 15 patients with pancreatic disease and symptoms of pancreatic exocrine insufficiency (PEI) malabsorbed R protein-cobalamin and yielded a mean ratio of 0.07 with a range of 0.02–0.15 (which did not overlap with that of normals or patients with other GI diseases). Eighteen patients with pancreatic diseases, but without symptoms of PEI, had a mean ratio of 0.61 (range 0.26–0.89). These authors feel that the nature of their new test (a) obviates need for quantitative urine collection, and (b) is useful in patients with either decreased renal function or combined pancreatic and intestinal diseases.

Solid Food Label for Measurement of Gastric Emptying. M. L. Fitzpatrick, A. M. Alderson; Hammersmith Hospital, London, U. K. *Br J Radiol* 52: 920, 1979

The authors have examined several methods for preparation of a solid radioactive meal for gastric emptying studies. It has previously been shown that surface radioactivity attached to solid foods is dissociated in the stomach. A method for labeling chicken liver in vivo with Tc-99m sulfur colloid was developed to escape the dissociation problem, but now a different material has successfully been used. Tc-99m-tin colloid was mixed with instant oatmeal in a standard oatmeal preparation, tested in vitro, and it was ascertained that between 82 and 97% of the label remains with the solid phase. In vivo studies showed very low levels of activity in the blood, evidence that the Tc-99m was not dissociating from the solid material and the tin colloid. Thus, for gastric empyting studies labeled oatmeal seems to be a simpler carrier of the radiopharmaceutical than chopped chicken livers.

Vascular Resistance Changes Distal to Progressive Arterial Stenosis: A Critical Re-evaluation of the Concept of Vasodilator Reserve. D. C. Levin, C. F. Beckmann, J. R. Serur; Harvard Medical School and Peter Bent Brigham Hospital, Boston, MA. *Invest Radiol* 15: 120–128, 1980

The authors have studied the relationship between arterial stenosis and blood flow. Five dogs were prepared by ligation of the collateral blood supply to their right hind legs. The external iliac or common femoral artery in each was instrumented with a flow probe, a snare-type occluder, a catheter for contrast injection, and blood pressure probes in the distal artery and the femoral vein. Peripheral resistance was obtained by dividing the pressure difference between the distal artery and the femoral vein by the flow. A series of experiments, before and after contrast injection for calibration of the stenosis and for a hyperemic stimulus, were performed over several hours. In one animal, after the usual procedures, an arteriovenous shunt was placed to divert the entire flow in the leg. The shunt was then itself ligated to mimic the peripheral resistance, and the series of experiments performed again.

The results of the experiments are as we have learned previously: the drop in flow with increasing stenosis occurs at approximately 90% stenosis in the resting state, but at 60% stenosis in the hyperemic state. However, the peripheral resistance values provide a surprise—the peripheral resistance does not rise until 90% stenosis is produced even in the hyperemic state. Further, there is an effect on the flow data of the leg shunt with adjusted resistance, just as one would expect if the peripheral resistance in the nonshunted animal does not change. Thus blood flow through the peripheral vascular bed does not depend upon compensatory dilatation of the peripheral arteriolar-capillary bed. The decrease in blood flow in the hyperemic state at approximately 60% stenosis is explained by recourse to basic hydrodynamic principles, which state that the less the distal pressure differential, the greater the effect of the stenosis on the flow differential.

External Evaluation of Regional Cardiac Lymph Drainage in Intact Dogs. G. L. Clark, B. A. Siegel, B. E. Sobel; Mallinckrodt Institute of Radiology. *Invest Radiol* 15: 134–139, 1980

The cardiac enzymes, such as creatine kinase, are used to assess the damage of myocardial infarction. The enzymes drain from the damaged heart muscle through cardiac lymphatics. The authors used Tc-99m sulfur colloid in a series of attempts to visualize the cardiac lymph nodes and other involved nodes and to see what effect disruption of the lymph drainage would have on visualization. Seventeen dogs were studied by one of a number of techniques. The techniques that successfully visualized the cardiac node were either a thorocotomy, followed by stripping the pericardium and injecting 0.2 ml of Tc-99m sulfur colloid intramurally into the left ventricular apex or by percutaneous puncture and intramural injection of the tracer through a special needle designed to ensure intramural injection. The cardiac lymph drainage was occluded in three dogs for 5 or 6 days before open chest injection. The cardiac node and other nodes were excised and counted to be sure that the nodes were correctly identified.

Activity in the cardiac nodes became visible within 1 min, peaked between 1 and 3 hr, and plateaued. In dogs with occluded lymph drainage, the nodes did not peak but continued to gain activity over the 200-min study. In one of these dogs the cardiac node was not visualized. Serial analyses for creatine kinase reflected no change when the percutaneous injection was used. The authors suggest the use of this technique particularly when enzymes are being measured in experimental situations.

Radionuclide Scans not Indicated for Clinical Stage-I Melanoma. R. A. Evans, K. I. Bland, M. J. McMurtrey, A. J. Ballantyne; Univ. of Texas, Houston TX. *Surg Gynecol Obstet* 150: 532–524, 1980

These authors report a retrospective study in 503 patients with all stages of cutaneous melanoma presenting at their institution over a 1-yr period. Of 230 asymptomatic patients found to have clinical Stage I disease, levels of invasion one through five (Clark classification) included 4, 29, 95, 97, and 5 patients, respectively. Of 162 liver scans (performed with 2–3 mCi Tc-99m sulfur colloid) on those 230 patients, 160 were true-negative, i.e., no metastasis occurring up to 3 mo later. The remaining two patients had false-positive liver scans, i.e., no confirmation of disease established within 1 yr. Of 160 brain scans performed with 20 mCi [^{99m}Tc] pertechnetate on the 230 patients, 158 were true-negative and two were false-positive. Of other patients classified into clinical Stage III or IV melanoma upon presenting, many had true-positive liver and brain scans. To a cost of $24,000 for the liver and brain scans in the Stage I patients must be added the expense of follow-up procedures to verify a false-positive scan. Accordingly, these authors have discontinued liver and brain scan in evaluating asymptomatic patients with Stage I melanoma.

A Preliminary Investigation of ^{67}Ga Citrate Distribution in Hyperferraemic Patients. F. W. Smith, P. P. Dendy, T. Pocklington, A. A. Dawson, M. A. Foster, J. R. Mallard; Aberdeen, Scotland. *Eur J Nucl Med* 5: 327–332, 1980

The effect of hyperferremia on Ga-67 citrate distribution was studied. Thirty patients received 100 mg iron-sorbitol citric acid complex (Jectofer) 2 hr before i.v. injection of 2 mCi Ga-67 citrate. Six controls were given only Ga-67. After injection of Ga-67 citrate, blood samples were drawn at 5 min and at 1, 24, and 48, or 72 hr, and total serum iron concentration was determined. Iron-binding capacity was measured with an electron spin resonance technique and Ga-67 activity of blood samples was determined in a well counter. Blood activity of samples was expressed as cts/ml/sec/(mCi injected). After injection of the radiotracer, patients

were scanned at 6, 24, 48, and 72 hr. Scintigrams were viewed on a color display unit. The authors found a considerable increase in plasma iron concentration and in iron saturation 2 hr after Jectofer injection. Iron levels remained high 1 hr after the Ga-67 application and normalized at 24 hr. After Ga-67 injection the initial circulating blood activity was much lower than in controls. Ga-67 activity of the blood then increased reaching a maximum at 24 hr, after which activity fell. At 72 hr the Jectofer group and the controls showed similar Ga-67 activity values. Scintigraphy at 6, 24, and 48 hr demonstrated the high blood background activity of controls, so that meaningful interpretation of scans was impossible. Scintigraphic abnormalities could be identified at 24 hr in patients who had received Jectofer, and most scans had increased Ga-67 skeletal uptake. 72 hr scans did not contribute more information than the 24 and 48 hr scintigrams. The authors conclude that Jectofer application clearly modifies Ga-67 incorporation and retention.

^{99m}Tc-Colloid Kits from the View Point of the Accretion in the Bone Marrow—with Spectral Reference to Comparison with ^{198}Au-Colloid. Y. Ito, A. Muranaka, K. Nagai, N. Otsuka, S. Nishishita, M. Uchida, T. Kaji; Kurashiki, Japan. *Eur J Nucl Med* 5: 319–326, 1980

The authors compared results obtained in RES scintigraphy with nine commercial technetium-labeled colloids. Au-198 colloid was used as a standard, and the products tested are listed. Labeling efficiency was determined by paper chromatography and was found to vary from 85 to 99.5%; however, in most colloids it was above 90%. Free technetium ranged from 0.1 to 6.5% depending on the product. The authors evaluated blood clearance, tissue distribution, urinary excretion, and RES scintigraphy. Each radiopharmaceutical was evaluated on ten albino rabbits. To determine blood clearance, blood was drawn at 5-min intervals by heart puncture. Tissue distribution was measured 30 min after injection of the radiopharmaceutical by calculating the radioactivity as percent dose in the whole organ. Gamma camera scintigraphy followed 30 min after i.v. injection of each radiotracer. A low-energy, parallel-hole collimator was used. Sixty patients were also examined 30 min after i.v. injection of 15 mCi Tc-99m colloid. The authors found blood clearance in rabbits to vary from 1.6 to 4.4 min, according to the colloid used. Marked differences in residual blood activity varying from 1.4 to 14.4% depending on the product, were noted 30 min after injection. The tissue distribution of all nine technetium-labeled colloids differed from that of Au-198 colloid. In general, hepatic and bone marrow uptake of Tc-99m colloid was lower than that of Au-198 colloid. The Au-198 colloid uptake of lungs, spleen, and kidneys was lower than that of Tc-99-labeled colloids. Blood and urinary radioactivity were distinctly elevated in all Tc-99m colloids when compared with Au-198 colloid. Furthermore, the urinary excretion differed greatly among the Tc colloids, ranging from 0.1 to 4.7%. Only four of nine products used resulted in scintigrams without bladder visualization. The bone marrow scintigrams reflected results found in the tissue distribution studies. The authors conclude that a Tc-99m-labeled colloid should be developed specifically for bone marrow scintigraphy.

Intrarenal Blood Flow Distribution in the Genetically Hypertensive Rat. T. J. Butt, D. R. Jones, P. Bolli, A. T. Wallis, F. O. Simpson; Dunedin, New Zealand. *Nephron* 26: 49–52, 1980

The xenon-washout technique was used to evaluate the renal vascular bed in the genetically hypertensive (GH) rat. Eight normotensive (N) rats were age matched with 16 GH rats. Mean BP in N rats was 129 ± 2.9 mm Hg. The GH rats had a mean BP of 171 ± 3.8 mm Hg. A polyethylene catheter inserted into the aorta via the left femoral artery was positioned at the origin of the left renal artery. (Arteriography verified catheter position.) A gamma camera with focused collimator was placed 4 cm above the left kidney, and 0.4–0.8 mCi Xe-133 in 80 μl or less saline were injected into the aorta in 0.5 sec with an air-operated injection system. Intra-arterial blood pressure was monitored. Three washout curves, each recorded for 12 min, were obtained from each animal. Data were gathered on a chart recorder and were also punched in digital form on paper tape for computer processing. The washout curves were subjected to compartmental analysis from which blood flow and distribution were calculated. The authors found the flow curves to yield three exponential components, and therefore three intrarenal flow compartments were assumed to exist. Mean blood flow per gram of renal tissue was found to be 2.61 ± 0.13 ml in N rats, and 1.94 ± 0.12 ml in GH rats. Furthermore, the two rat species showed a different intrarenal blood flow to each of the three flow compartments. In GH rats the first or fast compartment was reduced, the second compartment was relatively increased, and the third was similar to those of N rats. The mean kidney weight was the same in both rat strains. The reproducibility of the technique was assessed. The authors conclude that the mean renal blood flow is reduced in GH rats, but whether alteration of renal blood flow was causative for hypertension or resulted from it was not determined.

Visualization of Canine and Human Prostatic Lymph Nodes Following Intraprostatic Injection of Technetium-99m-Antimony Sulfide Colloid. W. D. Kaplan, W. F. Whitmore, III, R. F. Gittes; Harvard Medical School and Peter Bent Brigham Hospital, Boston, MA. *Invest Radiol* 15: 34–38, 1980

Lymph node visualization may be performed to determine the drainage pattern of an organ. The authors injected 1–2 mCi of Tc-99m-Sb_2S_3 in 0.1–0.2 ml solution directly into the prostate glands of nine dogs and one patient. Eight of the dogs were injected through an abdominal incision and one transrectally. From one to four nodes were visualized in each animal. The earliest visualization was recorded at 1 hr; no additional nodes were seen after 5 hr. No tracer was seen intraperitoneally, but radioactivity did appear in the urine and bladder due to leakage through prostatic ducts. In the patient, seven nodes were visualized. These were surgically removed and found to be disease-free. The prostate showed Stage B1 cancer. The literature suggests that absence and diminished uptake in nodes may indicate cancer, and the authors suggest that their technique warrants clinical trials in prostate cancer patients.

First Experiences with Commercial RIA Kits for Prostatic Acid Phosphatase (PAP). I. Böttger, R. Sintermann, H. Langhammer, H. W. Pabst; Technische Universität München, Federal Republic of Germany. *NucCompact—Compact News in Nuclear Medicine* (Darmstadt) 11: 110–115, 1980

Prostatic acid phosphatase (PAP) in serum was measured clinically by five double-antibody radioimmunoassay products and by a spectrophotometric method using enzymatic activity. In 18 normal male controls, PAP levels by all five products were either below test sensitivity or within each manufacturer's stated normal range. Normal ranges extended from 0–2 μg PAP/l to 1.2–5.6 μg/l. In 11 female controls from the thyroid outpatient clinic, PAP levels again were either below test sensitivity or within normal limits for males, which may be due to presence of a prostatic-like acid phosphatase or to similar measurable entities in female sera, as reported elsewhere. On a total of 41 sera from either healthy male controls or patients treated for prostatic carcinoma, PAP was

measured by both RIA Number one (normal range 1.2–5.6 μg/l) and enzymatic assay and yielded good correlation between techniques ($r = +0.92$, $p < 0.001$). In that comparison, however, nine patient sera were found to have elevated PAP levels by RIA but normal levels by enzyme assay, which may indicate greater specificity/sensitivity of RIA. In a separate study using RIA Number one, all 27 healthy male controls had PAP values within normal range. Of 31 patients treated for prostatic carcinoma who showed no metatases on bone scan, only five patients had elevated PAP. However, of 24 patients being treated and showing metastases to bone, PAP was elevated in 11. These authors have included RIA Number one in their routine diagnostic and therapeutic follow-up procedures for prostatic carcinoma.

Radioimmunoassay for 3,5-Diiodothyronine and Evidence for Dependence on Conversion from 3,5,3′-Triiodothyronine. L. Pangaro, K. D. Burman, L. Wartofsky; Walter Reed Army Medical Center. *J Clin Endocrinol Metab* 50: 1075–1081, 1980

A radioimmuniossay for 3,5 diiodothyronine (3,5 T_2) performed on unextracted serum is described and is shown to be sensitive and specific. The method utilizes a previously described technique for inner ring I-125 labeling. 3,5 T_2 appears to be derived from T_3, and this conversion does not appear to be inhibited by fasting. Seventy healthy subjects were investigated and found to have a serum 3,5 T_2 level of 4.3 ± 0.2ng/dl. In 10 hypothyroid patients the serum level was 1.4 ± 0.3 ng/dl, while in 14 hyperthyroid patients the serum 3,5 T_2 was 18.4 ± 2.3 ng/dl. Mean values obtained for both the hypothyroid and hyperthyroid patients were significantly different from the normal mean ($p < 0.001$). Fasting studies were performed in 15 obese subjects and the mean serum 3,5 T_2 level fell from 3.4 ± 0.3 (prefasting) to 2.5 ± 0.7 ng/dl (after fasting). This paralleled the fall in mean serum T_3 levels from 182 ± 20 to 126 ± 12 ng/dl; both decrements were significant ($p < 0.001$) by paired T test. Parallel changes were also observed in obese subjects and in patients receiving oral T_3. Sensitivity of the assay is 0.5 ng/dl and cross-reactivity with T_3 was found to have only a minimal contribution to the serum 3,5 T_2 levels found in normal subjects and in patients.

Detection and Quantitation of the Beta-Subunit of Human Chorionic Gonadotropin in Serum by Radioimmunoassay. W. L. Boyko, B. Barrett; St. Elizabeth Medical Center, Covington, KY. *Fertility and Sterility* 33: 141–150, 1980

The authors compared commercially available radioimmunoassay (RIA) kits specific for the beta-subunit of human chorionic gonadotropin (hCG) qualitatively as well as quantitatively in 213 individuals. Qualitative assays from both Wampole Laboratories and Monitor Science Corporation were found to be equivalent in clinical specificity (99.2%) in 122 normal controls. However, the clinical sensitivities were 95.6 and 89%, respectively, for the Wampole Beta-Tec and Monitor Science Beta-hCG assays. In quantitative assays, the Wampole Beta-Tec RIA gave serum values 1- to 10-fold higher than those obtained using the Monitor Science Beta-hCG system. Preliminary studies comparing two additional quantitative RIA kits (Serons hCG-β and Bio-RIA hCG-β rapid RIA) showed variable results. The authors concluded that such aberrant results can be expected when the same serum sample is assayed with different RIA reagents for β-hCG due to the lack of an acceptable reference preparation for hCG. They advised that the same commercial RIA agents should be utilized for monitoring patients with threatened abortion of trophoblastic disease to avoid inconsistent results and confusion.

Cystic Fibrosis: Its Characteristic Appearance on Abdominal Sonography. U. V. Willi, J. M. Reddish, R. L. Teele; Harvard Medical School, Boston, MA. *Am J Roentgenol* 134: 1005–1010, 1980

In a study of 24 patients with cystic fibrosis the authors found in six cases that the pancreas was rather small and showed increased echogenicity. In 50% of the patients examined abnormal hepatic patterns were observed with increased echogenicity seen irregularly distributed throughout the liver. Cholelithiasis and small, shrunken gall bladders were also frequently encountered. Although the abdominal manifestations were quite variable, the frequency of sonographic abnormalities in cystic fibrosis was found to be quite high and to increase with the age of the patient.

Echographic Characteristic of Malignant Lymph Nodes. B. J. Hillman, K. Haber; Univ. of Arizona Health Sciences Center, Tucson, AZ. *J Clin Ultrasound* 8: 213–216, 1980

In a review of 42 patients with sonographic evidence of malignant lymphadenopathy, the authors found no specific correlation between the sonographic patterns and histologic diagnoses. Varying degrees of echogenicity and sonolucency occurred as well as mixtures of internal echo patterns within the same patient. Of interest was the finding in five lymphoma patients of masses that were acoustically indistinguishable cysts. This appearance was noted in five of 23 lymphoma patients; no such pattern was observed in nodes enlarged by metastatic neoplasms. Sonograms representative of the spectrum of findings in lymphatic enlargement are presented.

Sonographic Differentiation Between the Umbilical Portion of the Left Portal Vein and Intrahepatic Bile Ducts. Y. Bandai, M. Makuuchi, G. Watanabe, T. Ito, M. Suigiura, T. Wada; Univ. of Tokyo, Tokyo, Japan. *J Clin Ultrasound* 8: 207–212, 1980

The left branch of the portal vein is identified by the sharp anterior angulation produced by its communication with the umbilical portion of the portal venous system. Branching of the left hepatic duct does not produce such a configuration but rather a Y-shaped division. The authors found it possible to differentiate the umbilical portion of the portal vein from dilated bile ducts in cases in which the anatomy of the porta hepatis was obscured by tumor. A right subcostal oblique scan was used to produce continuous pictures of the left branch of the portal vein in its junction with the umbilical portion. The authors suggest that real-time equipment will be valuable in this search. The left hepatic ducts were, in addition, demonstrated in approximately half of the cases encountered. The characteristic acute angulation of the left portal vein to its umbilical-portion transition was identified in all the normal controls and 95% of jaundice patients studied. Representative ultrasonograms are provided.

In Vitro Investigation of the Origin of Echoes within Biliary Sludge. R. A. Filly, B. Allen, M. J. Minton, R. Bernhoft, L. W. Way; Univ. of California, San Francisco, CA. *J Clin Ultrasound* 8: 193–200, 1980

The authors conducted a series of in vitro experiments to establish the cause of low-level echoes commonly referred to as "biliary sludge." By passing echogenic bile through a series of progressively smaller Millipore filters ranging from 100 μ down to 5 μ, the authors succeeded in removing the source of echogenicity. Microscopic and chemical evaluation identified the cause of echogenicity as particulate matter, largely calcium bilirubinate

pigment granules. Lesser amounts of cholesterol crystals were identified as well. Simple concentration of bile failed to produce similar internal echogenicity. The conclusion reached is that the source of echoes in biliary sludge as seen on sonograms is particulate matter (largely calcium bilirubinate particles with lesser amounts of cholesterol crystals) and is unrelated to the viscosity of the medium. Biliary sludge is considered an abnormal finding but not necessarily an indication for surgical intervention. Stasis promoted by fasting and diseases unrelated to the biliary tract can result in formation of sludge as well.

JOHN J. COUPAL
PEGGY A. DOMSTAD
ANDREW FRIED
University of Kentucky
Medical Center and
VA Hospital
Lexington, Kentucky

BARBARA Y. CROFT
University of Virginia Hospital
Charlottesville, Virginia

AUDREY V. WEGST
University of Kansas
Medical Center
Kansas City, Kansas

JOHN H. CLORIUS
Deutsches Krebsforschungszentrum
Heidelberg, Germany