and lungs, but none in the bone marrow (Fig. 2). Chest radiographs showed no abnormalities. Shortly thereafter there was massive and fatal tumor regrowth. Autopsy revealed no pathologic changes in the lungs.

In-111 chloride has been found to concentrate in the erythyroid system, and is used to visualize bone-marrow distribution (*3–6*). Normally, In-111 scanning shows the bone marrow and liver. The kidneys are visualized when the ion-binding capacity becomes saturated (*4,5*). In-111 lung uptake, however, has not been reported. In our two cases with In-111 lung uptake, no abnormalities were found in the respiratory system by either clinical or pathologic examination.

Although the exact mechanism is unknown, In-111 has been found to concentrate in tumors (*1,2*). Gallium-67 citrate, a tumor-seeking agent, has also been reported to accumulate diffusely in the lungs in patients with bleomycin toxicity, sarcoidosis, carcinomatosis, or opportunistic infection such as Pneumocystis carinii (*7–10*). In our cases, however, these conditions were neither proven nor considered possible. The cause of the In-111 lung uptake therefore remains unclear. Further investigation is desirable in order to determine its clinical value.

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## Diffuse Peritoneal Uptake of Ga-67 in Pancreatic Disease: A Possible Prognostic Indicator

The role of radiogallium (Ga-67) accumulation in the diagnosis of pancreatitis has been discussed recently. Tanaka and coworkers (*1*) documented uptake of radiogallium by the acutely inflamed pancreas, and we have shown the spread of pancreatitis to the pararenal space (*2*). In addition to these two patterns we have encountered a more diffuse distribution of radiolabel during pancreatitis, which is documented in the present letter.

**Case 1.** An unconscious 37-year-old man was brought to the emergency room. His relatives provided a history of his having severe abdominal pain and profuse sweating for 3 days. There was a history of "heavy drinking" for 23 years. The patient was cyanotic, body temperature 39°C, blood pressure unobtainable, and pulse 130/min. Respirations were labored, the abdomen tense. Serum amylase was 360 units (normal $>$ 150), alkaline phosphatase 122 (normal $>$ 70), and LDH 263 (normal $=$ 120). The hematocrit was 33%, and the white blood cell count 23,500 with a shift to the left. Blood gases were consistent with metabolic acidosis (pH $=$ 6.98, bicarbonate $=$ 7.5, $P_a CO_2 =$ 32, $P_a O_2 =$ 98). Laparotomy revealed acute hemorrhagic pancreatitis with bloody fluid throughout the peritoneal cavity. No bowel perforation was found. Several surgical drains were placed and a feeding jejunostomy was established. During the postoperative period, cultures of the drainage fluid grew *Klebsiella*; antibiotics were administered. The abdomen was soft. The patient developed the adult respiratory distress syndrome and was placed on a respirator. Chest roentgenograms demonstrated varying patchy densities and perihilar edema during this period. A gallium-67 citrate study was begun on the fourteenth day after the operation (Fig. 1). There were no physical findings of peritonitis. The patient signed out, against medical advice, on the thirtieth day. He was readmitted a week later in gram-negative sepsis, and died.

**Case 2.** A 54-year-old woman was admitted because of three attacks of right upper quadrant pain, not apparently related to meals. Past history was noncontributory. Temperature was 37°C, pulse 80, respirations 20, and blood pressure 150/80. There were no pertinent physical findings. The hematocrit was 41, white blood cell count 5,400 with a normal differential. An oral cholecystogram did not visualize the gallbladder. At surgery, cholecystectomy, removal of a common-duct stone, and a cholangiogram were performed. The surgically removed gallbladder was reported as showing cholecystitis and cholesterolosis. Postoperatively

**FIG. 1.** Anterior abdominal rectilinear scan in Case 1, obtained 24 hr after i.v. administration of Ga-67 citrate. Negative defect to viewer's left (upper) corresponds to hepatic area. Peritoneal cavity is outlined by radiotracer.

**FIG. 2.** Anterior thoraco-abdominal rectilinear scan in Case 2, performed 48 hr after i.v. administration of Ga-67 citrate. Image is somewhat mottled in appearance, due to patient motion, but clearly demonstrates a diffuse radiotracer pattern.

the patient developed a fever, infiltrates at both lung bases, and a distended abdomen. A leukocytosis was present with a shift to the left. Serum amylase was markedly elevated (1,800). One week postoperatively, the patient was nonresponsive and the blood pressure was unobtainable. An emergency laparotomy was performed. It revealed a firm and nodular pancreas in continuity with a mass along the upper abdomen and descending colon. Sporadic abscesses were noted in the abdomen; these grew out gram-positive enterococci. Multiple drains were placed. Postoperatively the patient was treated with antibiotics and i.v. nutrition. Her T-tube and abdominal drains continually grew out both *E. coli* and *Klebsiella*. Two weeks after the re-exploration, a gallium-67 citrate study was performed (Fig. 2). Gastrointestinal bleeding developed and endoscopy did not define the site. The patient died 2 weeks later, in gram-negative shock.

Both of these fatal cases of pancreatitis showed diffuse peritoneal uptake of Ga-67 after i.v. administration of Ga-67 citrate. The two events, diffuse distribution of radiolabel in the peritoneum and progression to death, might not always be coupled. The finding of such widespread radiogallium uptake in pancreatitis, however, likely indicated widespread disease and hence a difficult period of management.

Pancreatic inflammatory disease differs from other inflammations because of the exudation of exocrine enzymes and widespread tissue damage. Dilatation of the duodenal loop and transverse colon usually occurs, and pseudocyst formation, stricture of the colon, and retroperitoneal abscesses are commonly recognized complications (*3,4*).

While ultrasound and computerized tomography are primary noninvasive techniques for pancreatic imaging, radiogallium studies may be useful in the diagnosis of pancreatitis. In some cases the inflammatory process may be shown to be confined to the organ itself (*1*). The Ga-67 scans may also be useful in the detection of inflammed pseudocysts (demonstrating increased uptake) or in the demonstration of quiescent pseudocysts, which appear as cold areas on scans (*5,6*). The Ga-67 scans also have a role in demonstrating the spread of pancreatitis to the anterior pararenal space of the retroperitoneum (*2*).

In the previously published cases of Ga-67 images during pancreatitis, there has been no reference to radionuclide detection of diffuse peritonitis secondary to pancreatic disease. Case 1 presented here demonstrates a positive image defining the anatomic confines of the peritoneal cavity, while Fig 2 (Case 2) demonstrates diffuse patchy regions of uptake Several mechanisms may be implicated in the diffuse abdominal uptake. First, pancreatic edema may have spread digestive enzymes throughout the abdomen, through broaching of the anatomic barriers of the anterior pararenal space of the retroperitoneum Second, the mesentery of the large and small bowel may be involved, with vasculitis secondary to spread of pancreatic enzymes. Hunt has postulated that bowel stricture associated with pancreatitis is secondary to vasculitis (*7*). Diffuse Ga-67 uptake has been demonstrated in vasculitis without infective changes (*8*). Third, bacterial contamination of the peritoneum may follow pancreatitis.

In the two cases we have presented, radiogallium imaging demonstrated a major spread of the inflammation accompanying pancreatitis. The diffusely positive radionuclide image served as an indicator of the gravity of the disease. Although both of our patients died, survival might be possible in severe disease, given close monitoring for Gram-negative sepsis and maintenance of the patient during crisis. In these severe cases, the more unusual complications of pancreatitis may occur—such as adult respiratory distress syndrome (Case 1) and gastrointestinal bleeding (Case 2) (*9,10*).

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## The Percentage Uptake of Treatment Activity of I-131 by the Thyroid

In reply to the request of Dr. Charles L. Lewis in the *Journal* (*1*), our Department has, in most patients treated for thyrotoxicosis, established the 24-hr radioiodine uptake (RAIU-24) of the administered activity. The value of the treatment RAIU-24 was seldom equal to that of the diagnostic RAIU-24, being sometimes higher, sometimes lower than the latter. To date, I have not yet found a predictor for this behavior.

A remark in Dr. Lewis' letter, as well as the same tendency in some publications [e.g., (*2*)], prompts me to explain why we obtain the treatment RAIU-24 as a plea to all concerned to try to estimate—even if only roughly—the dose absorbed by the gland from the administered activity. To relate the outcome of the treatment to the administered activity (*2*)—instead of to the absorbed dose—helps little.

From any equation used to calculate the absorbed dose [e.g., see (*3*)], it can be seen that the following variables are important: the thyroid volume (or mass), the maximal uptake by the gland (usually taken to be the RAIU-24), and the effective half-life ($T\frac{1}{2}_{eff}$) of I-131 in the gland. To obtain the activity of I-131 needed to deliver approximately 3,500 rad, we do a preliminary calculation, using the diagnostic RAIU-24 and estimating the $T\frac{1}{2}_{eff}$. The thyroid volume is estimated by planimetry from the thyroid scan, and by measuring the gland's thickness either by ultrasound or, at present, on an oblique scan view. After the administration of I-131, RAIUs are repeated at 24 hr, and at 7 and 14 days. The delivered radiation dose is then recalculated, using the corrected RAIU-24 and the measured $T\frac{1}{2}_{eff}$. The difference between the preliminary and final calculations is sometimes remarkable.

This procedure does not give dose estimates as exact as one would wish and is open to many improvements (e.g., better estimates of the gland's volume, taking nonhomogeneity of radionuclide distribution into account, etc.). But, perhaps, the better the estimate of the absorbed dose by the gland, the more predictable the treatment results will become.

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## Synthesis of Criteria for Operability in Normal-Pressure Hydrocephalus Due to Bilateral Convexity Block

For patients with the clinical syndrome of normal-pressure hydrocephalus, the prediction of success or failure of shunting procedures on the basis of intraventricular stasis of radioactive tracers has diminished of late. Jacobs et al. (*1*) found this procedure to be of no value. We wish to call attention, however, to an extension of criteria for shunting, based on a series of more recent observations by ourselves and others that may increase the likelihood of subjective and objective clinical improvement.

The first of these observations was reported by Harbert and coworkers (*2*), who noted that the cisternographic agent, Ytterbium-169 DTPA, yielded poorer outlines of the ventricular system than had the previously used agent, RISA. Harbert attributed this finding to absorption of Yb-169 DTPA by the brain substance and related this to the transependymal movement of the smaller Yb DTPA molecule.

The second relevant report was that of James et al. (*3*), who documented the presence of transependymal movement of radioactive tracers as an alternative route of cerebrospinal fluid absorption in experimental animal models.

Thirdly, additional information now provided in the evaluation of normal-pressure hydrocephalus by cranial computerized tomography indicates that at least some patients

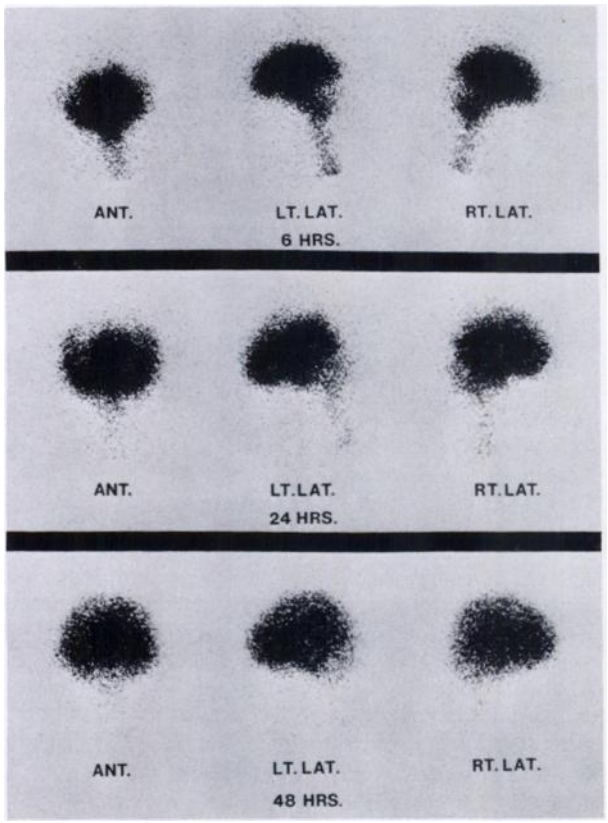


**FIG. 1.** Ytterbium-169 DTPA cisternogram showing bilateral convexity block to tracer migration, ventricular penetration of the tracer, and marked transependymal tracer migration by 48 hr. The cerebrogram is best evaluated by study of areas above and behind the ventricles on lateral views at 48 hr. Patient not improved after shunt.