

Diffuse Abdominal Uptake of Ga-67 Citrate in a Patient with Hypoproteinemia

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A 3-wk-old male, with abdominal distention and severe hypoproteinemia from poor nutrition, underwent a study that showed a persistent diffuse abdominal uptake of Ga-67 citrate, indicating pyogenic or tuberculous peritonitis. However, there were no corresponding clinical or laboratory findings. After a 1-wk course of hyperalimentation with albumin, furosemide, and protein, repeat radiographs showed reduction in bowel gas. It is suggested that hypoproteinemia should be considered as a possibility in the differential diagnosis when there is diffuse abdominal uptake of Ga-67 citrate, with careful clinical correlation. Possible mechanism of Ga-67 uptake in the peritoneal cavity is suggested.

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Radionuclide imaging with Ga-67 has been helpful in locating abdominal abscesses and in confirming the clinical suspicion of pyogenic or tuberculous peritonitis (1). Because of nonspecific clinical signs and symptoms, abdominal diseases are often difficult to diagnose. Diffuse abdominal uptake of Ga-67 citrate suggesting a peritonitis has also been observed in patients with ulcerative or pseudomembranous colitis, Crohn's disease, diffuse infiltration of lymphoma, carcinoma of the bowel, and alpha-chain disease (2). We report here a gallium scan that showed a persistent diffuse abdominal uptake of Ga-67 citrate, probably due to severe hypoproteinemia from poor nutrition.

CASE REPORT

A 3-wk-old male was admitted with a 1-wk history of diarrhea, vomiting and fever. He was a full term, 6.7-pound product of an uncomplicated pregnancy. Apgar scores at birth were 9 at 1 min and at 5 min. He had an uncomplicated postnatal period and went home about 48-hr after delivery.

On physical examination he was felt to be clinically dehydrated, and there were red, dull, and bulging tympanic membranes. Body temperature was 98°F on admission. He was rehydrated with intravenous fluids over the first two days of hospitalization. Because of a history of fever (although no elevation of temperature was ever documented), the patient had a sepsis workup including a cerebrospinal fluid (CSF) study that revealed 12 WBC and 840 RBC. No organisms were seen on the Gram stain. A repeat CSF study the next day showed 150 WBC and 410 RBC. However, CSF cultures from both lumbar punctures remained negative after 72-hr, and the blood cultures were also negative.

The patient was treated with a one-week course of gentamycin, ampicillin, and chloramphenicol. Three days later, while on continuous oral amoxicillin, he developed a 103°F fever, and a repeat sepsis workup was done. The CSF study showed 3 WBC, 4600 RBC, and no organisms. Several CSF, blood, urine, tympanocentesis, stool, oral, and nasopharynx cultures remained negative. The patient became afebrile after a week of NPO while on parental oxacillin and gentamycin therapy. He developed abdominal distention and decreased bowel sounds. Abdominal radiographs revealed a paralytic ileus with a thickened bowel wall and no free air (Fig. 1). Abdominal ultrasonography showed no focal abscess or intraperitoneal fluid collection. A whole-body image with Ga-67 citrate was then performed. The study showed a persistent, diffuse, abnormally increased area of activity in the abdomen, consistent with pyogenic or tuberculous peritonitis (Fig. 2). There were no clinical signs of peritonitis and the gastric aspirate for acid-fast bacilli was negative on several occasions. He was found to have a severe hypoproteinemia (3.5 total protein with 2.0 albumin), probably from poor nutrition. Alkaline phosphatase, SGOT, and immunoglobulin were all within normal limits. The patient was then treated with albumin, furosemide, and increased protein during a 1-wk course of hyperalimentation. Repeat abdominal radiographs demonstrated significant reduction of the gaseous bowel distention and thickened bowel wall compared with the previous week. An upper G.I. series, small-bowel study, barium enema, and repeat sonography were all subsequently found to be normal.

The patient's abdominal distention resolved with the return of normoproteinemia.

DISCUSSION

In retrospect, the abnormal gallium image simulating a peritonitis was most probably due to hypoproteinemia the result of poor

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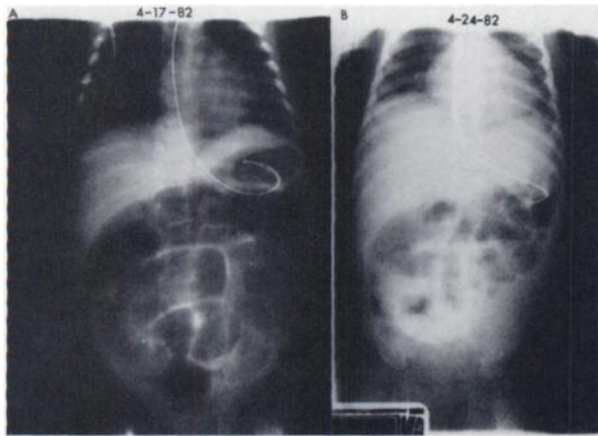


FIG. 1(A). Frontal abdominal radiograph shows distended bowel loops with thickened wall. No free air or air fluid level is noted. NG tube inserted. **(B).** Repeat study, after treatment with albumin and increased protein, shows significant reduction in bowel distention.

nutrition. The patient's abdominal distention and bowel-wall edema, which coincided with the severe episode of hypoproteinemia, self-corrected with the resolution of hypoproteinemia.

Gallium-67, as the carrier-free citrate, has been used in clinical nuclear medicine for the diagnosis and monitoring of certain neoplasms and pyogenic abscesses. After intravenous administration, ionic gallium rapidly binds to circulating plasma proteins (transferrin and lactoferrin). Approximately 20–30% is normally excreted through the kidneys by 24 hr (3). The liver and biliary tract then become the major excretory route, and the radioactivity appears in the bowel by 24 hr and accumulates in stool. Therefore, focal lesions in the abdomen may be difficult to recognize, although serial abdominal images usually show some changes in the distribution of colonic radioactivity. There have also been reports of altered gallium distribution using periodically related elements (4).

The kinetics of Ga-67 localization in inflammatory lesions has recently been the object of considerable study. Gelrud (5) postulated that one component of the initial accumulation at these sites is the diffusion of the unbound radionuclide from blood vessels, or an exudation of protein-bound gallium into the inflammatory site. More recently, Weiner (6) has shown that another component of Ga-67 accumulation in inflamed tissues is its affinity for the lactoferrin (LF) found at the site of inflammation. This LF has been shown to be deposited by polymorphs and neutrophils, and also to be synthesized *de novo* by glandular epithelial cells as an antibacterial agent (7). Finally, a third component of Ga-67 accumulation is direct bacterial uptake mediated by siderophores (8). Siderophores are iron-chelating agents of low molecular weight, capable of solubilizing extracellular iron oxides and metallic iron, thereby facilitating their cellular uptake.

Handmaker et al. reported a 97% accuracy from gallium scans in eighteen children with inflammatory disease. They recommended Ga-67 imaging for detection of occult abscesses, which are generally secondary to a primary systemic disease that predisposes the patient to infection (9). They also reported increased uptake of Ga-67 citrate in the spleens and epiphyseal plates of children.

Our patient, with no clinical or laboratory diagnosis of peritonitis or diffuse bowel disease, developed a diffuse abdominal uptake of Ga-67 citrate with minimal radioactivity in the liver. This suggested that significant amounts of Ga-67 were not able to bind to proteins and accumulated in the liver. Some bound and unbound

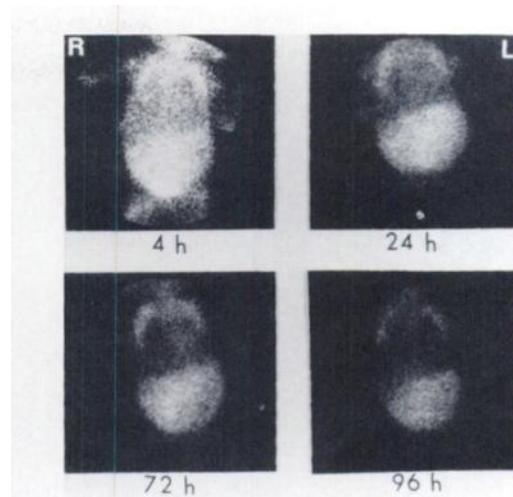


FIG. 2. Anterior scintigrams of chest and abdomen at 24, 72, and 96 hr after injection of Ga-67 citrate show persistent diffuse abnormal radioactivity in abdomen, indicating peritonitis. Note minimal radioactivity in liver. Intense activity in thoracic cage is believed due to overlapping rib activities.

activities probably were excreted by the kidneys, and the remaining unbound activities leaked into the peritoneal cavity. When the intake of protein is reduced, the supply of amino acids to the liver from the gastrointestinal tract becomes inadequate for the synthesis of normal amounts of serum albumin. Thus the oncotic pressure in plasma is reduced and the formation of extracellular fluid increases. This results in fluid accumulation in the extravascular compartment (10).

It is suggested that, with careful correlation, hypoproteinemia should be considered in the differential diagnosis of diffuse abdominal uptake of Ga-67.

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