The Role of Ga-67 Citrate Imaging and Diagnostic Ultrasound in Patients with Suspected Abdominal Abscesses

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Fifty patients with suspected abdominal abscesses were examined by [^{67}Ga] Gallium citrate imaging and abdominal sonography. Fifteen of the patients had a proven intra-abdominal abscess; Gallium-67 images were positive in 13 (87%), while the sonogram detected the abscess in 11 (73%). Nineteen patients had true-negative radionuclide images and sonography, and one had a false-positive result by both procedures. The remaining 15 patients did not have abdominal abscesses, but did have other abnormalities (e.g., pyelonephritis, extra-abdominal sites of inflammation) which were detected by the nuclide study. Gallium-67 imaging and abdominal ultrasound have similar sensitivity for detection of abdominal abscesses. A significant advantage of Gallium imaging is its ability to detect other inflammatory foci (both within and outside the abdomen).

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Both [^{67}Ga] Gallium-citrate imaging and diagnostic ultrasound have proved useful for the localization of inflammatory processes (*1–15*). Sonography has the theoretic advantages of providing immediate results, delivering no ionizing radiation, and being able to distinguish between fluid-filled masses (e.g., abscess) and those that are solid (e.g., tumor). On the other hand, Gallium images have proven quite accurate in diagnosing a wide variety of abscess and nonabscess forming inflammatory processes (*1–11*). The increasing use of these two procedures for localizing inflammatory processes suggested that a comparison of their relative accuracy would be beneficial. Therefore, a prospective study was undertaken to compare the ability of diagnostic ultrasound and Gallium-67 imaging to detect inflammatory processes in patients with suspected abdominal abscesses.

METHODS

Fifty patients were examined by Gallium-67 citrate imaging and an abdominal ultrasound scan to search for an abdominal source of a fever of undetermined origin. In each patient the two procedures were performed within a 48-hr interval. Twenty of the 50 patients had had a recent (<3 weeks) abdominal surgical procedure. Routine clinical and radiologic procedures had failed to reveal the source of fever.

Gallium-67 citrate was administered intravenously (50 μCi/kg) and images were performed 48 hr later. Unless the 48-hr views were normal, the study was repeated at 72 hr. The studies were performed on a dual probe rectilinear scanner with 2:1 minification of the image, and a window of 160 keV with a 160 keV baseline. Anterior and posterior images of the body were obtained with a count density of at least 750 ct/cm^2. Gallium-67 studies

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were considered abnormal when an area of increased activity was identified that did not change location between the 48- and 72-hr studies, and remained relatively as intense or appeared more intense on the 72-hr images. If radioactivity was seen in the kidney at 48 hr, it was considered an indication of a renal abnormality (*16*).

The ultrasound studies were performed in the bistable mode (22 cases) and grey scale mode (28 cases), with the patient in the supine position, obtaining longitudinal and transverse views at intervals of 2 cm. The images were recorded on Polaroid film and were interpreted by one reader (G.G.) without knowledge of the results of the gallium scan. The ultrasound examination was interpreted as positive for abscess if a well-defined sonolucent collection was found in the abdomen.

RESULTS

Fifteen of the 50 patients (30%) had abdominal abscesses proved by re-exploration, aspiration, or biopsy. [^{67}Ga] Gallium citrate images and ultrasound revealed a paravertebral abscess in a nonsurgical patient who presented with fever and low back pain. Both studies also revealed the abscess in 10 of 12 patients who had recent abdominal surgery. Two patients had perihepatic abscesses (one subphrenic, one subhepatic) that were detected only by gallium imaging. In these two patients the ultrasound studies (one grey scale, one B-mode) were inconclusive because of excess amounts of bowel gas. Two patients had false-negative radionuclide images and ultrasound studies (both B-mode). One of these patients had developed fever, positive blood cultures, and physical signs suggesting an abdominal abscess shortly after abdominal surgery. The nuclide images showed an area of faintly increased activity in the left upper quadrant of the abdomen that did not increase in activity between the 48- and 72-hr studies and was not considered significant. The sonogram revealed no well-defined area of sonolucency. At surgery a small (2.5-cm-diam.) abdominal wall abscess was found in the location of the "faint" Gallium activity. In the other patient with fever of undetermined origin a Tc-99m sulfur colloid liver scan demonstrated a small mass lesion of the liver. The Gallium citrate study and sonogram were normal. At surgery a small (2-cm-diam.) thick-walled hepatic abscess was discovered.

Nineteen patients whose subsequent clinical course revealed no evidence of an abdominal abscess had negative Gallium images and abdominal ultrasound. One other patient underwent surgery because of positive radionuclide images and B-mode ultrasound studies, but proved to have no intra-abdominal abscess. This patient had developed spiking fevers several weeks after undergoing a left nephrectomy and splenectomy. The Gallium study revealed a definite area of increased activity in the left upper quadrant and the sonogram showed sonolucency in the same area. At surgery the only findings were postoperative adhesions and a partially obstructed loop of bowel, filled with a mixture of gas and feces, in the left upper quadrant. The patient's subsequent clinical course was benign and her fever eventually subsided.

The remaining 15 patients had abnormal Gallium-67 studies, but normal ultrasound examinations of the abdomen and pelvis. Extra-abdominal sites of inflammation were identified in 8 patients; 3 patients with positive blood cultures had subacute bacterial endocarditis demonstrated by increased cardiac activity; 2 patients had focal areas of lower extremity cellulitis (unappreciated clinically); 3 had focal areas of gluteal or deltoid muscle uptake which were later proved to be parenteral injection abscesses. Previously unknown renal pathology was identified in 6 patients; 3 were later proved to have pyelonephritis by positive urine cultures; one had a renal biopsy which revealed Wegener's granulomatosis; and one was subsequently found to have renal vein thrombosis. The other patient, who had a recent renal transplant, had a clinical course and renal radionuclide studies consistent with acute tubular necrosis. Persistently increased colon activity in another patient with fever and diarrhea proved to be secondary to Crohn's disease of the colon.

Excluding the patients ($n = 15$) with extra-abdominal or nonabscess types of inflammation which ultrasound would not be expected to detect, the abilities of the two tests to detect abdominal abscesses were similar. In these 35 remaining patients the true-positive and true-negative rates for Gallium imaging and sonography in abscess detection were not statistically different (Table 1). The ability of Gallium citrate imaging to detect abdominal abscesses was similar to that of ultrasound irrespective of the ultrasonic mode; i.e., bistable or grey scale.

DISCUSSION

Numerous reports (*12–15*) have shown the ability of diagnostic ultrasound to detect abdominal abscesses. The size of an abscess can be accurately judged, and precise localization of the mass can help guide biopsy or drainage (*12*). In the current study, however, some limitations were noted. Suboptimal examinations may occur in patients with excess abdominal gas and in patients with bandages or tubing over the abdomen, as transducer contact is reduced or prevented.

TABLE 1. Ga-67 IMAGING AND ULTRASOUND IN THE DIAGNOSIS OF ABDOMINAL ABSCESSES (n = 35)*

	Ga-67	Sonography
True positives	13 (0.87)	11 (0.73)
False positives	1 (0.05)	1 (0.05)
True negatives	19 (0.95)	19 (0.95)
False negatives	2 (0.13)	4 (0.27)

* Rates for true-positives, false-positives, etc., given in parentheses. None of these differences is statistically significant.

In the present comparative study [^{67}Ga] citrate images localized 13 of the 15 intra-abdominal abscesses (87%). In the two patients with false-negative studies, the ultrasound examinations were also negative. There were two additional false-negative sonograms, but both examinations were technically suboptimal, as the patients had bandaged abdomens and excess abdominal gas. The sonogram identified an intra-abdominal abscess nearly as often (11/15, 73%) as the radionuclide study. The differences between the sensitivity (true-positive rate) and specificity (true-negative rate) of the two examinations were not statistically significant. Our results differ from those of a recently reported series of six patients with abdominal abscesses (*17*). Five had an abnormal Gallium accumulation in the abdomen, but only two had abnormal sonography. Three patients had proven intra-abdominal abscesses undetected by ultrasound. The authors concluded that Gallium imaging was more sensitive than ultrasound for the detection of intra-abdominal abscesses, but was less specific because of "other" causes of Gallium uptake, such as neoplasms. In a patient with signs of infection and no known malignancy, however, the nonspecific uptake of Gallium in neoplastic and inflammatory foci should not be a major problem.

Although the current study could not verify that Gallium images are more sensitive for detecting abdominal abscesses than ultrasound, the radionuclide study did identify additional nonabscess abnormalities in 15 patients, and aided clinical management by localizing a source of fever in 12 of those patients. The results suggest that Gallium studies may be particularly valuable in patients with fevers of undetermined origin who do not have specific localizing abdominal signs. Although the abdomen is a common site for an occult inflammatory process, an extra-abdominal process or nonabscess intra-abdominal process may be a source of fever. The results of this comparative study suggest that Gallium images obtained in search of a source of fever should include at least the area between the shoulder girdle and the proximal femurs in the field of view (even when the abdomen is the suspected source of fever).

One of the advantages of sonography in the current comparative study was the immediate availability of results. Several authors (*1,18,19*) have suggested, however, that 6 hr postinjection Gallium images are nearly as accurate as those obtained at 24 or 48 hr in detecting inflammatory foci. Hopkins et al. (*18*) detected 18 abscesses on both 6 hr and delayed views, but 2 abscesses were detected only by delayed imaging. The technique of early imaging with Gallium citrate makes the availability of these results and sonography more comparable.

The results of the current study confirm the utility of Gallium imaging and diagnostic ultrasound in detecting occult abdominal abscesses. Preliminary experimental results (*20*) suggest that other radiopharmaceuticals (e.g., In-111-leukocytes) may be superior to [^{67}Ga] Gallium citrate in detecting abscesses. Similarly, the increasing availability of grey scale ultrasound should provide improved detection by sonography. When whole-body computerized transmission tomography (*21,22*) becomes widely available, the role of radionuclides and ultrasound in the diagnosis of occult abdominal abscesses will probably need re-evaluation.

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