

Possible Pitfalls with Clinical Imaging of Indium-111 Leukocytes: Concise Communication

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Indium-111 leukocyte imaging is a reliable procedure for detecting abscesses. Problems such as cell clumping can occur before injection, thus altering the normal distribution. Furthermore, accumulation of the labeled leukocytes in the colon, brain infarcts, and accessory spleens has been observed. Thus, these physiologic and pathologic conditions other than abscesses must be borne in mind to avoid false-positive diagnoses of abscess.

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Several animal (1-3) and clinical (4-6) studies have demonstrated the utility of indium-111-labeled leukocytes for detecting abscesses. Compared with gallium-67 citrate, indium-111 leukocytes accumulate more in experimental abscesses and give higher abscess-to-tissue ratios (2). The clinical studies performed with indium-111 leukocytes have all shown the test to be accurate in detecting inflammatory processes. The technique for preparing the labeled leukocytes varies in different laboratories but does require separation of the leukocytes from the platelets and red blood cells, incubation of the leukocytes with indium-111 oxine, and separation of the labeled cells from otherwise bound radioactivity before injection. The manipulation of the cells introduces the possibility of cellular damage or clumping. Several hours after administration of the labeled leukocytes, the normal distribution demonstrates radioactivity in the liver, spleen, and bone marrow. Any other accumulation is considered abnormal. We have had several studies in which the accumulation of the labeled leukocytes was, or appeared to be, outside this normal distribution. This report describes abnormal-appearing distributions not associated with abscess.

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MATERIALS AND METHODS

In 140 patients we have made 175 indium-111 leukocyte studies between September 1978 and June 1979. The In-111 oxine is prepared as previously described (2). The leukocytes are obtained from 30-40 ml of heparinized blood sedimented without settling agents. The cells are labeled in dilute plasma.

Three to four and 20-24 hr after the administration of the labeled leukocytes, images are obtained with a large-crystal camera or a dual-probe rectilinear scanner with additional camera images.

REPORT OF CASES

Case 1. A 53-year-old woman had left upper quadrant pain and fever for 2 wk. She had a history of several operations including a splenectomy, cholecystectomy, and removal of a jejunal arteriovenous malformation. Ultrasonography revealed a left upper quadrant cystic lesion (Fig. 1A). An indium-111 leukocyte study demonstrated accumulation in the left upper quadrant corresponding to the lesion noted on ultrasound (Fig. 1B). Review of a Tc-99m sulfur colloid study performed 4 mo previously, failed to suggest a splenic remnant (Fig. 1C). Since this area of indium-111 leukocyte accumulation was felt not to represent spleen, aspiration of the "cyst" was attempted under ultrasonic guidance. Blood that clotted soon after withdrawal was obtained. A repeat

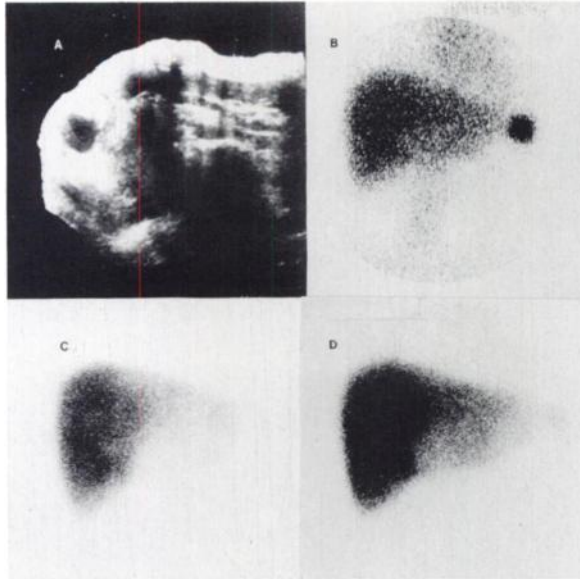


FIG. 1. Patient postsplenectomy, with left upper quadrant pain and fever. Transverse ultrasound study (A) reveals left upper quadrant transonic lesion. Indium-111 leukocyte image (B), obtained 18 hr after administration, shows accumulation in area of transonic lesion. Technetium-99m sulfur colloid study 4 mo previously (C) showed no spleen, whereas study performed after leukocyte study (D) revealed new splenic tissue.

Tc-99m sulfur colloid study demonstrated splenic tissue regeneration (Fig. 1D).

Case 2. A 35-year-old man with diffuse histiocytic lymphoma presented with abdominal pain and fever. He previously presented with a left ischial lesion and had radiation therapy to the left pelvis and hip area. Subsequently node resection in the left neck was attempted, and radiation given to that area. At the time of this study he had a large, open, purulent wound in the left supraclavicular area. An indium-111 leukocyte study demonstrated abnormal accumulation in the left supraclavicular wound, clumps of activity in the lungs, and decreased activity in the left pelvis and proximal femur (Fig. 2).

Case 3. A 24-year-old woman with idiopathic intestinal pseudo-obstruction underwent an exploratory laparotomy and placement of a jejunostomy tube. Postoperatively she was treated with enemas. She developed fever and wound infection. All indium-111 leukocyte study showed abnormal accumulation in the infected wound as well as activity in the left colon (Fig. 3).

Case 4. A 41-year-old man with a history of vasculitis (possibly Wegener's) presented with sudden onset of a left hemiparesis, fever, and *Staphylococcus aureus* sepsis. A transmission computed tomographic (TCT) scan of the head was normal (Fig. 4A). Three days later, an indium-111 leukocyte study revealed abnormal accumulation in the right parietal area and nasal sinuses (Figs. 4B, C). A repeat TCT of the head showed a non-

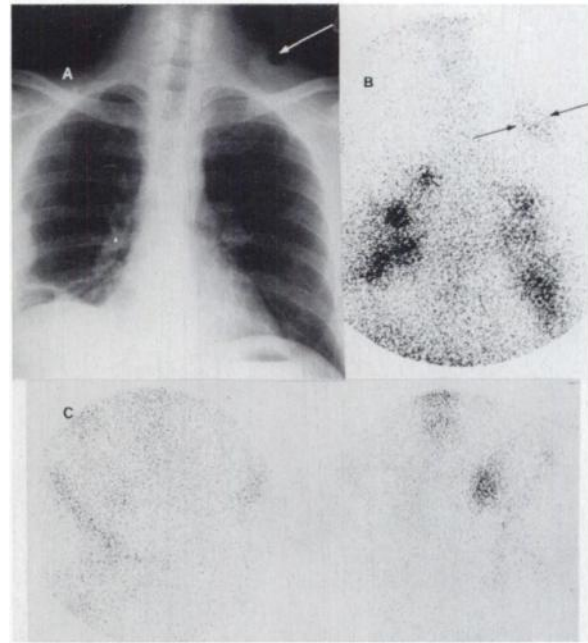


FIG. 2. Patient with lymphoma, after irradiation to left pelvis and left supraclavicular area, now has open purulent wound (arrow) above clavicle (A). Indium-111 leukocyte study at 18 hr after injection shows accumulation in wound (arrow) and clumps in lungs (B). Anterior (left) and posterior (right) images of pelvis (C) demonstrate decreased accumulation in left hemipelvis and proximal femur.

enhancing low-density lesion in the right parietal area (Fig. 4D). Sinus films revealed sinusitis. The patient developed no signs of cerebral abscess, and a cerebral infarction was diagnosed.

Case 5. A 62-year-old man presented with abdominal pain and fever. An indium-111 leukocyte study demonstrated an abnormal accumulation inferior and anterior to the spleen (Fig. 5A). Initially the surgeons were convinced that this was an abdominal abscess. However, the Tc-99m sulfur colloid spleen study (Fig. 5B) revealed a similar distribution, and ultrasound showed this to be solid, thus representing an accessory spleen.

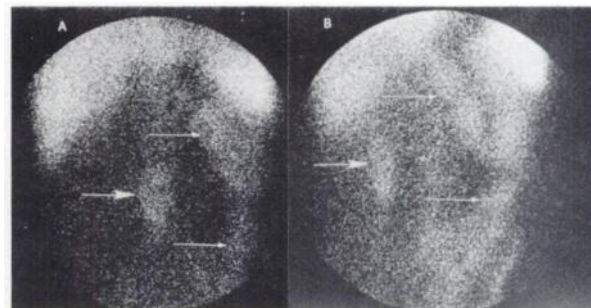


FIG. 3. Patient with intestinal pseudo-obstruction. After surgery she has infected mid-line wound and is being treated with multiple enemas. Anterior (A) and left anterior oblique (B) images of abdomen reveal abnormal accumulation in midline wound (large arrow), and in transverse and descending colon (small arrows).

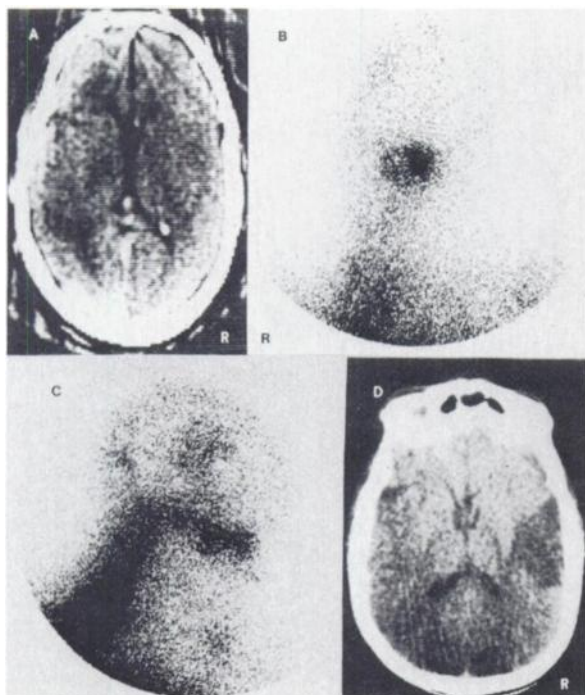


FIG. 4. Patient with vasculitis and fever, presenting with left hemiparesis. Initial TCT (A) is normal, whereas In-111 leukocyte study (B,C) reveals abnormal accumulation in right temporoparietal area and nasal sinuses. Subsequent TCT (D) reveals nonenhancing low-density lesion. R = right.

DISCUSSION

Several studies have demonstrated the utility of In-111 leukocyte imaging in evaluating patients with suspected inflammatory processes (4-7). Although there have been few false-positive studies reported to date, we have had several patients showing unusual localizations of the leukocytes that could be interpreted as abscesses. Persons interpreting indium-111 leukocyte studies need to be aware of abnormal or apparently abnormal accumulations that are not due to abscess.

Accessory spleens have been identified in several of our studies in patients after splenectomy. Accessory spleens are found at autopsy in 20 to 30% of all cases (8), but small accessory spleens may be suppressed by the normally functioning spleen. The normal In-111 leukocyte study demonstrates the greatest concentration of radioactivity in the spleen. In Case 1, the patient had a Tc-99m sulfur colloid study 4 mo previously, which did not demonstrate accumulation in the spleen. With no visible spleen on the sulfur colloid study, a "cystic" lesion seen by ultrasound, and recent abdominal surgery that failed to locate a spleen, an attempt was made to aspirate the "cystic" lesion to determine whether pus was present. As soon as clotting blood was obtained, the procedure was stopped. A repeat Tc-99m sulfur colloid liver/spleen study revealed that the radioactivity on the leukocyte study was spleen that had regenerated since the study

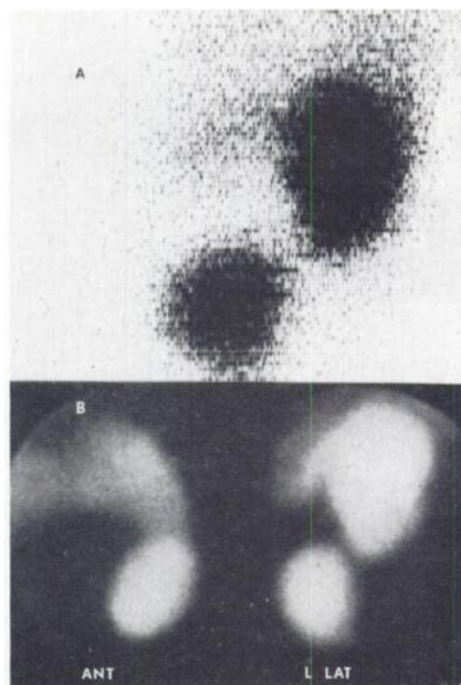


FIG. 5. Left lateral In-111 leukocyte scan of left upper quadrant reveals two separate accumulations of leukocytes (A). Tc-99m sulfur colloid images (B), anterior, and left lateral, show lower accumulation to be large accessory spleen.

performed 4 mo previously. The "cystic" appearance of the spleen by ultrasound was confusing. In some cases, however, solid structures may appear transonic if the structure is extremely homogeneous (9). In Case 5, the large accessory spleen could easily have been interpreted as an abscess. In patients with left upper quadrant accumulation of the indium-111 leukocytes, which could be in the spleen, a study with technetium-99m sulfur colloid or denatured autologous red cells should be performed to identify functioning splenic tissue.

On two or three of the first indium-111 leukocyte studies performed, clumps of the leukocytes were noted on the images even though none were identified microscopically. Review shows that these patient doses were all agitated before injection, causing frothing of the plasma. The association of frothing of the plasma and clumps of leukocytes has been noted previously, (D. A. Goodwin: personal communication). With extensive clumping, interpretation of the chest images is very difficult. Irregular abnormal accumulation has been seen with cystic fibrosis, and diffuse abnormal accumulation has occurred with adult respiratory distress syndrome. In patients with suspected inflammatory disease of the lungs, images of the chest should be obtained soon after the administration of the labeled leukocytes to determine whether any "clumps" are present. These early images will facilitate interpretation of chest images obtained the following day.

Symmetry of radionuclide accumulation is used to

determine normality in several types of studies in nuclear medicine. When there is asymmetry, one must ask whether one side has increased accumulation or the other side decreased. Symmetry is also used in evaluating the bone-marrow activity in the indium-111 leukocyte studies. The asymmetry seen in Fig. 2C is related to the previous radiation therapy to that area. Decreased bone-marrow uptake of the In-111 leukocytes has also been seen in patients with large tumors involving bone, in treated osteomyelitis, and in disc-space infection after surgery.

The cause of the colonic accumulation in Case 3 is thought to be related to inflammation induced by multiple enemas. The patient had no evidence of inflammatory bowel disease and did not have diarrhea. Abnormal intestinal accumulation could stem from labeled leukocytes swallowed from an inflammatory process in the upper respiratory tract or be secondary to a nasogastric tube. This patient did not have any symptoms of an upper respiratory infection, and her nasogastric and jejunostomy tubes had been removed 5 days before the In-111 leukocyte study. Furthermore, she had no evidence of abnormal uptake of labeled leukocytes in those areas to suggest an inflammatory process from which she could have swallowed the tracer. We have noted abnormal colonic accumulation in a patient with ulcerating colitis secondary to vasculitis, and in two patients diagnosed as having ischemic bowel disease.

Abnormal In-111 leukocyte accumulation in a wound infection has not generally been confused with abscess. By obtaining oblique and lateral views, abnormal accumulation in an abscess deep to the infected wound can be determined (10). Furthermore, normally healing wounds do not accumulate the In-111 leukocytes.

A previous animal study with In-111 leukocytes demonstrated accumulation in the inflammatory response with myocardial infarction (11). Such a response is typically seen around the margin of infarcted tissue several days after infarction. In cerebral infarction, the polymorphonuclear leukocyte infiltration begins at approximately 48 hr and is replaced by approximately 96 hr (12). This leukocyte infiltrate may be so intense that it simulates a septic infarct pathologically. Abscesses in

other areas of the body have had greater accumulation of the labeled leukocytes than is present in the cerebral infarction of Fig. 4. We have not studied a patient with a known brain abscess. Several studies have been negative in patients with suspected brain abscesses, including one postoperative patient with an area of low density on the computed tomographic study. Thus, inflammation in infarcted tissue must be considered with abnormal In-111 leukocyte accumulation.

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