Oral ^{99m}Tc-Pertechnetate: An Aid in the Differentiation of Epigastric Lesions

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Occasionally, abnormalities in the upper portion of the abdomen may be suspected by the appearance or configuration of the liver, spleen, or kidneys during radionuclide imaging. For example, during liver and spleen imaging with ^{99m}Tc-sulfur colloid, the spleen may appear separated from the liver or assume an unusual flattened configuration against the abdominal wall. The presence of an epigastric mass may be suspected. Since the stomach occupies that space between the left lobe of the liver and the spleen, the simple ingestion of ^{99m}Tc-pertechnetate following the routine liver and spleen images may resolve this problem readily by visualizing that space.

This technique will probably be of greatest value in the localization of subdiaphragmatic abscesses. There are several potential spaces in the abdomen that are subhepatic and subsplenic in location that are virtually impossible to evaluate with routine imaging techniques. Oral ^{99m}Tc-pertechnetate will demonstrate these abnormal spaces.

Oral administration of ^{99m}Tc-pertechnetate has been reported as a method for examining the esophagus *(1)* and for determining gastric emptying time *(2)*. Occasionally ^{99m}Tc-pertechnetate is given orally for brain and thyroid imaging when an injection is impractical, but it has not been used for localization of abnormalities in the abdomen. At The Children's Memorial Hospital oral ^{99m}Tc-pertechnetate has proven to be a valuable aid in the evaluation of suspected lesions in the upper portion of the abdomen during liver/spleen, kidney, and bladder imaging. It has also been used to localize calcified abdominal masses during bone imaging.

Method and Materials

Upon completion of a liver/spleen, kidney, bladder, or bone scan using technetium-labeled radiopharmaceuticals, the scintiphotos are reviewed by the staff physicians. If any of the views indicate abdominal abnormalities at that time, an oral ^{99m}Tc-pertechnetate study is performed.

After having received the appropriate technetium-labeled radiopharmaceutical for one of the specific studies performed above, the patients are given an oral dose of 500 μCi of ^{99m}Tc-pertechnetate. If normal pediatric ^{99m}Tc doses have been used for the routine study, then 500 μCi of oral ^{99m}Tc-pertechnetate is sufficient for simultaneous imaging of the upper abdominal organs. In most cases, the oral dose can be administered by drawing it into a syringe, removing the needle, squirting the radionuclide into the child's mouth followed by a small volume of water that provides a bolus for swallowing, and rinsing the radionuclide from the mouth and esophagus.

The child is then placed under the scintillation camera in the supine position. The high-sensitivity collimator is used and 500K count images are obtained. The initial view, the anterior, is obtained to localize the radioactivity in the fundus of the stomach. In the anterior projection (Fig. 1A) the fundus lies lateral to the left lobe of the liver and is medial to the spleen. A second image is obtained after the patient has been positioned for a left anterior oblique projection (Fig. 1B). This position tends to move the radioactivity into the body and antrum of the stomach. The separation between the liver and spleen normally seen in this projection is now noted to be occupied by the stomach. Delayed images will visualize the duodenum and jejunum. Finally, a lateral view (Fig. 1C) illustrates the anteroposterior relationships of the upper

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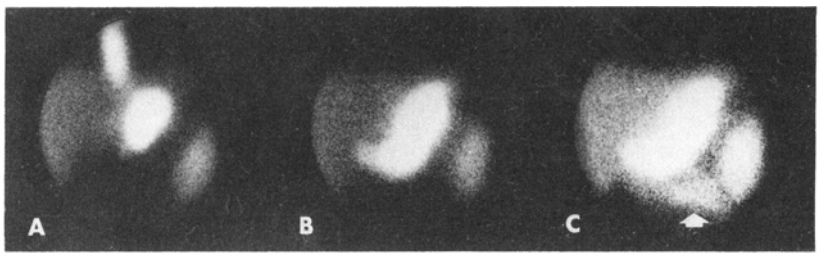

FIG. 1. (A) Normal anterior liver/spleen scan is illustrated with space between liver and spleen occupied by stomach. (B) Rotation of patient into LAO projection moves radioactivity into body and antrum. (C) Delayed LAO image demonstrates duodenum (arrow).

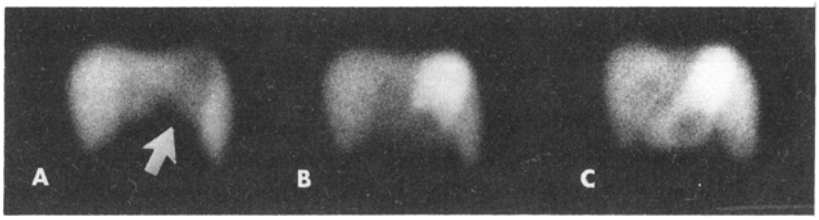

FIG. 2. (A) Liver/spleen scan shows questionable defect between liver and spleen. (B) Defect is occupied by stomach in anterior and (C) LAO projections.

abdominal organs. Alternatively, if sufficient water is ingested to distend the stomach, one can move the scintillation camera about the patient to image the organ relationships.

Results

During liver/spleen imaging with ^{99m}Tc-sulfur colloid, the spleen may appear separated from the liver or assume an unusual flattened configuration against the abdominal wall. The presence of an epigastric mass may be suspected, especially if there has been a history of a splenic trauma or if the possibility of a left-sided subdiaphragmatic abscess exists. When a prominent space is seen separating the liver and spleen, visualization of the stomach with oral ^{99m}Tc-pertechnetate will resolve the question since the stomach normally occupies the space between the left lobe of the liver and the spleen. In Fig. 2A, B and C, the prominent space previously seen separating the liver and spleen is demonstrated by the oral ^{99m}Tc-pertechnetate to be completely occupied by the stomach.

This technique will probably be of greatest value in the localization of subdiaphragmatic abscesses. Little difficulty is encountered in those collections localizing immediately beneath the hemidiaphragms because the abscess space separates lung from liver and spleen radioactivity, producing an evident abnormality. However, there are several potential spaces in the upper portion of the abdomen that are subhepatic and subsplenic in location. Even the lesser sac, a potential space behind the stomach, can localize an abscess collection. These spaces are virtually impossible to evaluate with routine imaging techniques. Oral ^{99m}Tc-pertechnetate will demonstrate these abnormal spaces, particularly on the left side of the abdomen.

A liver/spleen scan on a child with a colonic anastomosis breakdown following surgical correction for Hirschsprung's disease was ordered when the child did not respond as promptly as expected after a colostomy to divert the fecal stream from the anastomosis leak. The anterior view on the liver/spleen scan (Fig. 3A) shows medial placement of the spleen from the abdominal wall. The abdominal wall margin was marked using a small amount of ^{99m}Tc-pertechnetate in a syringe that was moved along the patient's lateral abdominal wall. Occasionally, the spleen may appear in such a position normally. Oral ^{99m}Tc-pertechnetate shows that the stomach is displaced to the right, and on delayed images (Fig. 3B and C) the proximal small bowel is also displaced medially and inferiorly. Thus the abscess space in a subsplenic location is well localized. At surgery a large 250-cc abscess collection was found in the subsplenic space displacing the stomach and bowel medially and extending along the lateral gutter.

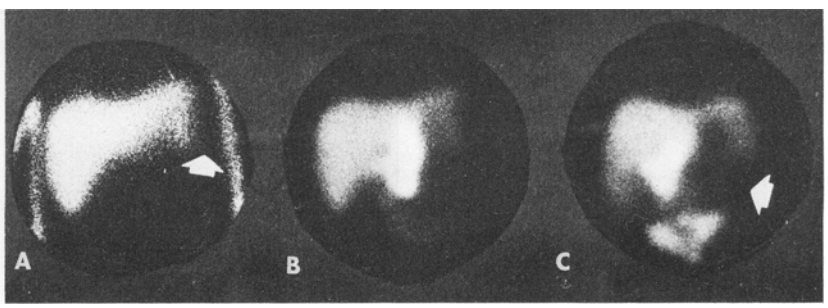

FIG. 3. (A) Subsplenic abscess is suspected by medial displacement of spleen from marker along lateral abdominal wall (arrow). (B) Delayed oral ^{99m}Tc-pertechnetate images show stomach and small bowel medially displaced. (C) LAO projection illustrates space (arrow) occupied by abscess in subsplenic location.

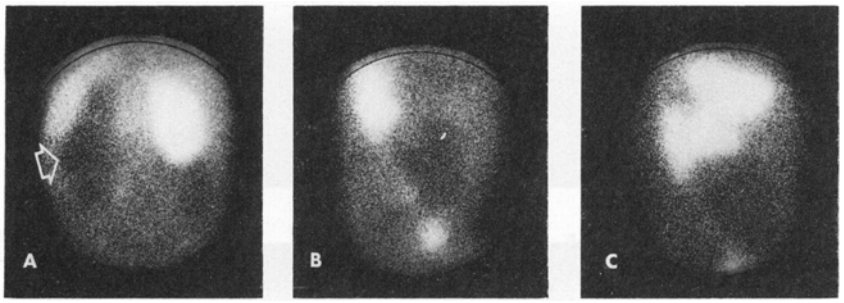

FIG. 4. (A) Avascular area is noted (arrow) on left during renal imaging. Differentiation between cystic renal lesion and swallowed air in stomach is necessary. (B) Oral ^{99m}Tc-pertechnetate is viewed in stomach and (C) above avascular area that proved to be multicystic kidney.

In another patient an avascular area was found on the left side of the abdomen during renal imaging with ^{99m}Tc-DTPA (Fig. 4A). Since distension of the stomach with swallowed air is common in crying children, one must differentiate this possibility from a cystic renal lesion. Technetium-99m-pertechnetate in the stomach appears to be above the avascular area (Fig. 4B), and on the lateral view it is located anteriorly (Fig. 4C). At surgery the avascular area proved to be a multicystic kidney. A similar problem was resolved with oral ^{99m}Tc-pertechnetate when an avascular area was found above the left kidney. A cystic renal duplication was considered. The avascular area proved to be swallowed air in the stomach (Fig. 5A and B). The oral ^{99m}Tc-pertechnetate in the stomach is anterior to the kidney in the lateral view.

In a child with neuroblastoma, a localized radionuclide accumulation was seen during bone imaging with ^{99m}Tc-polyphosphate, (Fig. 6A and B) corresponding to the known calcifications in the mass as viewed on roentgenograms. Oral ^{99m}Tc-pertechnetate was given to define the position and relationship of the stomach to the mass. In the lateral view, the stomach is anterior and superior to the mass (Fig. 6C).

As a last example of the use of oral ^{99m}Tc-pertechnetate, one can differentiate absorbed ^{99m}Tc-pertechnetate in the stomach from upper urinary tract activity due to vesicoureteral reflux during radionuclide cystography. Twenty percent of patients without vesicoureteral reflux have been found to absorb significant amounts of ^{99m}Tc-pertechnetate through the bladder mucosa *(3)*. Since the target organ for ^{99m}Tc-pertechnetate in the abdomen is the stomach, sufficient amounts may accumulate to be imaged and thus be confused with minimal reflux (Fig. 7A and B). Oral ^{99m}Tc-pertechnetate resolves the problem by showing that the radioactivity is in a position corresponding to that of the stomach (Fig. 7C).

Dosimetry

There is a minimal increase in the radiation burden to the patient produced with the addition of oral ^{99m}Tc-pertechnetate to the initial imaging procedure. It is estimated that 500 μCi of oral ^{99m}Tc-pertechnetate will produce a total-body radiation dose of 7 mrads and a gastric mucosa dose of 70 mrads *(4)*. The information gained is well worth the additional radiation burden.

Conclusion

The administration of oral ^{99m}Tc-pertechnetate to evaluate suspected abnormalities in the upper portion of the abdomen is a valuable technique. It is of great value for examining the subsplenic space and especially for localizing subsplenic abscesses. Oral ^{99m}Tc-pertechnetate can differentiate swallowed air in the stomach from cystic renal

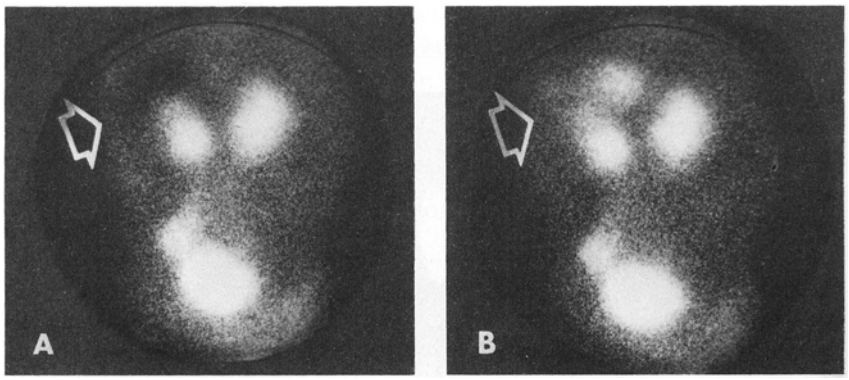

FIG. 5. (A) Avascular area above left kidney on the lateral view (B) identifies avascular area as air in stomach when oral ^{99m}Tc-pertechnetate fills that area.

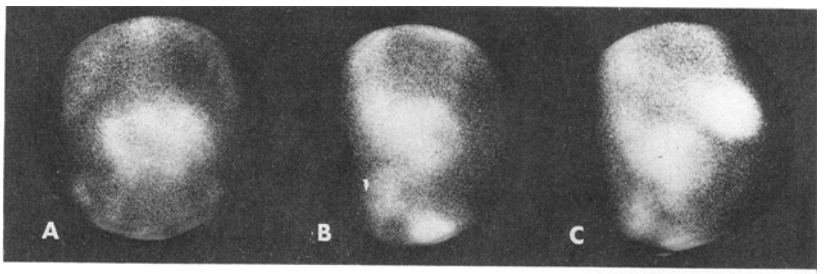

FIG. 6. (A) Calcified abdominal neuroblastoma mass is seen in anterior view (B) lateral projections during bone imaging with ^{99m}Tc-polyphosphate. (C) Oral ^{99m}Tc-pertechnetate fills stomach, which lies anterior and superior to mass.

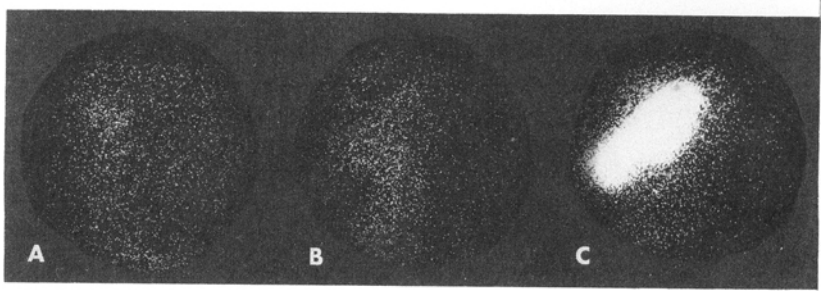

FIG. 7. (A) Residual radioactivity localizes in anterior and (B) lateral projections of abdomen following radionuclide cystography. Differentiation of stomach radioactivity versus vesicoureteral reflux is obtained with oral ^{99m}Tc-pertechnetate that fills stomach and corresponds with lateral image (C).

lesions and can differentiate absorbed ^{99m}Tc-pertechnetate in the stomach from vesicoureteral reflux. The procedure is simple to perform and adds only a few extra minutes to the total examination time. A 500-μCi dose of oral ^{99m}Tc-pertechnetate, in conjunction with other organ-specific ^{99m}Tc-labeled radiopharmaceuticals is sufficient for simultaneous imaging of the stomach and the upper abdominal organs. This adds about 7 mrads to the whole-body radiation dose to the patient.

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