THE USE OF INSPIRATION-EXPIRATION SCINTIPHOTOGRAPHS TO DETERMINE THE INTRINSIC OR EXTRINSIC NATURE OF LIVER DEFECTS

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The diagnosis of hepatic lesions is often one of exclusion since structures intrinsic to the liver (portal structures, gallbladder fossa, hepatic vein, separation of the lobes), and extrinsic to the liver (rib cage, sternum, gallbladder, kidney, barium in the colon, intra-abdominal and retroperitoneal tumors), as well as artifacts (overlying breast, camera field artifact) can produce defects on liver scans which may be confused with pathological entities within the liver (1-5). When the origin of a defect is uncertain, inspiration-expiration views may be of value by demonstrating whether or not the defect represents a structure or lesion within the liver. Given a reasonably cooperative patient the method is simple to perform, requires no special equipment, and the results are immediately available.

METHOD

In our laboratory an 8-mCi dose of 99mTc-sulfur-colloid is administered for a liver scan. One-million-count anterior, posterior, and lateral liver views are obtained on the Anger camera (similar views of the spleen are also obtained routinely). The anterior view of the liver is usually made with breath-holding (6). We also routinely obtain 100,000-count inspiration and expiration anterior views of the liver to evaluate pliability (7).

If a solitary lesion that cannot be definitely localized as intrahepatic or extrahepatic is identified, one-million-count breath-holding inspiration and expiration views are produced in the following manner. The patient is positioned to obtain the view in which the lesion is most clearly seen. To produce the inspiration view the patient is instructed to take a deep breath and hold it, raising his finger when he can no longer hold his breath. Counts are collected until this signal is given. After a period of normal breathing the patient is again asked to hold his breath and additional counts are collected. This procedure is continued until one million counts have been obtained. This generally requires three or four breath-holding periods and 1½–2 min of counting. Without moving the patient, the expiration view is obtained in the same manner, except that the patient is instructed to breathe out as much as possible before holding his breath.

The two views are inspected and liver movement is assessed visually. A change in liver position between the two views must be readily perceptible if this method is to yield valid results. The defect is then identified on each view. If the position of the defect relative to the liver changes between the two views, i.e., if the defect does not move to the same degree as the liver, then it must represent a structure or artifact extrinsic to the liver; an intrinsic lesion such as a neoplasm or abscess can be confidently excluded. If the relationship of the defect to the liver does not change between the two views, the defect probably represents a structure or lesion within the liver although in this case it may represent an extrinsic structure such as the gallbladder which is moving in unison with the liver.

Although one-million-count inspiration-expiration views are usually necessary for successful application of this method, a large defect may also be identified on the 100,000-count inspiration-expiration views used to evaluate pliability.

RESULTS

The following three cases illustrate this method:

Case 1. WE, a 74-year-old white male with a previous history of carcinoma of the right colon and right hemicolectomy presented with anemia, melena, rectal bleeding, dark urine, jaundice, and a palpable liver. The liver scan revealed a large defect in the

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right lobe (Fig. 1A). The inspiration and expiration views (Figs. 1B and C) demonstrated that the defect did not move with the liver. At surgery a markedly distended gallbladder was found in association with recurrent carcinoma involving the head of the pancreas and second and third portions of the duodenum. The gallbladder was bound to the small bowel, omentum, and retroperitoneal structures by dense adhesions that prevented it from moving with the liver. (The patient died 10 days postoperatively.)

The fact that the defect did not move with the liver indicated that it was produced by something extrinsic to the liver, which in this case proved to be an enlarged gallbladder whose movement was restricted by adhesions.

**Case 2.** HH, a 57-year-old white male presented with sensory and motor loss in the arms and legs considered most likely to represent a diffuse demyelinating syndrome. A survey for malignancy was carried out which included a liver scan. The scan demonstrated a defect in the right lobe. Inspiration-expiration views (Fig. 2) showed that the defect did not move with the liver, and the defect was therefore considered to be an artifact, probably related to the overlying rib cage. Numerous other tests failed to reveal findings suggestive of malignancy. A myelogram performed 3 months later revealed cervical disc disease, which was the probable etiology of the neurological findings. An anterior fusion was performed and has resulted in improvement in the patient's symptoms.

The defect in the liver would probably have been diagnosed as a metastatic neoplasm if inspiration-expiration views had not been obtained.

**Case 3.** JS, a 67-year-old Negro male with a history of heavy drinking presented with weakness, weight loss, and a palpable liver. The liver scan revealed a region of decreased uptake in the right lobe posteriorly which on inspiration-expiration views (Fig. 3) shifted with the liver and was therefore considered to represent a cirrhotic nodule. A liver biopsy revealed early micronodular cirrhosis. During the following 6 months the patient's condition did not change, and a subsequent liver scan again demonstrated the defect of the right lobe, unchanged from the earlier study.

The inspiration-expiration views showed that the defect probably originated from a structure or lesion within the liver, which in view of the history and pathological findings was most likely a cirrhotic nodule.

**DISCUSSION**

We have found this method of obtaining inspiration-expiration views valuable in determining the intrinsic or extrinsic nature of hepatic defects. Its greatest value lies in demonstrating the nonpathological nature of small defects produced by extrinsic structures such as the rib cage as in Case 2. It can also be used to confirm the artifactual nature of overlying breast tissue and camera field defects although the more direct methods (elevating the breast, obtaining a field flood) are preferable. When an artifact is misdiagnosed as a pathologic structure, the patient may be subjected to unnecessary diagnostic procedures and incorrect therapy. This method has often helped us to avoid such a misdiagnosis.

The method must be used with some caution when it indicates the origin of a defect to be intrinsic to the liver since an extrinsic mass that moves with the liver will appear to be intrinsic by the criteria of this method. In Case 1 the gallbladder was prevented from moving with the liver by adhesions that bound it to retroperitoneal structures and so the corresponding defect on liver scan could be recognized as having an extrahepatic origin. Generally the gallbladder will move with the liver and

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**FIG. 1.** Case 1: 74-year-old man with colonic carcinoma. A is anterior liver scan. Large defect is present in right lobe. B is inspiration view, and C is expiration view (100,000 counts each). Defect does not move with liver, and therefore does not represent intrinsic liver lesion. Hydrops of gallbladder was found at surgery.

**FIG. 2.** Case 2: 57-year-old man with suspected diffuse demyelinating syndrome. A is anterior liver scan, inspiration view; and B, expiration view, one million counts. Defect in right lobe does not move with liver, and therefore does not represent intrinsic liver lesion.
will appear to be an intrinsic mass by the criteria of this method. Similarly, a defect produced by barium in the hepatic flexure of the colon will be considered intrahepatic since the flexure moves with the liver. Such possibilities must be kept in mind and additional studies (e.g., abdominal x-ray, cholecystogram) must be obtained when necessary.

Occasionally the method cannot be applied because the patient cannot hold his breath. In other instances, the patient's respiratory excursion is limited, making interpretation of results difficult. In most cases, however, the method can be applied readily. It is simple, fast, requires no additional administration of radionuclide, and produces very useful information.

CONCLUSION

Serial inspiration and expiration views taken with the patient in the same position will often aid in determining the nature of a defect seen on a liver scan. If the defect moves to the same degree as the liver, its origin is most probably intrinsic to the liver; if it does not move to the same degree, its origin is definitely extrinsic to the liver.

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REFERENCES