Hepatobiliary Scintigraphy in Patients with Bile Leaks

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Hepatobiliary scintigraphy has been recognized as a useful tool in detecting the presence and sites of bile leaks. The clinical settings in which bile leaks are likely to occur, as well as some of the scintigraphic patterns seen in patients with bile leaks, are reviewed here. Tips for technologists are offered on interventions that might enhance the quality of information available to the nuclear physician.

The occurrence of iatrogenic leaks in the biliary tree following biliary or hepatic surgery is well documented (*1–3*). In addition, abdominal trauma is sometimes responsible for bile leaks. Rarely, gallbladder rupture and bile leakage occur as a result of acute inflammation or infection. The technetium-99m (^{99m}Tc) iminodiacetic acid (IDA) scan has been shown to be of value in detecting bile leaks, especially after surgery, where distortion of anatomic landmarks can interfere with evaluation via ultrasound or computed tomography (*4–7*). Awareness on the part of the technologist of the possibility of a bile leak can guide him/her in taking special views to demonstrate a leak.

CASE 1

An elective cholecystectomy was performed on a 48-yr-old woman diagnosed as having chronic cholecystitis. For 2–3 yr the patient had been experiencing intermittent eructation and right upper quadrant pain. Ultrasound had confirmed cholelithiasis. Preoperative chemistry studies revealed no evidence for liver dysfunction or biliary tract obstruction.

Five days after an uneventful cholecystectomy a hepatobiliary scan was ordered to rule out an obstructed common bile duct. The patient's total bilirubin (6.3 mg/dl, normal = 0.2–1.0 mg/dl), direct bilirubin (4.3 mg/dl, normal = 0–0.2 mg/dl), and alkaline phosphatase (310 U/l, normal = 30–115 U/l) had all become abnormally elevated. The patient had developed an ileus and vague diffuse abdominal discomfort.

The biliary scan (Fig. 1), performed with 5.1 mCi of ^{99m}Tc-labeled disofenin, revealed evidence of a bile leak and bile ascites. Under ultrasound guidance paracentesis was performed, and ascitic fluid was aspirated from the peritoneal cavity (Fig. 2A). The ascitic fluid was imaged (Fig. 2B) under the scintillation camera, demonstrating the presence of radionuclide. The appearance of a drop of the fluid (Fig. 3A) and chemical analysis (Fig. 3B) confirmed the presence of bile.

The site of the bile leak was located and repaired at the time of reexploration.

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CASE 2

A 57-yr-old woman was admitted to the hospital complaining of epigastric pain, nausea, vomiting, and a 2-wk history of progressive jaundice. Initial laboratory studies suggested an obstructive jaundice: total bilirubin 13.6 mg/dl (normal = 0.2–1.0 mg/dl), direct bilirubin 7.4 mg/dl (normal = 0–0.2 mg/dl), and alkaline phosphatase 427 U/l (normal = 36–92 U/l).

Ultrasound revealed one large stone in the gallbladder, a common bile duct of 6-mm diameter, and the possibility of a stone in the common bile duct. A biliary scan with 2 mCi ^{99m}Tc disofenin (Fig. 4) showed evidence of an obstruction of the biliary tract. After confirming the obstruction with a percutaneous transhepatic cholangiogram, surgery was performed.

Surgical exploration revealed a large liver, which was abnormally greenish, and a common hepatic duct/common bile duct stricture suggesting a long-standing obstructive process.

The gallbladder, containing a single large stone, was removed but no stone was recovered from the biliary ducts. A stricture of the common hepatic duct and proximal common bile duct required inspection, probing, and dilatation. Inspection and biopsy revealed no evidence of malignancy. A Penrose tube was sutured in place to drain postsurgical fluid from the hepatorenal pouch external to the liver.

Three to four days after surgery the patient developed a distended abdomen and low grade fever. Cultures revealed infection of the drainage and therapy with antibiotics was started. Although the biliary scan (Fig. 5) showed evidence of a bile leak, there was marked improvement from the preoperative scan and return of substantial bile flow through the biliary tract and intestine.

During the next 5–7 days, the bile drainage and leak subsided. Chemistry studies returned to normal. The Penrose drain was removed and the patient was discharged.

DISCUSSION

Clinical Settings

There are no clear-cut symptoms that point to an easy, reliable diagnosis of a bile leak. A bile leak patient may complain of pain, tenderness, swelling, nausea, and low-grade fever, yet these symptoms are similar to those describing acute cholecystitis or a host of other abdominal diseases. Despite nonspecific symptoms, there are two major clinical settings where bile leaks are most likely to be found: patients who have undergone biliary/hepatic surgery, and patients suffering from abdominal trauma of the penetrating and (less commonly) blunt type.

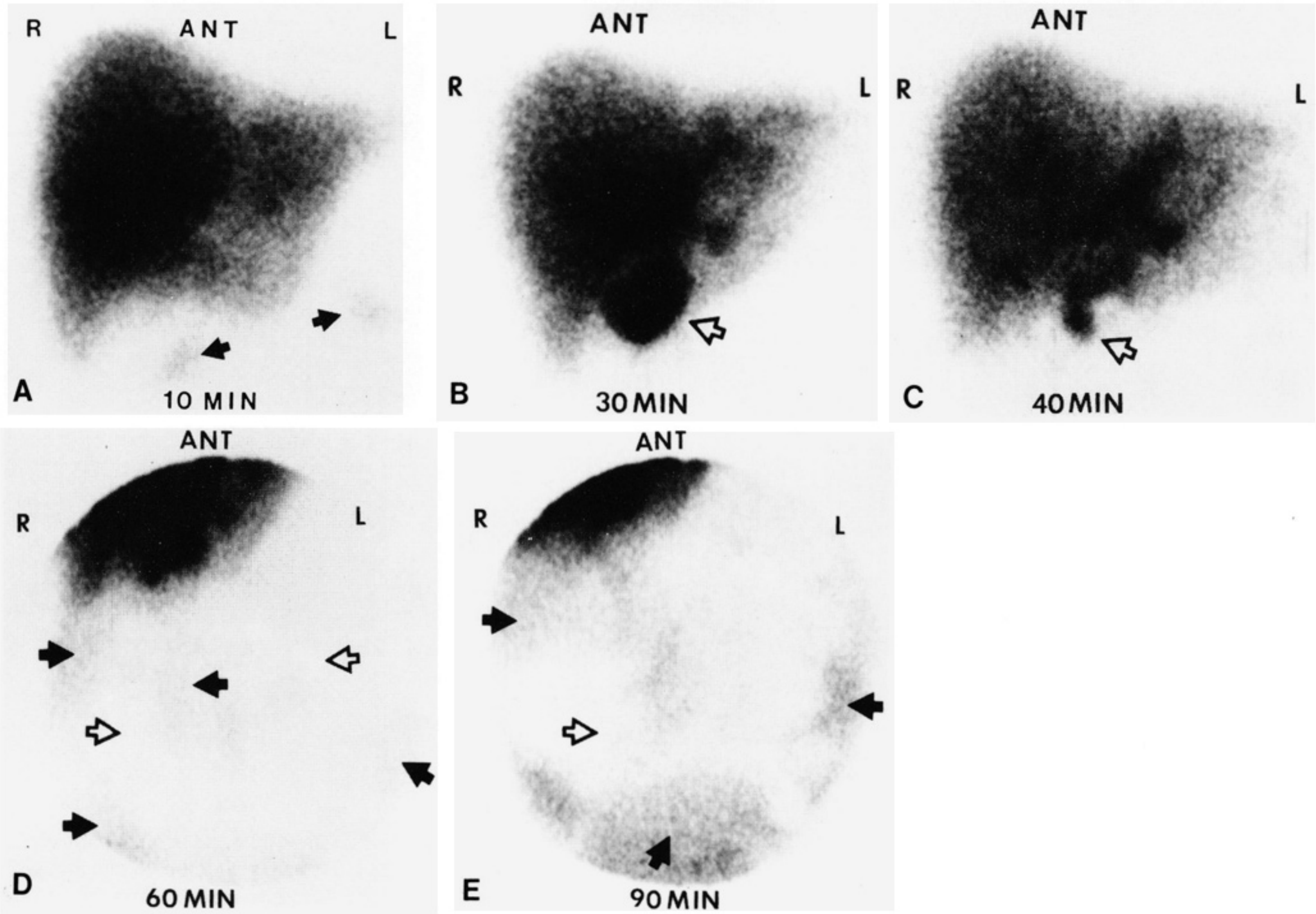


FIG. 1. (A) Anterior view of liver at 10 min on biliary scan. Arrows show early renal activity. (B) Anterior view at 30 min; (C) at 40 min. Open arrow (B) shows large collection of radionuclide, which is reduced at open arrow in (C). In combination with abdominal tracer appearance, the changing pattern at open arrow is determined to be site of bile leak. Abdominal images at 60 min (D) and 90 min (E) with pattern of bile ascites. Open arrows show photon deficient areas of bowel.

Since first performed in 1882 by Dr. Carl Johann August Langenbuch (*8*), cholecystectomy has become one of the most common surgical procedures in the United States (*9*). The significant incidence of patients with postcholecystectomy distress (meaning persistance of symptoms) led Pribram in 1950 to suggest the existence of a specific postcholecystectomy syndrome (*10*). The literature reports symptomatic cure in only 50%–80% of cholecystectomy patients (*11*).

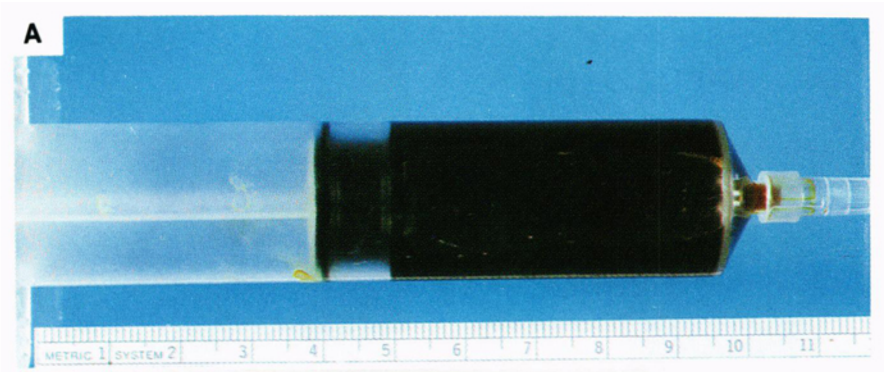
Many postcholecystectomy patients retain their symptoms, yet the referring physician is often at a loss in ascertaining whether these symptoms are due to ineffective surgical intervention or result from postoperative complications such as infection or bile leak. Inadvertent surgical damage to the extrahepatic bile tree during cholecystectomy or common bile duct exploration can lead to a leak of bile out of the damaged duct into the abdominal cavity, resulting often in bile ascites (*12*). The postcholecystectomy syndrome should therefore be considered in any patient with symptoms of pain, tenderness, swelling, and low-grade fever as a possible result of bile leak. It should be noted that the postcholecystectomy patient can be someone in whom there was greater than a 5-yr span between cholecystectomy and distress (*13*).

It has been suggested by Weissmann et al. (*14*) that any patient suffering blunt or penetrating abdominal trauma should be considered for biliary disruption, even if the incident occurred weeks, months, or years earlier. Traumatic bile cysts often develop slowly; the patient may seem to recover fully from the initial trauma, yet develop intermittent abdominal pain, distension, fever, jaundice, or anorexia at a later date. If the traumatic bile cyst ruptures, the result can be free bile in the peritoneal cavity. Extravasation of bile into the peritoneal cavity may lead to chemical peritonitis or, if the leaking bile is infected, a fulminating and frequently fatal peritonitis (*2*).

The Technologist's Role

The technologist is often the first person in the nuclear medicine department to interact with the patient. Many technologists are involved in acquiring patient histories (*15*). Understanding the clinical problem will allow a technologist to tailor a study to the specific circumstances. In a patient with a history of biliary/hepatic surgery or abdominal trauma whose symptoms include pain, tenderness, swelling, nausea, and low-grade fever, the possibility of a bile leak must be considered.

Once the possibility of a bile leak has been established, special images can be added to the department's standard hepatobiliary protocol. There are three things that should be kept in mind when detecting bile leaks: aberrant activity, lower abdominal images, and delayed films at least 1 hr after injection.



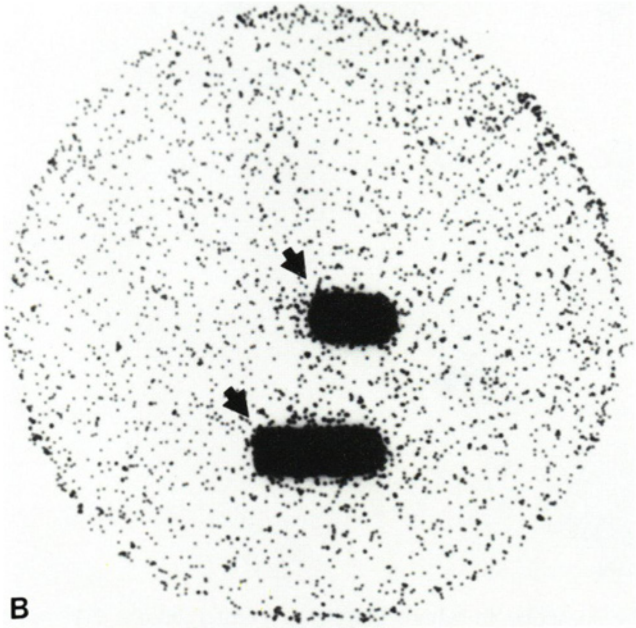


FIG. 2. (A) Syringe with fluid obtained from abdomen by paracentesis under ultrasound guidance immediately after the 90 min images in figures 1D and 1E. (B) Radioactive fluid as shown in (A) in two separate syringes (arrows) confirms that the tracer was leaking into the peritoneal cavity instead of following the usual route of bowel excretion.

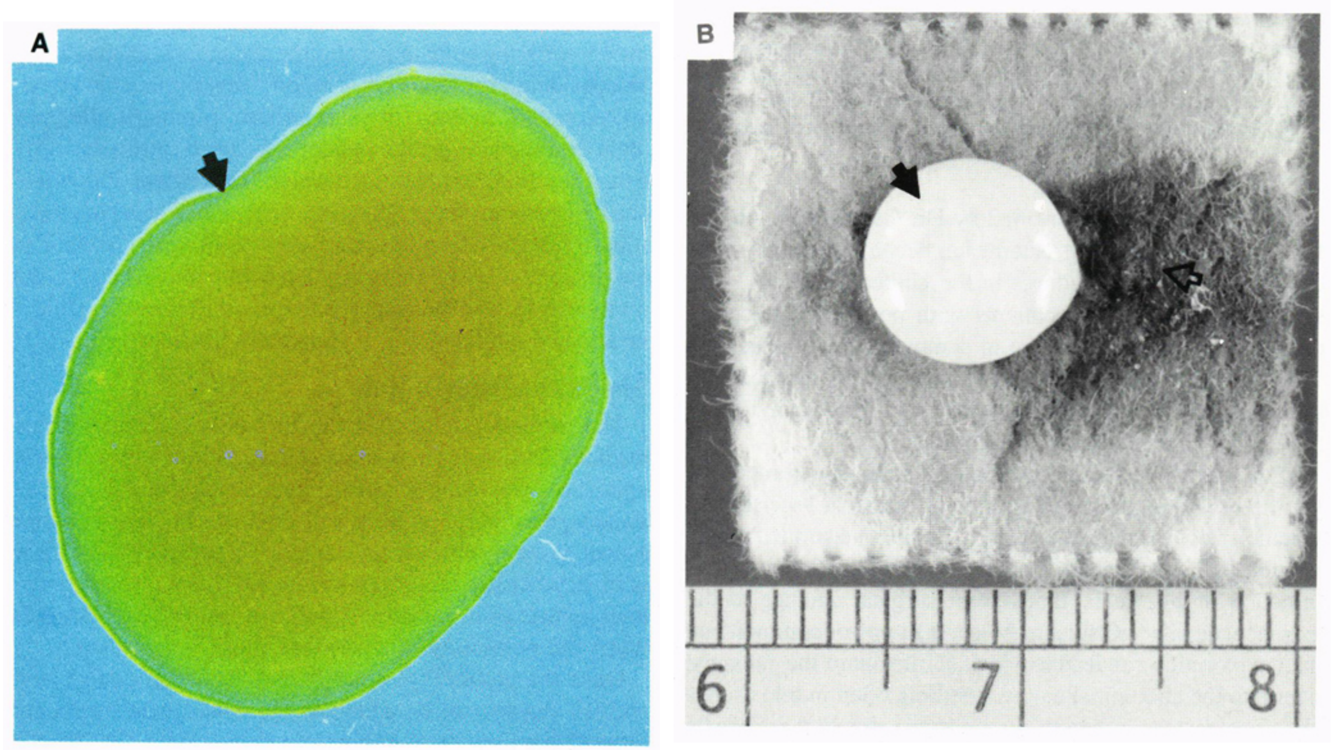


FIG. 3. (A) Arrow points to drop of the bile-stained fluid, confirmed to be leaking into the peritoneum. (B) The ictotest used to confirm the presence of bile in the peritoneal fluid obtained. The solid arrow indicates the tablet placed on a pad impregnated with the fluid being tested for bile. After adding distilled water to the tablet, the presence of bile is confirmed by the color of the pad (open arrow).

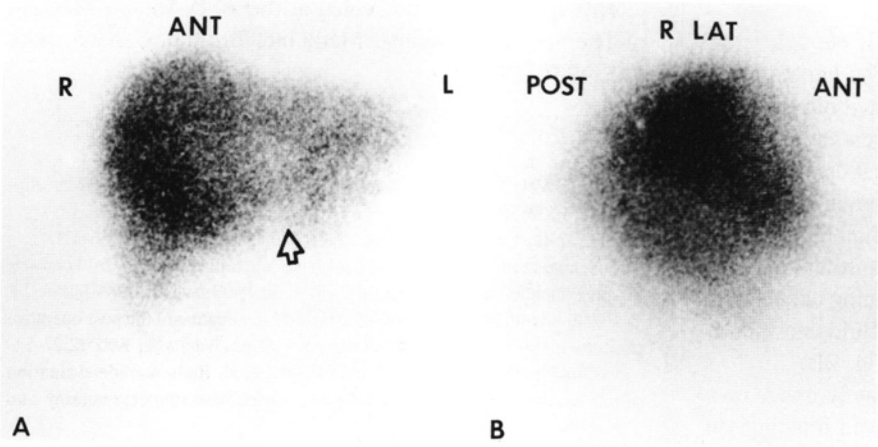


FIG. 4. (A) Anterior and (B) right lateral views of liver on preoperative biliary scan taken at 3 hr. Absence of tracer in biliary tract and intestine to 4 hr is compatible with biliary tract obstruction.

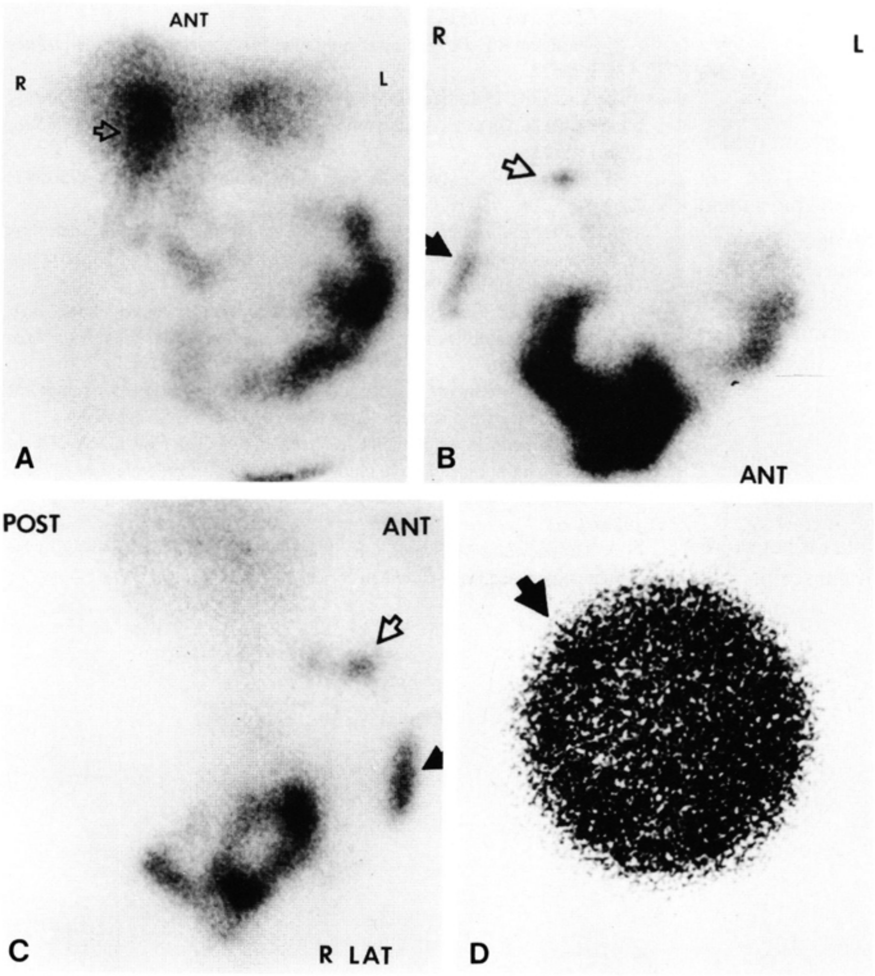


FIG. 5. (A) Postoperative anterior biliary scan at approximately 1 hr. Open arrow shows ill-defined increased tracer at site of bile leak. (B) Anterior and (C) right lateral postoperative biliary scan at 2 hr. Open arrow is site of drainage tube carrying bile leak fluid from abdominal cavity to external collection bag. Solid arrows indicate drainage collection bag. (D) Fluid from external collection bag in a cup shows radioactivity, confirming that the radioactive tracer leaked from the biliary tract and was collected by the drainage tube.

Since there is no "classic" image pattern associated with bile leaks, attention should be paid to the hepatobiliary images and whether there is any tracer in extrabiliary or extraurinary sites. Bile leaking from the biliary tract tends to initially collect in a space (Morrison's pouch) below the liver.

Recent postsurgical patients sometimes have a Penrose tube that drains any fluid from within the abdominal (peritoneal) cavity. Imaging this tube allows discrimination between biliary structures and a possible leakage of bile into the abdomen tnat is draining out through the tubing (Fig. 5B). A portion of the fluid from the tubing can also be counted in a well counter or on the camera face (Fig. 5D) for evidence of counts above background. If the technologist identifies activity thought to be aberrant, additional lateral or oblique views will often confirm the location (Fig. 5C).

Not all bile leaks are focal and discrete. If enough bile is leaking, ascitic abdominal fluid collects. The hepatobiliary images will often show diffuse activity throughout the abdomen (Fig. 1D). Since other biliary structures may visualize and give the appearance of a normal study, it can be helpful to position the detector over the lower abdomen in an effort to enhance diffuse activity in that region (Fig. 1E). If radioactive bile is imaged in the ascitic abdomen, further confirmation may be sought by the physician's performing paracentesis of the ascitic fluid (Fig. 2A). This ascitic fluid can then be checked for counts as described earlier (Fig. 2B).

Most nuclear medicine departments routinely image up to 1 hr after injection of ^{99m}Tc IDA, with delayed imaging employed only if the routine films are abnormal. In detecting bile leaks, however, the scan can be normal at 1 hr, yet at 2 or 3 hr postinjection show evidence of a diffuse leak or more discrete fistula. Weissmann et al. (*4*) reported that in a study group of 12 bile leak cases, views obtained at 1 hr or longer were instrumental in detecting the presence of bile leaks in six studies.

In summary, the technologist can play an important role in the evaluation of postcholecystectomy abdominal pain. By being alert to the possibility of a bile leak at the time the patient history is acquired, the technologist can plan special views to evaluate for the presence of leaks and be aware of characteristic imaging patterns that may confirm a bile leak. The technologist can also assist the physician in performing further confirmatory procedures such as paracentesis of abdominal fluid to detect radioactive bile.

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