

# Intravenous Cholescintigraphy Using Tc-99m-Labeled Agents in the Diagnosis of Choledochal Cyst

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**Twelve patients with choledochal cyst have undergone intravenous radionuclide cholescintigraphy (IVRC) with Tc-99m-labeled HIDA or PG before surgery. The most characteristic findings are: (1) A round or ovoid photon-deficient area in the region of the gallbladder in the early images; (2) progressive accumulation of radioactivity in the same region in later images, especially at 2 hr after injection; (3) the long axis of this particular area directed downward and to the patient's left from the right midclavicular line, suggesting the direction of the common bile duct; and (4) persistent pooling of the tracer up to 24 hr, even after a fatty meal. By these criteria, correct diagnoses have been made preoperatively in ten of 12 cases (83.3%). We conclude that IVRC using Tc-99m HIDA or Tc-99m PG is an excellent first-line diagnostic tool for choledochal cyst.**

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Choledochal cyst is a relatively rare developmental anomaly that occurs more frequently in Japan than elsewhere, and is most often seen in females under 10 yr of age (1). Preoperative diagnosis is difficult because of infrequent presentation of the typical clinical triad, i.e., abdominal pain, jaundice, and abdominal mass (1,2). Conventional radiographic studies—including upper GI series, oral cholecystography (OC), and intravenous cholecystography (IVC)—have been accomplished successfully in only a few patients (3,4).

Intravenous radionuclide cholescintigraphy (IVRC) with I-131 rose bengal established the diagnosis of choledochal cyst in 1970 by William et al. (5). Since then hepatobiliary scintigraphy has been advocated as a nontraumatic, safe, and accurate tool for the diagnosis of choledochal cyst (6,7). Since 1975, Tc-99m-labeled pharmaceuticals such as pyridoxylidene-glutamate (PG) or N-(2,6-dimethylphenylcarbamoylmethyl)iminodiacetic acid (HIDA) have replaced iodine-labeled com-

plexes for liver and biliary-tract studies because of better image quality, lower radiation dose, and more rapid biliary excretion than with the earlier agents (8-10).

IVRC has been performed with Tc-99m PG or Tc-99m HIDA on 12 patients with choledochal cyst proved by subsequent operation in our hospital. This paper reviews the Tc-99m PG or Tc-99m HIDA IVRC findings of these patients, and reevaluates diagnostic accuracy as well as possible clinical application.

## MATERIALS AND METHODS

In a 4-yr period, there were 724 patients who had had Tc-99m PG or HIDA IVRC before their biliary surgery. Among them were 12 patients with choledochal cyst. The diagnosis of choledochal cyst was proven by surgical findings of cystic dilatation of the common bile duct and by subsequent excision with histological confirmation of the cystic lesion. Preoperative studies with upper GI series were performed on two patients; oral or i.v. cholecystography (OC and IVC) in two, ultrasonography in ten, and endoscopic retrograde cholangiography (ERC) in three patients. Every patient received preoperative IVRC using Tc-99m PG or HIDA.

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**TABLE 1. SUMMARY OF IVRC FINDINGS WITH Tc-99m-LABELED AGENTS IN 12 CASES OF CHOLEDOCHAL CYST**

Findings	No. of times present (%)
1. Nonvisualization of GB	9 75.0
2. Nonvisualization of CBD	9 75.0
3. Deficient image at GB	10 83.3
4. Accumulation of tracer in later images	11 91.7
5. Persistence of pooling longer than 6 hr	10 83.3
6. Long axis of this particular area similar to that of CBD	11 91.7

GB: gallbladder; CBD: common bile duct.

IVRC was performed after overnight fasting. Serial images were obtained using a gamma camera\* at 5, 15, and 30 min, and at 1, 2, 4, 6, and 24 hr after intravenous administration of 2-6 mCi Tc-99m PG or HIDA. All cholescintigrams were read, and an IVRC diagnosis made, before biliary surgery.

**RESULTS**

There were four male and eight female patients, from 4 to 49 yr old, with only four subjects (33.3%) younger than 10. The clinical triad of choledochal cyst presented in only five patients (41.7%). Clinical diagnosis of choledochal cyst was made in four persons (33.3%) and was considered in the list of differential diagnosis in an additional four.

In the preoperative examinations, OC and IVC in two cases with serum bilirubin <1.9 mg% failed to visualize the biliary tract. An upper GI series in two patients showed displacement of the duodenal bulb. Eight out of

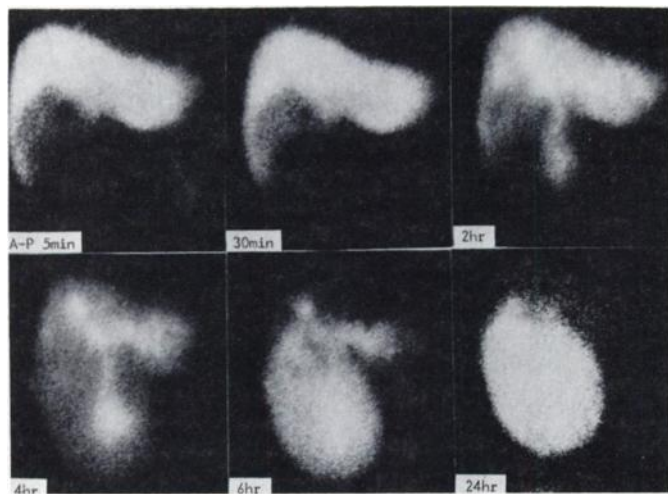
ten patients undergoing ultrasonography demonstrated the presence of a cystic lesion in subhepatic area. Two out of three examinations demonstrated cystic dilatation of the common bile duct at endoscopy. Therefore, the diagnostic rates of ultrasonography and ERC are 80% and 66.6%, respectively.

The IVRC findings in the 12 cases are summarized in Table 1. The three different patterns found are shown in Figs. 1 (Pattern A), 2 (Pattern B), and 3 (Pattern C). Pattern A shows a photon-deficient area around the gallbladder region in the early images, with progressive accumulation of radioactivity in the corresponding region 2 hr after injection and persistence of the tracer pooling up to 24 hr. Pattern B shows a constantly high background and persistent photon-deficient area in the subhepatic region. Pattern C shows early and progressive accumulation of the tracer in the "common bile duct," tubular-shaped and persisting up to 22 hr after injection. Ten cases presented with Pattern A and were correctly diagnosed before surgery as choledochal cyst. Two patients presented with Patterns B and C, respectively, and were diagnosed as impaired liver function (B) and incomplete biliary obstruction probably due to choledocholithiasis (C). The diagnostic rate of IVRC in our series is 83.3%. During the same period, no false-positive diagnosis of choledochal cyst was made in the more than 700 patients who had IVRC before biliary surgery.

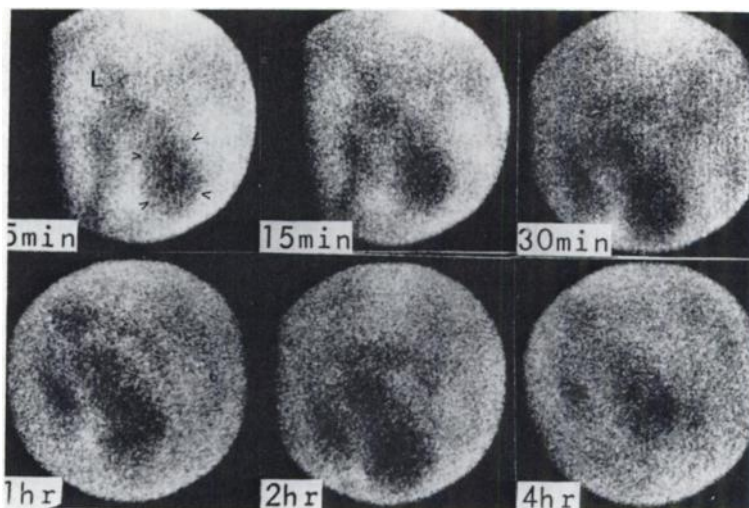
**DISCUSSION**

There are several reports concerning the difficulty in the diagnosis of choledochal cyst preoperatively, especially in subjects older than infants (1). It is frequently misdiagnosed as cholecystitis, cholelithiasis, choledocholithiasis, abdominal tumor, hepatic cyst, or tumor with obstructive jaundice (1). Thus, a search for a more reliable and accurate diagnostic tool is quite important from the clinical point of view.

The diagnostic value of OC and IVC in choledochal



**FIG. 1.** IVRC findings of 19-yr-old man (Pattern A). Note photon-deficient area below right lobe of liver in images from 5 min to 1 hr, and progressive accumulation of tracer after 2 hr, persisting up to 24 hr after injection. Long axis of this abnormal accumulation is similar to that of common bile duct and could be differentiated from an enlarged gallbladder. During operation, capacity of cyst was found to be 1500 ml.



**FIG. 2.** IVRC findings of 13-yr-old girl (Pattern B). Note constantly high background as well as presence of negative image below right lobe of liver throughout whole course of study. Arrowheads indicate lesion. L indicates liver.

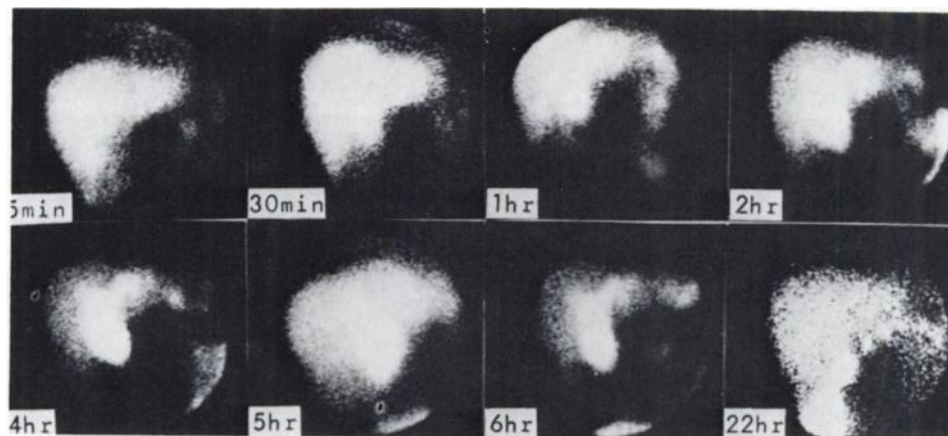
cyst is very limited. Silberman et al. (3) reported that only three out of 405 cases were correctly diagnosed by conventional radiographic cholangiography. Jaundice is the main obstacle. Upper GI series yielded positive results in 84% of patients (4). However, displacement of the stomach and duodenal bulb is an indirect sign and not a specific finding for choledochal cyst. In our series, OC and IVC as well as upper GI series were used only occasionally for the above-mentioned reasons. Ultrasonography and ERC are much better than conventional radiography in the demonstration of cyst. But ultrasonography is not a functional study that can always demonstrate the communication of the cyst and bile duct (11,12). As to ERC, it is technically difficult, time consuming, and uncomfortable for the patient, and as yet available in relatively few centers (13,14), especially for pediatric patients. Therefore, it is not an ideal initial diagnostic method for choledochal cyst.

The simplicity, safety, and value of IVRC using Tc-99m-labeled agents in the diagnosis of hepatobiliary

diseases have been studied and confirmed for years (14-16). Even in jaundiced patients with high bilirubin (up to 10 mg%), it is still possible to demonstrate the biliary tract (17). Therefore, the application of the Tc-99m-labeled hepatobiliary studies of the abnormal biliary excretion caused by congenital anomaly of the bile duct should be superior to that of conventional radiographic studies. The high diagnostic rate (83.3%) achieved in our series confirms that IVRC using Tc-99m-labeled agents is a good diagnostic test for choledochal cyst.

Through analysis of the serial scintigrams shown in Figs. 1-3 and the findings summarized in Table 1, different patterns can be recognized. The scintigraphic findings of Pattern A are characterized as follows:

1. A spherical or ovoid photon-deficient area around the region of the gallbladder in the early stages, suggestive of enlarged gallbladder or abnormal cystic dilatation of the biliary tract or an abdominal space-occupying lesion such as a tumor.



**FIG. 3.** IVRC findings of 37-yr-old woman (Pattern C). Note progressive accumulation of tracer in "common bile duct," which is persistently seen up to 22 hr. Note also delayed visualization of bowel activity.

2. Progressive accumulation of radioactivity in the corresponding region in later images, usually 2 hr after tracer injection, confirming the communication of this abnormal area with the biliary system.

3. The long axis of this particular area directed downward and to the patient's left, similar to that of the common bile duct, differentiating a bile-duct anomaly from one in the gallbladder.

4. Persistence of tracer pooling up to 24 hr, reflecting functional disturbance of biliary excretion caused by this cystic lesion.

By these objective and dynamic findings, the Tc-99m PG or HIDA IVRC can demonstrate not only the size and shape of the choledochal cyst, but also its functional disturbance, an impossibility with any other diagnostic method. Ten out of 12 patients (83.3%) in our series presented with this pattern and were easily and correctly diagnosed. Therefore, this pattern and these criteria are highly characteristic of choledochal cyst.

Incorrect diagnosis was made by IVRC in only two patients with choledochal cyst. One was a patient with secondary biliary cirrhosis and frank jaundice who showed Pattern B. The other was a patient with fusiform dilatation of the common bile duct who showed Pattern C. Further study with ultrasonography and/or ERC is necessary in these patients, who fortunately represent only a minority. Most patients can be correctly diagnosed by serial cholescintigraphy.

FOOTNOTE

\* Elscint dymax UF or Nuclear Chicago pho/gamma IV.

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