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Cystic Duct Cholangiography

Leo Chaikof, MD,* T.L. Friedlich, MD, R.A. Affifi, MD and H. Weizel, MD

A series of 837 cystic duct cholangiograms has been reviewed. The technique is simple and safe to carry out. It is not time consuming and does not require any unusual equipment. It has reduced the incidence of common duct exploration and has decreased the incidence of retained common duct stones. It is stressed that, unless the operative cholangiogram fulfills the criteria of a normal cholangiogram, especially in relation to size and tapering of the lower end of the duct, then common duct exploration should be carried out. Its almost routine use can only increase the general quality and accuracy of biliary tract surgery.

Although operative cholangiography was first used in 1932 by Mirizzi, it is still not done routinely as part of the surgical procedure in biliary tract operations. According to Jolly, Baker et al, only 18% of members of the American Surgical Association use it routinely. Despite a great deal of discussion pro and con in the literature, it appears that, if the frequency of common duct exploration can be reduced, certainly its associated morbidity and mortality can also be decreased.

Glenn and Beil claimed 42.4% of common duct explorations and Colcock and Perey claimed 72% of the choledochotomies they surveyed, respectively, were negative and unnecessary. We will show that the incidence of common duct exploration as well as retained common duct stones has been decreased with the use of cholangiography.

Method

The patient is positioned on a Bucky diaphragm on the operating table. Endotracheal anesthesia with nonexplosive agents and muscle relaxants is then employed. The gall bladder field is exposed and the peritoneum overlying the ampulla of the gall bladder toward the bile duct is split. The cystic duct and artery are then visualized and the cystic artery is ligated and divided. Occasionally, it is somewhat easier to visualize the cystic duct and to catheterize this first.

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The cystic duct is ligated at its junction with the gallbladder. The tie is left long to act as a traction suture, and a second loop tied distally and held on tension. The duct is then partially incised and a #5 ureteral catheter is then inserted for a distance of 3-4 cms. Prior to the insertion of the ureteral catheter, a #20 needle is fixed into the proximal end of the catheter and saline is flushed through the catheter. This serves to test the patency of the catheter before it is inserted and also to rid it of air. Care should be taken not to advance the catheter too far lest it enter the duodenum. Care should also be taken to make sure the catheter is in the cystic duct so that the dye will not extravasate. Occasionally, at a point approximately 1.5 cms from its entry into the common bile duct, the cystic duct may contain a valve which may be difficult to negotiate with the catheter. When this happens it may help to hold the distal part of this duct tense and to thread the cystic duct with a fine probe. This can also serve to delineate the fact that this so called difficult area is not being produced by a stricture or a small calculus.

The catheter is then secured in place with a silk suture and a syringe containing 20 cc of dye (Dilute Conray) is then attached. Radio-opaque materials such as sponges and clamps are then removed and a sterile drape used to cover the field. For radiologic films, the patient is placed in slight Trendelenburg position (so that the hepatic ducts will fill better) at approximately 15-20° tilt to the right so that the biliary tract is not located over the vertebral column. When the x-ray technician is ready, the surgeon instills 5-10 cc of dye, the anesthetist momentarily stops the patient's breathing, and a film is obtained. A new
Spasm of the sphincter of Oddi. Because of the normal configuration and tapering, and normal size of the duct, no surgical exploration was carried out.

Figure 2

The criteria of a normal cystic duct cholangiogram are as follows:

1. No filling defect in the ducts.
2. Contrast medium readily enters the duodenum.
3. The terminal segment, usually 1½ cms in length, narrows as it approaches and enters the ampulla. This narrowing is in a tapered fashion and the presence of the configuration is important. We do not accept a duct as normal even with dye entering the duodenum and no visible filling defects if its lower end is cut across rather sharply with no tapering.
4. The duct diameter is less than 12 mms.
5. No excess retrograde filling of the intrahepatic ducts. Normally there is filling of the tertiary radicles around the hilar area and there is considerable range of normal in this parameter. When we refer to
Radiologic film shows a sharp cutoff at the lower end of the duct, with a relatively normal size common duct, and dye readily entering the duodenum. Exploration revealed a stone at the lower end of the common bile duct (arrow).

Discussion of Cases

Indications for Exploration. The following may be listed as absolute indications for common duct exploration:

1. Palpating a stone in the duct.
2. The presence of persistent jaundice.
3. The presence of a dilated common bile duct.

The relative indications for common duct exploration are as follows:

1. Multiple small stones in the gall bladder and/or cystic duct.
2. A past history of jaundice.
3. A past history of pancreatitis.
4. A clinical history of recurrent biliary colic.
Cystic Duct Cholangiography

### TABLE I
CYSTIC DUCT CHOLANGIOGRAPHY ON 837 PATIENTS.

<table>
<thead>
<tr>
<th>Description</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal cholangiograms</td>
<td>719</td>
<td>86%</td>
</tr>
<tr>
<td>Number of choledochotomies required with old criteria</td>
<td>316</td>
<td>38%</td>
</tr>
<tr>
<td>Number of choledochotomies done</td>
<td>118</td>
<td>14%</td>
</tr>
<tr>
<td>Positive choledochotomies</td>
<td>86</td>
<td>74%</td>
</tr>
<tr>
<td>Unsuspected stones</td>
<td>27</td>
<td>3.2%</td>
</tr>
</tbody>
</table>

### TABLE II
SIZE OF COMMON BILE DUCT FELT BY OPERATING SURGEON TO BE ENLARGED ON VISUAL INSPECTION AND PALPATION.

<table>
<thead>
<tr>
<th>Description</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinically enlarged</td>
<td>40</td>
</tr>
<tr>
<td>Cholangiograms</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>15</td>
</tr>
<tr>
<td>Abnormal (choledochotomy done)</td>
<td>25</td>
</tr>
<tr>
<td>Common duct explorations</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>8</td>
</tr>
<tr>
<td>Abnormal</td>
<td>17</td>
</tr>
</tbody>
</table>

5. ‘Thickened’ head of pancreas.
6. The presence of muddy bile or gravel in the gall bladder or ducts.
7. Thickened and contracted gall bladder.

At our institution we have done over 1,000 operative cholangiograms. Cholangiography is accepted almost as a routine procedure by almost all surgeons on our active staff. We feel that visualization of the common bile duct by dye injected via the cystic duct has no place where an absolute indication to open the common bile duct exists. In other words, in these situations the common bile duct should be opened and explored without first doing a cystic duct cholangiogram.

Patients with relative indications of common duct exploration should have a cystic duct cholangiogram. If the operative cholangiogram fulfills the previously listed criteria of a normal cystic duct cholangiogram, we then do not do a choledochectomy.

We feel that even though an absolute indication for common duct explorations exists, a confirming operative cholangiogram should be carried out via the T-tube.

Results

In Table 1, results of cystic duct cholangiography show that 86% (719/837) of all cystic duct cholangiograms were normal. Using previously recognized criteria for common duct exploration, 36% (316/837) of all our cholecystectomies would have required common duct exploration. With the use of operative cholangiography, only 14% (118/837) of our patients had a common duct exploration, a reduction of greater than 50%.

In those patients undergoing common duct exploration after a cystic duct cholangiogram, 74% (86/118) had positive pathological findings while 26% were normal. As illustrated in our own series, negative common duct exploration will be decreased 50% or more with increasing reliance on operative cholangiography.

In an analysis of 40 cases where the surgeon felt that the common duct was dilated on visual inspection and palpation before cholangiography was carried out, 15 patients had normal cholangiograms. Therefore, a common duct exploration was not carried out. The remaining 25 cholangiograms revealed the duct diameter to be 12 mm or greater and common duct exploration was therefore carried out. In four cases there was
"gravel", or grossly thickened and muddy bile, in the common duct. Thirteen common duct explorations revealed the presence of stones in the common duct. Cholangiograms revealed the stones in seven cases while six cases revealed only the presence of an enlarged common duct and the stones were not visualized (Table II).

We feel therefore that common duct exploration should be carried out, even though no stones may be visualized on the cholangiogram, if the diameter of the common bile duct is greater than 12 mm. Cholangiography allows a more reliable assessment of the size of the common bile duct, where the size may be questionable on visual examination.

Seventeen false positive cholangiogram studies were noted. On further review of the x-ray films, air bubbles were considered to be present in the common duct.

In two false negative cholangiograms, the main error was an overlooked stone in the hepatic duct. It should be stressed that the biliary tree should be carefully visualized as usually attention is focused to the area of the common duct distal to the cystic duct and the entrance of the dye into the duodenum. On two occasions a stone was found in the hepatic duct during later review of the cholangiograms. In one case it was verified by a T-tube cholangiogram.

In approximately 118 patients, two cases of retained common bile duct stones were noted after cholangiography and common duct exploration. The incidence of retained common duct stones is approximately 2%.

Complications

One patient had a myocardial infarction on the sixth postoperative day and expired. In two cases there was an extravasation of dye around the biliary tree due to a false passage. Postoperatively these patients did well. There were no duct injuries in over 1,000 cystic duct cholangiograms. One patient developed a subphrenic abscess which was treated with broad spectrum antibiotics and drainage.

Discussion

Errors and pitfalls in interpretation and technique are as follows:

1. Small stones can be obscured by dye: This can result in a false negative reading. Several authors advocate using smaller amounts of dye in the initial films. Ferris' advocates using 0.1 normal HCl initially to prevent the medium from flowing into the duodenum by causing spasm of the sphincter of Oddi and therefore retaining the dye so that it will completely outline the biliary tree. However, these precautions will not prevent missing small stones if the duct is wide. Le Quesne measured common bile duct diameter on operative cholangiograms and one year later on intravenous cholangiograms. He feels that 10 mm represents the upper limits of normal and that 12 mm indicates common bile duct obstruction. Therefore, the absolute criteria for the normal size of a common duct is no greater than 12 mm. This danger is too real to accept a cystic duct cholangiogram as normal, even if all other criteria are met.

2. False positive x-ray pictures can be obtained if care is not taken to rid the system of air. However, these visualizations are usually quite spherical and, unlike stones, change position or disappear on repeat films. If a defect is suspected of being an air bubble, 5 cms of dye can be further injected and the
films repeated. If there is still doubt then the common duct should be explored. Air bubbles are the commonest causes of false positive cystic duct cholangiograms.

3. Another situation which may prompt a false positive is that of spasm of the sphincter of Oddi. This will result in little or no dye entering the duodenum. If this spasm occurs following a T-tube cholangiogram, it may be disregarded if the duct exploration was complete and a #7 Bake's Dilator is readily passed into the duodenum, and if the lower end of the duct has the usual tapered narrowing.

4. Care must be taken to look at the hepatic radicles where a stone may be overlooked.

5. It is important that the anesthetist stop the patient's breathing during the x-ray exposure. Even minimal motion will make the films unreliable.

Why Routine Use?

Cystic duct cholangiography is so valuable an addition to the surgeon's armamentarium, we advocate its almost routine use. In an elderly patient with a single large calculus and no relative indication for common duct exploration, possible operative cholangiography should not be carried out. Yet, it might be argued that in an older patient we should be absolutely sure that the common duct is completely clear. In our hands the extra time needed is no more than 5-10 minutes. While waiting for the films to be developed and returned, the cholecystectomy portion of the operative procedure can be carried out within 3-5 minutes of the taking of the film. In our institution there has been no increase in patient mortality or morbidity because cystic duct cholangiography has been added routinely.

With the routine use of operative cholangiography, unsuspected pathology may be found such as a silent common duct stone, or stenosis of the sphincter of Oddi. In our series, 27 or 3.2% of patients (Table 1) harbored totally unsuspected or "silent" common duct stones. Isaacs and Daves16 reported 8% of operative cholangiograms that showed unsuspected common duct stones. Nienhaus and LeQuesne15 report about a 5% incidence of unsuspected common duct stones. Intraductal polyp and other lesions of the common duct or ampulla may be visualized.

Nienhaus17 states that there is an incidence of approximately 8% to 27% retained common duct stones even after common duct exploration. As a sidelight, if a common duct is explored and an operative cholangiogram taken via an inserted T-tube, re-exploration may be needed in 8% to 13% of cases. There is at least a 10% greater incidence of missing common duct stones when operative cholangiography is not carried out. In our series, there was a 2% incidence of missed stones in the biliary tree following operative cholangiography.

We also feel that the use of operative cholangiography increases the safety of biliary tract surgery. Wide variation in biliary tract anatomy contributes to operative trauma of the biliary tree. Schulenberg18 reported major ductal anomalies in 10% of his cases with cholangiography while Hayes et al19 demonstrated clinically significant variation in 47.5% of cases. Cattell20 has reported that at least 80% of the strictures of the common duct are due to trauma of the ductal structures at the time of surgery. The necessity of careful dissection, imposed by cholangiography, avoids undue trauma to the ductal system.
And, the radiological visualization of the ductal system also reveals anatomical variations and strictures. In our series, followup study revealed no ductal injury.

Operative cholangiography after common duct exploration also:

1. Confirms the fact that the duct is free of stones.
2. Permits the surgeon to reoperate immediately if a stone is still present.
3. Provides a permanent record that the duct is free of stones at the time of operation.

References