Bile Leaks After Laparoscopic Cholecystectomy

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Biliary Injuries during Cholecystectomy

- In the 1990s, high rate of biliary injury was due in part to learning curve effect.
- In reviews by Strasberg et al. and Roslyn et al., the incidence of biliary injury during open cholecystectomy was found to be 0.2-0.3%.
- The review by Strasberg et al. in 1995 of more than 124,000 laparoscopic cholecystectomies reported in the literature found the incidence of major bile duct injury to be 0.5%.
As surgeons passed through learning curve, have reached “steady-state” and there has been no significant improvement in the incidence of biliary duct injuries.
Incidence of biliary injury when laparoscopic cholecystectomy is performed for acute cholecystitis is three times greater than that for elective laparoscopic cholecystectomy and twice as high as open cholecystectomy for acute cholecystitis.
The aberrant right hepatic duct anomaly is the most common problem.
The most dangerous variant is when the cystic duct joins a low-lying aberrant right sectional duct. These injuries are underreported since occlusion of an aberrant duct may be asymptomatic and even unrecognized.
Causes of Laparoscopic Biliary Injury

- Failure to properly occlude cystic duct.
- Injury to ducts in the liver bed is caused by entering a plane deep to the fascial plate on which the gallbladder rests.
- Misuse of cautery may cause serious bile duct injuries with loss of ductal tissue due to thermal necrosis.
- Pulling forcefully up on the gallbladder when clipping the cystic duct causing a tenting injury in which the junction of the common bile duct and hepatic duct is occluded.
In 1995, Strasberg and Soper modified the Bismuth classification of bile duct injuries:

- **Type A** - bile leak from a minor duct still in continuity with the common bile duct. These leaks occur at the cystic duct or from the liver bed.
- **Type B** - occlusion of part of the biliary tree. Usually the result of an injury to an aberrant right hepatic duct. In 2% of patients, the cystic duct enters a right hepatic duct rather than the common bile duct-common hepatic duct junction. The aberrant duct may be a segmental duct, a sectoral duct (the right anterior or posterior duct), or even
Type C- bile leak from duct not in communication with common bile duct. Usually diagnosed in early postoperative period as an intraperitoneal bile collection.

Type D- lateral injury to extrahepatic bile ducts. May involve the common bile duct, common hepatic duct, or the right or left bile duct.

Type E- circumferential injury of major bile ducts. This type of injury causes separation of hepatic parenchyma from the lower ducts and duodenum. May be treated by percutaneous or endoscopic techniques depending on length of stenosis or if
Classification of Biliary Duct Injuries:
Misidentification injuries: 2 main types.
1) common duct is mistaken for cystic duct and is clipped and divided.
2) the segment of an aberrant right hepatic duct, between entry of the cystic duct and junction of the common hepatic, is mistaken to be the cystic duct.
Routine intraoperative cholangiography-Fletcher et al. in 1999 found that intraoperative cholangiography had a protective effect for complications of cholecystectomy in a retrospective study of 19,000 cholecystectomies.

Operative cholangiography is best at detecting misidentification of the common bile duct as the cystic duct and will prevent excisional injuries of bile ducts if the cholangiogram is correctly interpreted.

Poor at detecting aberrant right ducts, which unite with the cystic duct before joining the common
Intraoperative conversion of biliary injury is usually an indication for conversion.

Simple type D injuries are repaired by closure of the defect using fine absorbable sutures over a T-tube and placement of a closed suction drain in the vicinity of the repair.

Type D injuries that are thermal in origin or that are complex are best repaired by hepaticojejunostomy.
Significant postoperative bile leaks occur in up to 1% of patients undergoing laparoscopic cholecystectomy compared to 0.5% in open cholecystectomy.

Usually present within first week but can manifest up to 30 days after surgery.
Diagnosis of Bile Leaks

- Clinical manifestations of bile leaks include abdominal tenderness, generalized malaise and anorexia.
- Bile drainage from drains placed at the initial operation.
- Diagnosis of bile leak should be suspected whenever persistent bloating and anorexia last for more than a few days; failure to recover as smoothly as expected is the most common early symptom of an intraabdominal bile collection.
Minor bile leakage is common after open or laparoscopic cholecystectomy and is often related to disruption of small branches of the right intrahepatic duct entering the gallbladder bed.

These leaks, usually from the liver, occurred in 25% of 105 patients prospectively evaluated with ultrasonography by Elboim et al.

Such leaks may require no therapy, surgical placement of a drain at the time of the original procedure, or subsequent placement of a percutaneous drain for symptomatic bilomas that are recognized postoperatively.
Noninvasive imaging (US/CT scan) is essential to define biloma that may require percutaneous or surgical drainage.

HIDA scan may show presence of an active bile leak and general anatomic site of leakage.

MRCP also provides imaging of the biliary tract, demonstrating dilation or stenosis of the biliary tract, and stones in the cystic duct remnant, the pancreas, and the pancreatic ducts; however, it does not allow concomitant therapeutic measures or physiologic assessment of bile flow (so cannot detect if a leak is active).
ERCP and percutaneous transhepatic cholangiography (PTC) can provide an exact anatomical diagnosis of bile duct leak, while at the same time allowing for treatment of the leak by appropriate decompression of the biliary tree.
<table>
<thead>
<tr>
<th>Test</th>
<th>Major functions</th>
<th>Characteristics</th>
<th>Negative outcomes</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hepatobiliary scintigraphy</td>
<td>Detect bile leak</td>
<td>Can be used with low levels of jaundice. Poor localization of site of leakage.</td>
<td>Noninvasive</td>
<td>Low</td>
</tr>
<tr>
<td>Ultrasound</td>
<td>Detect biloma, detect dilated bile ducts</td>
<td>Localizes bile collections well. Bowel gas interferes. Some user dependency.</td>
<td>Noninvasive</td>
<td>Low</td>
</tr>
<tr>
<td>Fistulagram</td>
<td>Detect site of leak and presence of biloma</td>
<td>Very useful when established external fistula exists.</td>
<td>Noninvasive</td>
<td>Low</td>
</tr>
<tr>
<td>CT scan</td>
<td>Detect biloma, detect dilated bile ducts</td>
<td>Can be combined with percutaneous aspiration.</td>
<td>Noninvasive</td>
<td>Moderate</td>
</tr>
<tr>
<td>ERCP</td>
<td>Detect exact site of leak or obstruction</td>
<td>Can be combined with sphincterotomy and drainage to treat Type A and D injuries.</td>
<td>Invasive</td>
<td>Expensive</td>
</tr>
<tr>
<td>Percutaneous transhepatic</td>
<td>Detect exact site of leak and obstruction. Demonstrates intrahepatic biliary anatomy.</td>
<td>Decompresses ducts, can be used for some Type A and D injuries and E injuries with stricture. Important planning step for surgery and for treatment of cholangitis. Catheters guide operative dissection.</td>
<td>Invasive</td>
<td>Expensive</td>
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Treatment of Bile Leaks

- The principle of treatment is to reestablish a pressure gradient that will favor the flow of bile into the duodenum and not out of the leak site.
- This means removing any physiological or pathological obstruction such as the normal sphincter of Oddi pressure or a retained bile duct stone.
In cases where there is a bile duct stone, removal of the stone with sphincterotomy is treatment of choice.

If there is no stone, then internal stenting with or without sphincterotomy has shown to be effective in treating bile leaks.

A retrospective study by De Palma et al. in 2002 showed that sphincterotomy alone was highly effective in producing closure of bile fistulas by reducing endobiliary pressure.
Endoscopic internal stenting is currently procedure of choice for treating bile duct leaks (usually types A, C and D).

7Fr and 10 Fr stents can be inserted without sphincterotomy.

A prompt therapeutic response with cessation of bile extravasation in 70-95% of cases within a period of 1-7 days.
In the past, nasobiliary drains were used because they did not require sphincterotomy, and removal did not require second endoscopic procedure. However, nasobiliary drains are poorly tolerated and they are not able to transport more than one-third of daily bile production which makes them less effective than internal stents.
Another method of non-surgical treatment of bile leak is PTC drainage.

However, bile ducts are usually of normal caliber when there is leakage, which makes the procedure difficult.

PTC is usually reserved for instances when ERCP is unsuccessful or in preparation for surgical repair.
Intrahepatic bile duct injuries are not easily accessible by the retrograde route. In certain instances, the distal part of the injured bile duct may be closed and ERCP, therefore, may fail to reveal any contrast extravasation. Bile can thus continue to leak from the proximal part of the injury, and response to endoscopic treatment will be lacking.

In this case, PTC may be useful, or repair surgically.
Experimental

”Histoacryl” glue approved in Europe for the sealing of biliary fistulae; and botulinum toxin injection to sphincter of Oddi successful in canine models.