

# Accuracy of Percutaneous Transhepatic Cholangiography in Predicting the Location and Nature of Major Bile Duct Injuries

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## ABSTRACT

**Purpose:** To determine the ability of percutaneous transhepatic cholangiography (PTC) to predict accurately the anatomic location and nature of major bile duct injuries, to examine the contribution of endoscopic retrograde cholangiopancreatography (ERCP) and PTC to the diagnosis of injuries to the low-inserting right posterior segmental ducts, and to compare the ability of radiologists and gastroenterologists to detect injuries to the low-inserting right posterior segmental duct.

**Materials and Methods:** PTC images and operative reports of 78 consecutive patients who underwent surgical repair of major bile duct injuries at the authors' institution were retrospectively reviewed. The location of injury was assessed according to the Bismuth classification. Images were also evaluated for the presence of a biliary stricture, biliary leak, or both. Imaging observations were compared with findings obtained during surgical biliary reconstruction.

**Results:** PTC correctly predicted the anatomic location of injuries in 85% of patients. Incorrect Bismuth type was assigned in 12 patients. Seven of the errors (58%) originated from the inability to distinguish injuries at the confluence of the lobar ducts from injuries involving the cephalad 2 cm of the common hepatic duct. Injuries to the right posterior segmental duct were detected more often on ERCP images by gastroenterologists than by diagnostic radiologists. In four patients (5%), biliary strictures were masked on PTC by the presence of a concomitant leak.

**Conclusions:** PTC accurately depicts the location and nature of major bile duct injuries in most patients.

## ABBREVIATIONS

ERCP = endoscopic retrograde cholangiopancreatography, PTBD = percutaneous transhepatic biliary drainage, PTC = percutaneous transhepatic cholangiography

Major bile duct injuries are encountered following 0.4%–0.6% of laparoscopic cholecystectomies (1). However, bile duct injuries are recognized intraoperatively in only 20%–30% of laparoscopic cholecystectomies (2,3). Cholangiography is used to delineate the anatomy of the intrahepatic and extrahepatic bile ducts; to determine the location of the injury; and to show whether a biliary stricture, a biliary leak, or both are present. Availability of high-quality cholangiograms, which accurately depict the location and nature

of the injury, is important for surgical planning of the repair because up to 70% of attempts at surgical repair may be unsuccessful if the cholangiographic data are incomplete (4). Percutaneous transhepatic cholangiography (PTC) also serves as the first step for placement of percutaneous transhepatic biliary drainage (PTBD) catheters. PTBD catheters divert bile, help the hepatobiliary surgeon identify the injured ducts at the time of operative repair, and allow access to the biliary system for percutaneous interventions such as balloon dilation of strictures (1).

Evaluation of the biliary system in the setting of bile duct injury frequently starts with endoscopic retrograde cholangiopancreatography (ERCP). This imaging modality helps differentiate between a cystic duct leak and an injury to an intrahepatic or extrahepatic bile duct (1). However, if a major bile duct injury resulted in duct occlusion or transection, ERCP would show only a stump of the common bile duct (5). In addition, injury to the low-inserting right posterior segmental duct draining Couinaud segments VI and VII (Fig 1) may

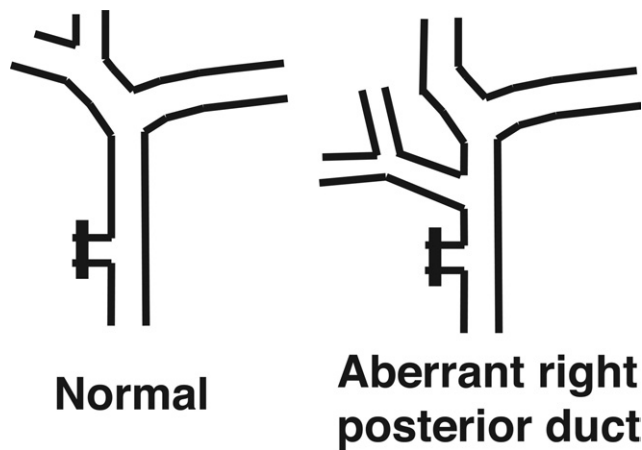
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**Figure 1.** Schematic representation of the normal biliary anatomy and of the aberrantly inserting right posterior segmental duct anatomic variant.

be missed on ERCP (6). Aberrant right posterior segmental duct injuries are often suspected in the setting of clinical or imaging evidence of a bile leak (perihepatic fluid collection on postcholecystectomy cross-sectional imaging or copious bilious output from surgical drains) but “normal” ERCP (6–9). If ERCP fails to show the intrahepatic ductal anatomy, the surgeons at our institution rely on PTC.

Several classification schemes for bile duct injuries have been proposed (10,11). At our institution, hepatobiliary surgeons routinely use the Bismuth (11) classification (Fig 2), which groups injuries according to the anatomic location and is important in planning the site of a future biliary-enteric anastomosis. Understanding the nature of the injury is also important for guidance of the repair process (12). Cholangiography is used to distinguish between a transected duct, a completely occluded duct, and a duct that has been partially obstructed. Recognition of these findings at PTC has technical implications to placement of biliary drainage catheters. Since its introduction into clinical practice, PTC has served as an important imaging modality for delineation of biliary anatomy and pathology. However, the accuracy of PTC in predicting the location and nature of the injuries has not been previously validated. The purposes of this study were to determine the ability of PTC to predict accurately the anatomic location and nature of bile duct injuries, to examine the contribution of ERCP and percutaneous cholangiography to diagnosis of injuries to the low-inserting right posterior segmental ducts, and to compare the ability of radiologists and gastroenterologists to detect injuries to the low-inserting right posterior segmental duct.

## MATERIALS AND METHODS

### Patients

Our retrospective case series study was approved by the Committee on Human Research of the institutional review board. The requirement for informed consent for participa-

tion in the study was waived. Between July 1999 and July 2008, 78 consecutive patients (57 women and 21 men, average age 46 years) underwent hepaticojejunostomy (73 patients) or choledochojejunostomy (5 patients) for treatment of major bile duct injuries, which occurred during laparoscopic cholecystectomy. None of these patients had previous attempts at surgical repair of their injuries, and all were referred to our hospital from other institutions. All patients underwent PTC and placement of PTBD catheters before surgical repair. Additional imaging was obtained for 68 (87%) of the patients before PTC. Additional studies included ERCP alone (14 patients), contrast-enhanced computed tomography (CT) of the abdomen alone (12 patients), CT in combination with ultrasound (4 patients), or combination of ERCP and CT (38 patients). Magnetic resonance (MR) cholangiopancreatography was obtained in addition to ERCP and CT in two patients. Lastly, two patients underwent hepatobiliary scintigraphy (hepatobiliary iminodiacetic acid scan) in addition to ERCP and CT. The average time interval between PTC and biliary reconstruction was 32 days; the average time interval between last presurgical cholangiogram and biliary reconstruction was 20 days.

### Typical Approach to Patients with Bile Duct Injuries

The typical diagnostic and therapeutic approach to patients with suspected bile duct injuries treated at our institution depends on the clinical presentation of the patient. If a patient presents with symptoms of biliary obstruction (jaundice, pruritus), the first step in the diagnostic work-up is ERCP. If all major intrahepatic biliary radicles are not opacified on ERCP, PTC is performed. These patients may also undergo cross-sectional imaging with contrast-enhanced CT, MR imaging, or ultrasound to assess for the extent of biliary ductal dilatation before PTC. Patients with a suspected leak (ie, bilious output from a surgical drain) undergo ERCP and contrast-enhanced CT. The purpose of performing ERCP is to differentiate between patients with a cystic duct leak or an incomplete duct tear (who are treated by placement of an endoscopic biliary stent) and patients with a complete duct transection, who are then referred for PTC. A contrast-enhanced CT scan is usually obtained in these patients as well to assess the presence of any undrained fluid collections. Percutaneous CT or ultrasound-guided drainage of such collections is also performed. MR cholangiography is not routinely used at our institution for evaluation of patients with a suspected bile duct injury. Hepatobiliary scintigraphy is used only if ERCP or PTC is unable to show conclusively extraluminal contrast material accumulation in a setting of high clinical suspicion for the presence of a bile leak.

### Percutaneous Transhepatic Cholangiography Technique

Fine-needle cholangiography was performed to identify intrahepatic bile ducts. Fluoroscopy alone was used to

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