

# Non-Operative Management of Right Posterior Sectoral Duct Injury Following Laparoscopic Cholecystectomy

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## Abstract

**Objective** The purpose of this study is to describe the outcomes of conservative management for patients with right posterior sectoral bile duct injury acquired during laparoscopic cholecystectomy.

**Methods** This retrospective, consecutive case series reviews seven patients with an isolated injury to the right posterior or right hepatic duct occurring during laparoscopic cholecystectomy.

**Results** Seven patients with an isolated right sectoral duct injury were studied, six women and one man aged 22 to 71 years (mean age, 43.6 years). Diagnosis of bile duct injury occurred between 1 day and 13 weeks after the initial cholecystectomy. Three patients had plastic biliary stents placed and six patients had JP drains placed. All patients in this series were managed conservatively, with no reoperation for formal repair of the bile duct. Length of follow-up ranged from 2 to 14 months (mean, 8.2 months). At last follow-up, all patients were asymptomatic with no biliary drainage.

**Conclusions** Conservative management is an important option for patients with an isolated right posterior bile duct injury.

**Keywords** Bile duct · Bile duct injury · Iatrogenesis · Cholecystectomy · Laparoscopic cholecystectomy

## Introduction

Iatrogenic bile duct injury is a major cause of morbidity and mortality following laparoscopic cholecystectomy, occurring in 0.5–1.4% of cases.<sup>1</sup> The presence of variant biliary anatomy increases the risk of such injuries. Prior studies have estimated that 19–39% of the population have anatomic variations of the biliary tree.<sup>2,3</sup> These aberrant ducts can be mistaken for the cystic duct and clipped or cauterized inadvertently.

The most common biliary anomaly, occurring in 4–8% of patients, is an aberrant insertion of the right posterior duct into the biliary tree, usually inserting close to the cystic duct (Fig. 1).<sup>2–4</sup> Intraoperatively, it can be mistaken for the cystic duct and injured, either in isolation or in conjunction with the “classic” bile duct injury, where the common bile duct is mistakenly clipped.<sup>5,6</sup> This low-lying duct provides the only drainage for hepatic segments 6 and 7. As such, injury to the right posterior sectoral duct can present with biliary fistula, biloma, abdominal pain, or peritonitis.<sup>1,6–11</sup> Many patients, however, remain asymptomatic, and it is likely that the frequency of this type of injury is underreported.<sup>7,8</sup>

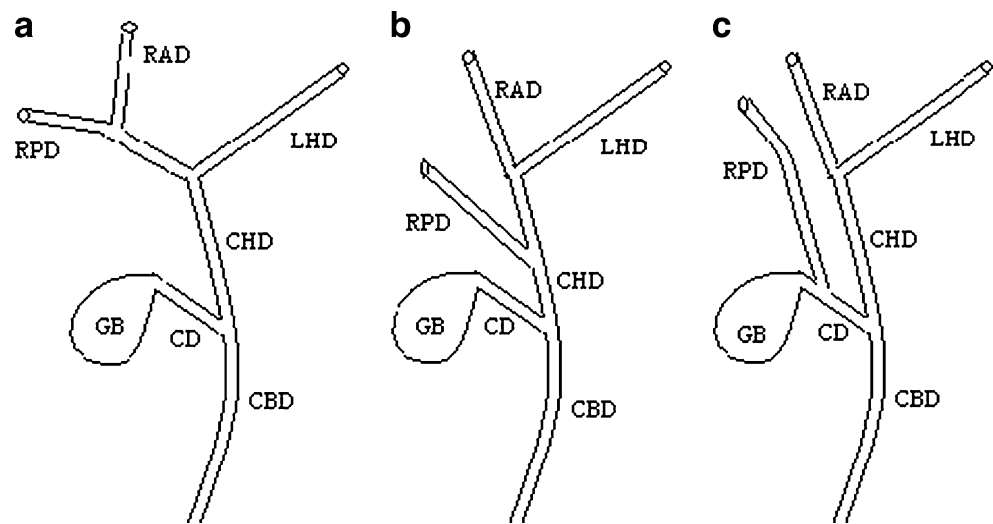
An isolated right posterior bile duct injury presents a unique challenge for two key reasons. First, diagnosis is often elusive, as endoscopic retrograde cholangiopancreatography (ERCP) can be read as normal in the setting of continued bile leak or biloma.<sup>9,10</sup> Second, while classic bile duct injury has a conventional repair (the Roux-en-Y hepaticojejunostomy), in this non-classic injury the treatment of choice is not well defined. With limited literature and experience to guide therapy for this injury, many surgeons do routinely perform Roux-en-Y in order to reattach the right posterior system.<sup>6,9,12</sup>

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**Fig. 1** Variations in right posterior duct anatomy. *CBD* common bile duct, *CD* cystic duct, *GB* gallbladder, *CHD* common hepatic duct, *LHD* left hepatic duct, *RPD* right posterior or duct, *RAD* right anterior duct. **a** Normal hepatic ductal anatomy, **b** low insertion of RPD into CHD, and **c** insertion of RPD into CD



Herein, we present a case series of seven consecutive patients referred to our institution over a 3-year period with isolated injury to a right hepatic posterior sectoral duct. All seven patients were managed conservatively with drains and stent placement but without reoperation for bile duct repair. These patients have had full recovery with complete symptom resolution and no clinical or radiological evidence of continued bile leak or cholangitis.

## Materials and Methods

The patients in this series were referred to the senior author (JMS) on the hepatobiliary surgery service at Emory University Medical Center in Atlanta, GA for evaluation and treatment of a suspected or known bile duct injury. The patients had previously undergone laparoscopic cholecystectomy in the 3-year period between August 2006 and August 2009. A retrospective review of all clinical docu-

ments was performed, including hospital and outpatient visit records and radiology images.

## Results

### Patient Demographics

This study includes seven consecutive patients with an injury to the right posterior hepatic duct; six women and one man aged 22 to 71 years (mean, 43.6 years). Patient characteristics and details of presentation and diagnosis are outlined in Table 1.

### Presentation and Diagnosis

Bile duct injury was discovered in one of three fashions that will be discussed separately. Two patients had suspected injuries intraoperatively. In one case, a bile leak was

**Table 1** General patient information

Age (year)/sex/race	Initial procedure <sup>a</sup>	Presentation with bile duct injury	Diagnostic modality	Time from cholecystectomy to diagnosis	Final diagnosis <sup>b</sup>
55/F/C	LC converted to open	Bile drainage	CT fistulogram	8 weeks	RPD injury
27/F/H	LC	RUQ pain	Intraoperative cholangiogram	0 days	RPD injury
53/F/C	LC converted to open	Bile drainage	MRCP	6 weeks	Right hepatic duct injury
71/M/C	LC	Asymptomatic	MRCP	3 weeks	RPD injury
36/F/AA	LC	Biloma, jaundice, RUQ pain, N/V	ERCP	3 weeks	RPD injury
22/F/C	LC	Bile drainage	MRI	1 day	RPD injury
41/F/C	LC	Biloma, RUQ pain	MRCP	13 weeks	RPD injury

*F* female, *M* male, *C* Caucasian, *H* Hispanic, *AA* African American, *LC* laparoscopic cholecystectomy, *RUQ* right upper quadrant, *CT* computed tomography, *MRCP* magnetic resonance cholangiopancreatography, *RPD* right posterior sectoral duct

discovered shortly after ligation and transection of the cystic duct. The surgeon unsuccessfully attempted an ERCP, placed a right upper quadrant Jackson-Pratt (JP) drain prior to closing, and transferred the patient to our center. Magnetic resonance imaging (MRI) demonstrated that the bile leak was due to an isolated right posterior duct injury. The second intraoperative diagnosis was identified on intraoperative cholangiogram as a right posterior ductal injury (Fig. 2). The surgeon placed a clip on the injured duct and placed a JP drain.

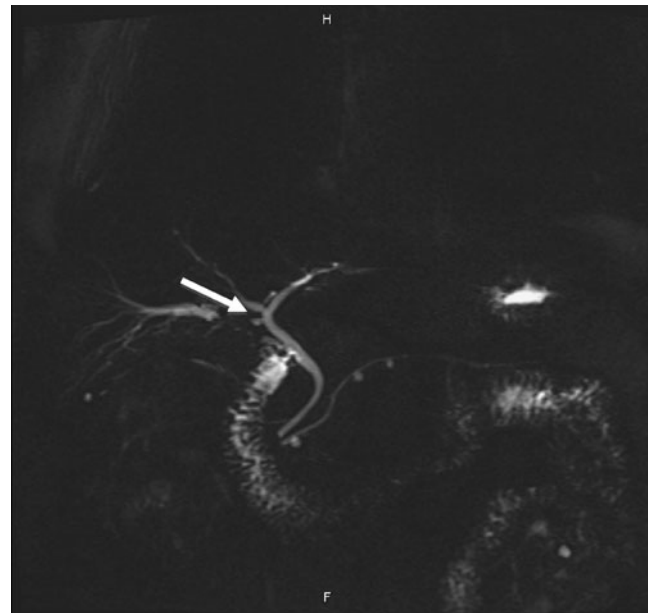
The other five patients presented ambulatory within 2 weeks of the initial cholecystectomy. Identification of the anatomic location of the ductal injury was made using various modalities, including ERCP, MRCP, and CT fistulogram (Fig. 3). Three patients presented with continued percutaneous bilious output from JP drains, without biloma or other symptoms. The remaining two patients presented with biloma and right upper quadrant pain, one of whom had accompanying chills, diaphoresis, nausea/vomiting, and jaundice. Final diagnosis for six patients was an isolated right posterior sectoral duct injury; one patient had a right hepatic duct injury (Table 1).

#### Management and Follow-Up

All patients were managed conservatively, with no reoperation for bile duct repair. Five patients had JP drains placed intraoperatively; the remaining two patients had drains placed postoperatively at the time of diagnosis with bile duct injury (Table 2). All patients received complete follow-up by one hepatobiliary surgeon. In three cases, patients received plastic biliary stents to mitigate local inflammation should they proceed with subsequent biliary repair. These patients, however, became asymptomatic during this initial period and did not undergo the planned



**Fig. 2** Intraoperative cholangiogram demonstrating a filling defect in the right posterior sectoral system



**Fig. 3** Magnetic resonance cholangiopancreatography showing clipped cystic duct with a low-inserting right posterior duct stump (arrow)

surgical repair. In the remaining four cases, patients were given the options of Roux-en-Y hepaticojejunostomy, segmental hepatectomy, or waiting with repeat blood tests and imaging for spontaneous resolution.

Ultimately, all patients experienced complete symptom resolution on follow-up. JP drains were removed between 1 and 16 weeks postoperatively. In two patients, the drains were advanced slowly over the course of several weeks. Drainage at time of removal was less than 20 cm<sup>3</sup>/day for all patients. Magnetic resonance imaging in all patients was either normal or showed some degree of atrophy of the right posterior liver with compensatory hypertrophy of the left segments (Fig. 4).

Follow-up was complete and ranged from 2 to 14 months, with an average duration of 8.2 months (Table 3). All patients were asymptomatic at their last clinic visit. Two patients had no complaints and thus no clinical indication for laboratory evaluations at follow-up visits. After IRB approval, multiple attempts were made to contact these patients to document normalization of liver enzymes; however, it was not possible to reach either patient.

#### Discussion

Anomalous right posterior sectoral ducts represent the most common anatomic variant of the biliary tract (Fig. 1). Ligation of this duct, which provides the only drainage to hepatic segments 6 and 7, can lead to bile leak or biloma and present with pain, cholangitis, or peritonitis. This

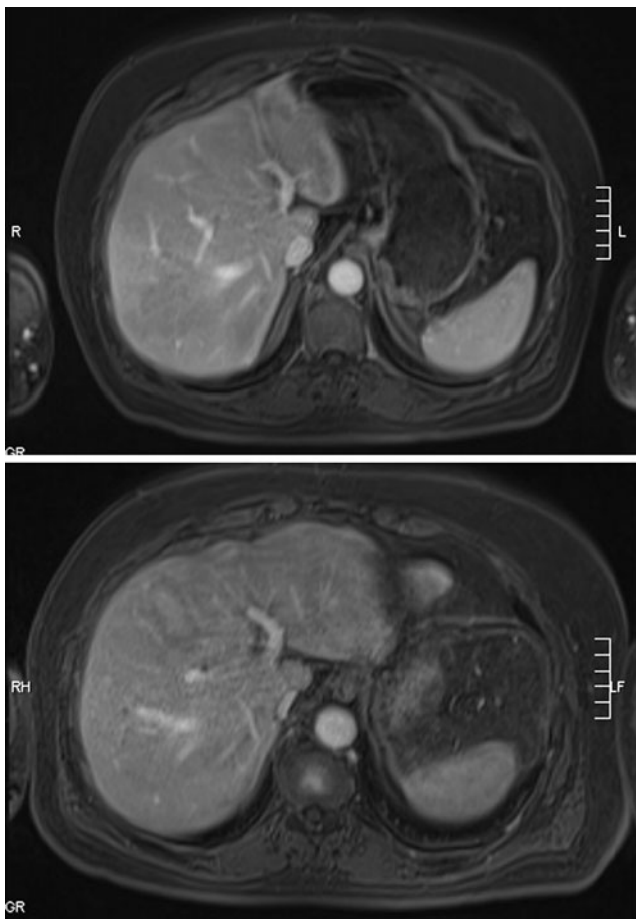
**Table 2** Details of clinical management

Age (year)/sex/race	Drain placed <sup>a</sup>	Initial volume of bile drainage	Bile drainage at drain removal	Time until removal of drain	Management of drain prior to removal
55/F/C	Intraop	>30 cm <sup>3</sup> /day	5 cm <sup>3</sup> /day	9 weeks	Drain slowly withdrawn
27/F/H	Intraop	0 cm <sup>3</sup> /day	0 cm <sup>3</sup> /day	1 week	None
53/F/C	Intraop	300 cm <sup>3</sup> /day	10 cm <sup>3</sup> /day	6 weeks	None
71/M/C	Intraop	Not recorded	<5 cm <sup>3</sup> /day	1 week	None
36/F/AA	1 week, replaced at 4 weeks	>500 cm <sup>3</sup> /day	10–20/day	7 weeks	Drain slowly withdrawn
22/F/C	Intraop	200 cm <sup>3</sup> /day	0 cm <sup>3</sup> /day	8 weeks	None
41/F/C	13 weeks	Not recorded	Not recorded	16 weeks	None

F female, M male, C Caucasian, H Hispanic, AA African American, *Intraop* intraoperatively

<sup>a</sup> All drains referred to are Jackson-Pratt drains

anatomic variant is of considerable interest, both due to an increased likelihood of injury during cholecystectomy and because this type of injury presents a diagnostic and therapeutic challenge.



**Fig. 4** Venous phase magnetic resonance imaging demonstrating hypertrophy of left lower and middle segments at 12 months after initial operation (*bottom image*) when compared with image from the same patient at 2 months after initial operation (*top image*)

In the present series, we found excellent outcomes with conservative management. This approach to right posterior duct injury represents a change in our practice. This change began as an unintended consequence of the circumstances surrounding the first two cases of the series. The first patients were offered operative repair; however, due to lack of insurance approval in one case and insurance coverage in the other, both patients delayed full evaluation after the original laparoscopic cholecystectomy. In both cases, pain and biliary drainage had resolved with normalization of liver function tests before an operative repair could be scheduled. Consequently, these patients were offered conservative treatment with the possibility of performing right partial segmentectomy of the liver in the event of recurring symptoms. As both patients remained asymptomatic, conservative management became the treatment of choice for isolated right posterior duct injuries in our practice.

There are numerous reports of right-sided bile duct injuries that advocate for a variety of therapies. Meyers et al. reported 14 cases of injury to an aberrant right sectoral duct, either in conjunction with a classic injury or in isolation.<sup>6</sup> In the isolated right posterior duct injuries, three had biliary symptoms and underwent Roux-en-Y repairs. The remaining four patients were sent home for an attempt at spontaneous closure; two patients were successful and the other two continued to have high-output fistulae and underwent Roux-en-Y of the solitary duct. Christensen et al. described five patients with ligation of an aberrant right hepatic bile duct at cholecystectomy.<sup>11</sup> Four of these patients were treated with Roux-en-Y repair and one with partial hepatectomy.

In others reports, management strategy is secondary—with Roux-en-Y reconstructions almost a given—as they focus on the diagnostic dilemma posed by right posterior duct injury. Usually, these case reports describe patients presenting months after surgery with continued symptoms, often with a biloma, in the face of a normal ERCP.<sup>6,7,9–11</sup> In

**Table 3** Follow-up and recovery

	Age (year)/sex/race	Length of follow-up (months)	Lab values at last follow-up <sup>a</sup>		
			Alkaline phosphatase (U/L)	Aspartate aminotransferase (U/L)	Alanine aminotransferase (U/L)
	55/F/C	2.3	n/a	n/a	n/a
<i>F</i> female, <i>M</i> male, <i>C</i> Caucasian,	27/F/H	12.8	n/a	n/a	n/a
<i>H</i> Hispanic, <i>AA</i> African American, n/a not applicable	53/F/C	13.7	145	26	28
	71/M/C	6.6	64	23	31
<sup>a</sup> Laboratory reference ranges: alkaline phosphatase, 32–92 U/L; aspartate aminotransferase, 15–41 U/L; alanine aminotransferase, <34 U/L	36/F/AA	8.1	90	23	19
	22/F/C	4.2	138	44	60
	41/F/C	9.8	206	35	37

such patients, the placement of a drain to evacuate the biloma led, in each case, to significant symptom resolution. Lillemoe et al. described nine patients with isolated right segmental duct injury, focusing mainly on the diagnostic challenge these injuries present.<sup>9</sup> After correct diagnosis was made via percutaneous cholangiography, percutaneous biliary stents were placed which led to prompt resolution of all signs of biliary sepsis. Our report tallies with the Lillemoe's description, as the patients presented here also experienced symptom resolution with proper drainage of bile. In the Lillemoe series, however, after allowing time for biliary drainage, all nine patients underwent scheduled Roux-en-Y hepaticojejunostomy.

No operative management is without risk. Studies of operative management for bile duct injury report complication rates of up to 43%.<sup>12</sup> Reports of isolated right posterior duct repairs tend to be case studies of small numbers of patients, but development of anastomotic stenosis following Roux-en-Y is a common feature, occurring in up to 33% of patients.<sup>9,10</sup> Accordingly, to limit iatrogenesis, if the conservative approach is successful, it ought to replace operative management.

Conservative management and spontaneous resolution in this injury appears in the literature as early as 1935. A case report described a patient who underwent surgery for a choledochal cyst in which the right hepatic duct was ligated.<sup>13</sup> The patient remained asymptomatic for years. At a subsequent abdominal operation, the surgeons noted that the right lobe of the liver had atrophied, with compensatory hypertrophy of the left lobe.<sup>13,14</sup> This atrophy/hypertrophy complex mirrors the MRI findings in our patients.

Most importantly, the conservative approach is supported by the benign natural history of an isolated right posterior duct injury. Strasberg et al. categorize the problem of injury to a sectoral duct as resulting in either obstruction (type B injury) or bile leak (type C injury).<sup>8</sup> For occlusive injuries, they comment that these patients are often asymptomatic and that the undrained hepatic segment

generally experiences atrophy with compensatory hypertrophy of the remaining portions. Should the patient become symptomatic, however, they continue to advocate hepaticojejunostomy or segmental hepatic resection.

Bile duct injury has been a significant complication of cholecystectomy since its inception, and the problem has become more common in the advent of laparoscopic surgery.<sup>5,15</sup> The classic bile duct injury, transection of the common bile duct, results in a loss of connection between the biliary and enteric systems. The classic repair is a Roux-en-Y hepaticojejunostomy to reconnect the biliary tract and allow for bile drainage.

Isolated sectoral duct injuries present a different problem than common bile duct injury. The biliary system remains connected to the duodenum, and only a section of the liver is left without proper drainage. To reconnect this hepatic section, a Roux-en-Y procedure is often performed. Other options that have been reported include induced atrophy or surgical resection of the involved liver segment.<sup>1,8</sup> Reports of patients managed without surgery are rare in the literature. Some case series of bile duct injuries require operative management as part of their inclusion criteria.<sup>15</sup> Reports that do consider spontaneous resolution generally do so only for asymptomatic patients.<sup>8,12</sup> In our experience, six of the seven patients we describe presented with biliary symptoms, ranging from bile leak to biloma and cholangitis, and still underwent successful conservative management.

Many questions still remain in determining the appropriate treatment algorithm for this type of injury. Severity of symptoms, the volume of liver drained by the transected duct, and presentation with leak versus stricture all certainly come into play when deciding the most appropriate course of action. Finally, patient preference can also play a role in deciding whether to attempt a definitive operative treatment or allow time for the injury to heal spontaneously. A prospective case series is required to confirm our findings and better assess the role each of these factors plays in choosing a treatment plan. In the meantime, the current report draws attention to a sometimes neglected option in the

surgical literature: the possibility of conservative management as a first line treatment for symptomatic patients.

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