

# Aberrant Right Hepatic Artery in Laparoscopic Cholecystectomy

Matthew J. Blecha, MD, Angela R. Frank, MD, Todd A. Worley, MD, Francis J. Podbielski, MD

## ABSTRACT

**Introduction:** Presented herein is a case in which an aberrant right hepatic artery (RHA) passes anterior to the infundibulum and fundus of the gallbladder and courses to an unusually anterior hepatic entry.

**Case Report:** A 54-year-old female with a history of biliary colic was scheduled for laparoscopic cholecystectomy. Laparoscopic dissection revealed an aberrant right hepatic artery (RHA) anterior to the infundibulum and fundus of the gallbladder. Further dissection revealed the cystic artery to branch laterally off this RHA over the gallbladder fundus anteriorly. The cystic artery then wrapped posterolaterally on the gallbladder's surface to its neck. After the gallbladder was removed, the aberrant RHA was readily visible traveling across the gallbladder bed and entering the liver at an unusually anterior location. Intraoperative images are included. The procedure was completed laparoscopically without complication.

**Discussion:** The origins and paths of both the cystic and right hepatic arteries have several documented anomalies. We are unaware of any reports of an RHA that transverses the entire neck and fundus of the gallbladder before such an anterior hepatic entry.

**Conclusion:** This case serves as a striking reminder of the variations in extrahepatic biliary and vascular anatomy. Ligation of this uniquely located aberrant RHA could have led to intraoperative hemorrhage or potential hepatic ischemia.

**Key Words:** Laparoscopic cholecystectomy, Aberrant hepatic artery

## INTRODUCTION

The extrahepatic vascular and biliary anatomy of Calot's triangle is well known to be inconsistent and highly variable. This provides a recurrent challenge for the surgeon performing laparoscopic cholecystectomy. Careful dissection of the cystic duct and artery is required with a constant mind on the numerous anatomical possibilities to avoid both conversion requiring hemorrhage and postoperative biliary leak. Presented herein is a case in which an aberrant right hepatic artery (RHA) passes anterior to the infundibulum and fundus of the gallbladder and courses to an unusually anterior hepatic entry.

## CASE REPORT

A 54-year-old female presented to her primary care physician with complaints of intermittent epigastric pain accompanied by nausea and vomiting. Her symptoms did not last longer than 15 minutes per episode and had been occurring 2 to 4 times per week for 2 months. A physical examination was unremarkable with neither right upper quadrant tenderness nor jaundice. The outpatient workup revealed multiple gallstones on ultrasound without signs of cholecystitis. Liver function studies, including bilirubin and alkaline phosphatase, were normal. The patient was given the diagnosis of biliary colic and scheduled for an elective laparoscopic cholecystectomy.

At operation, the procedure was initiated with establishment of pneumoperitoneum and the standard two 12-mm and 10-mm trocars in the midline with two 5-mm ports laterally. The omentum was adherent to the anterior surface of the gallbladder. These adhesions were seen as likely evidence of previous gallbladder inflammation despite no such ultrasound findings. The bulky omentum was dissected off the gallbladder, although some tissue remained anteriorly. Immediately visible upon retraction of the gallbladder was a thick tissue band covered in omental remnants extending from the area of the common bile duct towards the infundibulum. Initially thought to be the cystic duct, the size and path of this structure was not compatible. Dissection of adhesions revealed the structure to be an aberrant right hepatic artery adherent to the anterior surface of the gallbladder, enveloped in its peri-

St. Joseph Hospital, Chicago, Illinois, USA (all authors).

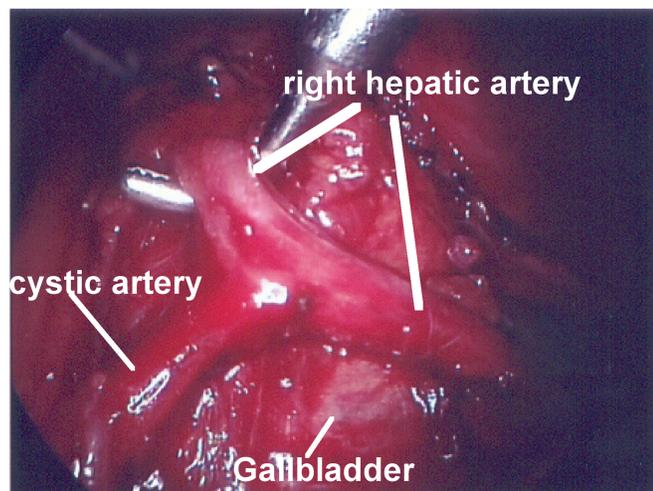
Address reprint requests to: Todd A. Worley, MD, Department of Surgery, St. Joseph Hospital, 3037 N. Clark St, 3B, Chicago, IL 60657, USA, E-mail: toddanthonyworley@yahoo.com

© 2006 by JLS, *Journal of the Society of Laparoendoscopic Surgeons*. Published by the Society of Laparoendoscopic Surgeons, Inc.

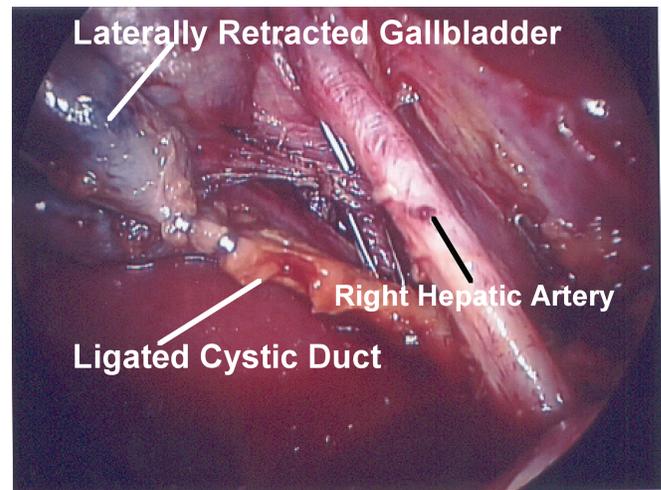
toneal covering. Further dissection revealed the cystic artery to branch laterally off this RHA over the gallbladder fundus anteriorly (**Figure 1**). The cystic artery then wrapped posterolaterally on the gallbladder's surface to its neck. The cystic artery was clipped and ligated and the RHA was completely freed from the gallbladder. The gallbladder was then able to be retracted superolaterally allowing dissection of the cystic duct. The duct was clipped proximally and left open for insertion of cholangio-catheterization (**Figure 2**). The cholangiogram was normal. No other arterial supply to the gallbladder was encountered. After the gallbladder was removed, the aberrant RHA was readily visible traveling across the gallbladder bed and entering the liver at an unusually anterior location (**Figure 3**). The remainder of the procedure was completed as an uncomplicated laparoscopic cholecystectomy.

## DISCUSSION

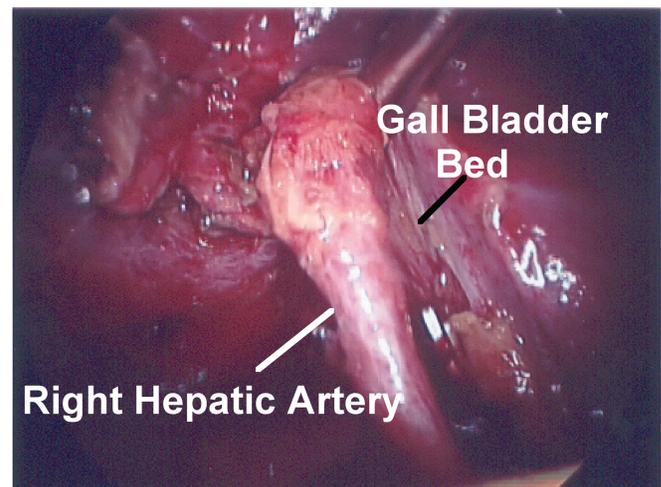
The origins and paths of both the cystic and right hepatic arteries have several documented anomalies. A single cystic artery with a dominant course originating at the flexure of the right hepatic artery within Calot's triangle passing posteromedially to the cystic duct toward the gallbladder neck is most common (70% to 80%). In approximately 5% of patients, the cystic artery courses outside of Calot's triangle to the gallbladder. Frequently seen cystic artery variants include double artery (15% to 20%), cystic artery originating from an aberrant right hepatic artery (5% to



**Figure 1.** The aberrant right hepatic artery (above right angle dissector) adherent to the anterior surface of the gallbladder. The cystic artery branches off this RHA and wraps laterally around the gallbladder towards the infundibulum.



**Figure 2.** With the cystic artery ligated and the right hepatic artery dissected off the gallbladder, the gallbladder was then able to be retracted laterally, allowing for cystic duct identification and ligation for cholangiography.



**Figure 3.** After the gallbladder has been removed, the right hepatic artery is elevated with a probe to illustrate its high site of hepatic entry. Superiorly, the artery has adherent remains of omental tissue residual from the preoperative inflammation and adhesions.

10%), left hepatic artery origin (1% to 3%), and gastroduodenal artery origin (3% to 7%).<sup>1-2</sup>

The RHA has an equal number of anatomical variations. Studies of hepatic arterial anatomy during liver harvesting for transplantation provide an excellent database documenting anomalies.<sup>3-5</sup> A replaced RHA is seen in 15% to 25% of patients, of which the vast majority reveal the RHA branching off the superior mesenteric artery. Other aber-

rant RHA sources are the gastroduodenal artery, right gastric artery, and aorta. While the RHA is seen anterior to the junction of the cystic and common bile ducts in a quarter of patients, these pass posteromedially to the gallbladder and cystic duct before entering the liver.<sup>3,5-7</sup> While an RHA adherent to the cystic duct and gallbladder neck is described amongst the most rare of anomalies,<sup>8</sup> we are unaware of any reports of an RHA that transverses the entire neck and fundus of the gallbladder before such an anterior hepatic entry.

Inadvertent right hepatic artery ligation in cholecystectomy has been associated with liver ischemia, sometimes warranting hepatic lobectomy.<sup>11</sup> An angiographic study would be needed to confirm the origin of this RHA and whether it was an accessory RHA or a true single aberrant RHA—this, however, was not clinically indicated. The size of the vessel (**Figures 1 and 2**) alone is sufficient evidence of its significance.

## CONCLUSION

Based on historically observed patterns, this RHA was most likely of superior mesenteric origin. This case serves as a striking reminder of the variations in extrahepatic biliary and vascular anatomy. Ligation of this aberrant RHA could have led to intraoperative hemorrhage or potential hepatic ischemia.

## References:

- Balija M, Huis M, Nikolic V, Stulhofer M. Laparoscopic visualization of the cystic artery anatomy. *World J Surg.* 1999;23:703–707.
- Suzuki M, Akaishi S, Rikiyama T, Naitoh T, Rahman MM, Masuno S. Laparoscopic cholecystectomy, Calot's triangle, and variations in cystic arterial supply. *Surg Endosc.* 2000;14:141–144.
- Hiatt J, Gabbay J, Busuttill R. Surgical anatomy of the hepatic artery in 1000 cases. *Ann Surg.* 1994;220:50–52.
- Michaels N. Newer anatomy of the liver and its variant blood supply and collateral circulation. *Am Surg.* 1987;112:337–347.
- Jones R, Hardy K. Surgical technique—the hepatic artery: a reminder of surgical anatomy. *J Royal Coll Surg Edinburgh.* 2001;46:168–170.
- Moore K. *Clinically Oriented Anatomy.* Philadelphia, PA: Lippincott Williams & Wilkins; 1992;199.
- Scott-Conner C, Hall T. Variant arterial anatomy in laparoscopic cholecystectomy. *Am J Surg.* 1992;163:590–592.
- Covey AM, Brody L, Maluccio M, Getrajdman G, Brown K. Variant hepatic arterial anatomy revisited: digital subtraction angiography performed in 600 patients. *Radiology.* 1992;224:542–547.
- Alves A, Farges O, Nicolet J, Watrin T, Sauvanet A, Belghiti J. Incidence and consequence of an hepatic artery injury in patients with postcholecystectomy bile duct strictures. *Ann Surg.* 2003;238:93–96.
- Wong M, Lucas C. Liver Infarction after laparoscopic cholecystectomy injury to the right hepatic artery and portal vein. *Am Surg.* 2001;67:410–411.
- Uenishi T, Hirohashi K, Tanaka H, Fujio N, Kubo S, Kinoshita H. Right hepatic lobectomy for recurrent cholangitis after bile duct injury during laparoscopic cholecystectomy: report of a case. *Hepatogastroenterology.* 1999;46:2296–2298.
- Greenfield LJ, Mulholland MW, Oldham KT, Zelenock GB, Lillemoe KD. Biliary anatomy and physiology. In: *Surgery: Scientific Principles and Practice.* 3<sup>rd</sup> ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2001.
- Brunnicardi FC, Anderson DK, Biliar TR, Dunn DL, Hunter JG, Pollock RE. *Schwartz's Principles of Surgery.* 8th ed. New York, NY: McGraw-Hill Professional; 2004;1190.