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Aberrant Vascular Anatomy During Laparoscopic Cholecystectomy: A Case Report of Double Cystic Artery

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ABSTRACT

Introduction: Laparoscopic cholecystectomy is the standard surgical procedure for the management of benign gallbladder pathology. Anatomical variation, including aberrant cystic artery, increases the risk of complications during laparoscopic cholecystectomy. Obtaining a critical view of safety is important to avoid major vascular and bile duct injury.

Case description: We present a case of aberrant anatomy with two cystic arteries of equal caliber in a 41-year-old female undergoing laparoscopic cholecystectomy for acute cholecystitis.

Discussion: This case report aims to emphasize the importance of thorough knowledge of hepatobiliary vascular anatomy, as well as variations beyond the critical view of safety, which will contribute to the safety and success of laparoscopic cholecystectomy.

Key Words: Anatomic variation, Cholecystectomy, Double cystic artery, Laparoscopic.

INTRODUCTION

Laparoscopic cholecystectomy is the standard surgical procedure for the management of symptomatic cholelithiasis and acute cholecystitis. Knowledge of anatomy is crucial to a safe and successful laparoscopic cholecystectomy. The 'critical view of safety', first described by Strasberg et al. in 1995, involves clearing the hepatocystic triangle of fat and fibrous tissue to visualise the single cystic artery and single cystic duct entering the gallbladder.¹ However, in cases of anatomical variation, other structures may be encountered within the hepatocystic triangle. Anatomical variation increases the risk of complications during laparoscopic cholecystectomy.² Therefore, a thorough understanding of the anatomy and its variations is required. We present a case of two cystic arteries of equal caliber observed entering the gallbladder during laparoscopic cholecystectomy.

CASE REPORT

A 41-year-old female presented to the emergency department with a two day history of right upper quadrant pain and nausea. She was otherwise systemically well. She had a similar episode one week prior which had self-resolved. She was referred for an outpatient abdominal ultrasound which demonstrated a 13-mm mobile gallstone and a 12-mm impacted gallstone at the gallbladder neck. She had a history of polycystic ovarian syndrome and previous laparoscopy for endometriosis. She had no allergies, and vaped and consumed alcohol on occasion.

On examination, she appeared well, with a soft abdomen, right upper quadrant tenderness, and positive Murphy's sign. White cell count was $11.2 \times 10^9/L$ and C-reactive protein was 63.6 mg/L with normal liver function tests. Given the clinical suspicion of cholecystitis with a recent ultrasound confirming cholelithiasis, she was consented for laparoscopic cholecystectomy.

The patient underwent emergency laparoscopic cholecystectomy. She was induced under general anaesthesia and positioned supine. Laparoscopy revealed acute gangrenous cholecystitis. The hepatocystic triangle was dissected

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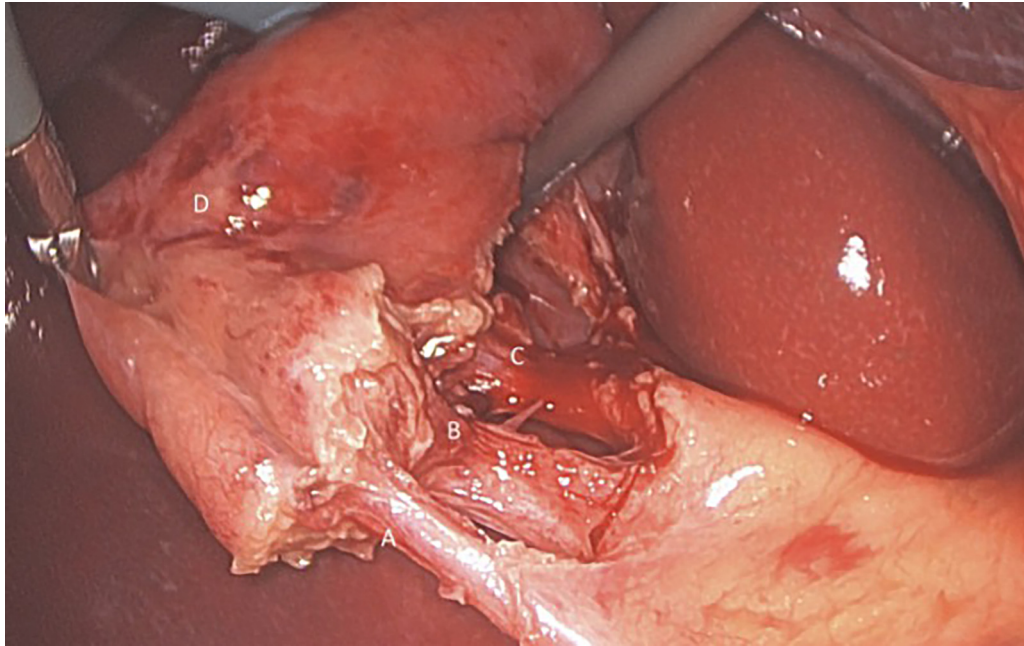


Figure 1. Hepatocystic triangle with three structures seen entering the gallbladder. **A** and **C**) double cystic artery, **B**) Cystic duct, **D**) Gallbladder.

to achieve the critical view of safety. This revealed three structures seen entering the gallbladder, of which two were pulsatile. In order to exclude possible right hepatic artery crossing the Calot's triangle, all three tubular structures were traced to the gallbladder and confirmed that they do not eventuate in the liver substance (**Figure 1**). The two pulsatile structures were partially transected without ligation to demonstrate arterial blood flow, and thus identified as two discrete cystic arteries on either side of the cystic duct (**Figure 2**). Surgical clips were then applied. An intra-operative cholangiogram demonstrated no filling defects, aberrant biliary anatomy and free flow of contrast into the duodenum. The gallbladder was then dissected off the liver bed with electrocautery and retrieved via the infraumbilical port with an endocatch bag. A single Blake drain was inserted through the lateral port and placed in the gallbladder fossa. The pneumoperitoneum was evacuated, ports removed under vision, local anaesthesia administered, the umbilical fascial defect was closed with 0 Biosyn, and the port sites closed with absorbable sutures.

The patient was admitted to the ward postoperatively. The drain was removed on postoperative day 2 due to minimal and haemoserous output. Histopathology demonstrated acute chronic calculous cholecystitis and no evidence of malignancy. She was discharged home on postoperative day 2 with oral analgesia.

The patient presented to hospital again on postoperative day 5 with sudden onset severe right-sided abdominal pain with subjective fevers. The white cell count was $16.8 \times 10^9/L$ and liver function tests were not elevated with a bilirubin of $5 \mu\text{mol/L}$. The hemoglobin was stable at 127 g/L. She was commenced on broad-spectrum intravenous antibiotics. Emergency laparoscopy demonstrated four quadrant biliary peritonitis. The gallbladder fossa was closely inspected, demonstrating an intact bile duct stump controlled with lig-clips and no demonstrable bile leak. Following laparoscopic washout with 1L of sodium chloride 0.9%, Floseal and Fibrillar were administered to the gallbladder fossa and two Blake drains were placed in the pelvic and subhepatic spaces.

Computed tomography cholangiogram postoperatively demonstrated integrity of the major bile duct and cystic stump, and free flow of contrast into the duodenum, confirming the operative cholangiogram findings. The source of the hypothesized bile leak was a small caliber bile duct at the surgical bed, arising from the proximal hepatic duct. An endoscopic retrograde cholangiopancreatography (ERCP) was performed which also confirmed no major injury to the biliary tree, or the ducts of Luschka. Following sphincterotomy, a plastic stent was placed in the main bile duct to preferentially drain bile into the duodenum. The patient improved post-ERCP and the drains were removed the following day given

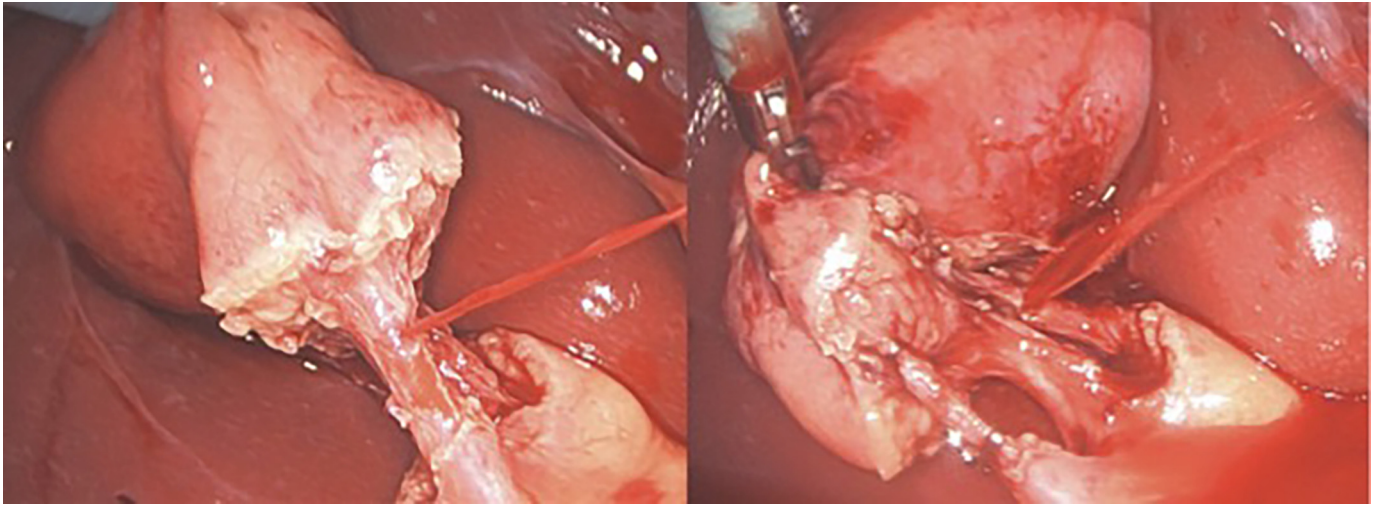


Figure 2. Arterial blood flow confirming presence of double cystic artery.

minimal and haemoserous output. She was discharged home and was clinically well on routine two-week follow-up.

DISCUSSION

Calot's triangle, bordered by the common hepatic duct, the cystic duct, and the inferior border of the liver, is an important landmark for the identification of the cystic duct and the origin of the cystic artery during laparoscopic cholecystectomy.³ The cystic artery most commonly arises from the right branch of the hepatic artery proper as a single vessel. As the cystic artery approaches the gallbladder, it divides into two branches, the larger anterior superficial and the smaller posterior deep branch. The superficial branch courses below the serosa on the left side of the gallbladder, while the deep branch runs posteriorly between the gallbladder and its fossa. The two branches then form anastomoses in the gallbladder parenchyma.^{2,4}

We demonstrated a case of two cystic arteries entering the gallbladder in a patient undergoing laparoscopic cholecystectomy. This occurs when the superficial and deep branches of the cystic artery have separate origins.⁵ Variation in branching can be explained in the embryology of the biliary system. In the fourth week of gestation, the gallbladder develops from the hepatic diverticulum of the foregut, which receives a rich blood supply from the ventral splanchnic arteries.⁶ During development, most of these vessels degenerate to form the resultant vascular network. As this pattern of degeneration is highly variable, aberrant anatomy of the cystic artery may occur.^{7,8}

Previous literature reports the incidence of two cystic arteries, or double cystic artery, ranging from 10 – 25%.^{4,8–12} Accidental ligation, resulting in hemorrhage, may occur where an aberrant second cystic artery arises far from the landmark of Calot's triangle. It is therefore imperative that the operator is aware that double cystic artery may occur in up to a quarter of cases and is an important consideration in cases of haemorrhage of unclear source.

CONCLUSION

We present a case of double cystic artery, both arising from the right hepatic artery. It is essential that surgeons have a thorough understanding of the hepatobiliary vascular anatomy, as well as variations beyond the critical view of safety, which will contribute to the safety and success of laparoscopic cholecystectomy.

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