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Case Report

Rare case of accessory cystic artery treated with laparoscopic cholecystectomy

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ABSTRACT

Anomalies of the cystic artery are of significant clinical importance during laparoscopic cholecystectomy, with accessory cystic arteries posing a challenge for surgeons due to increased risk of vascular injury and hemorrhage. This case report describes a 45-year-old female patient who underwent laparoscopic cholecystectomy for symptomatic cholelithiasis, during which an accessory cystic artery was identified. Careful dissection and precise intraoperative management allowed for the successful identification and ligation of both the main and accessory cystic arteries, preventing intraoperative complications. The patient had an uneventful recovery and was discharged on postoperative day two. This case emphasizes the importance of preoperative awareness of vascular variations and highlights the need for meticulous surgical technique to avoid potential complications in patients with accessory cystic arteries.

Keywords: Gall bladder diseases, Challenge anatomy, Lap chole, Minimal access surgery, Hepatobiliary anatomy

INTRODUCTION

The significance of the cystic artery (CA) is closely tied to the history of cholecystectomy. By 1890, early modern surgeons were skeptical about the procedure's usefulness, but over time, cholecystectomy became widely accepted. Despite its acceptance and widespread use, there remained a sense of apprehension due to recurring complications, particularly those involving the CA, a critical structure to be ligated and divided during the surgery.

Today, laparoscopic cholecystectomy is performed globally, with established practices in urban centers in India and growing adoption in peripheral areas. The CA is the key structure targeted for clipping or ligation during both laparoscopic and conventional cholecystectomies. Complications such as hemorrhage or hepatobiliary injury often arise during the dissection and ligation of the CA, primarily due to variations in its course and relation to the biliary ducts. These persistent complications have spurred ongoing interest among surgeons, radiologists, and anatomists in studying this artery. Typically, the CA originates from the right hepatic artery (RHA) to the right of the common hepatic duct (CHD) within Calot's triangle. Upon reaching the neck of the gallbladder, it divides into superficial and deep branches that supply the peritoneal and non-peritoneal surfaces of the gallbladder, respectively. These branches anastomose over the body and fundus of the gallbladder and provide numerous twigs to the liver substance.[1,2] In 25% of individuals, the superficial and deep branches of the CA have separate origins, a condition known as double CA according to Michels.[3]

Calot's triangle, described by Calot in 1891, is traditionally bounded by the cystic duct (CD), CHD, and the CA. In 1981, Rocko et al highlighted possible variations in this region and defined a triangle bordered by

the CD, CHD, and the lower edge of the liver.[4] In 1992, Hugh et al suggested renaming Calot's triangle to the hepatobiliary triangle due to frequent anatomical variations in this area. Careful dissection of Calot's triangle is essential for both conventional and laparoscopic cholecystectomies. Hemorrhage can occur during the search for the CA if these variations are not considered, potentially increasing the conversion rate to open surgery. Furthermore, laparoscopic visualization presents anatomical relations differently compared to conventional cholecystectomy, underscoring the need for thorough knowledge of cystic arterial variations to safely perform the procedure.[6] This cross-sectional, observational, quantitative, and descriptive study aims to document the normal and variant anatomy of the CA, contributing to the enhancement of cholecystectomy safety.

The cystic artery commonly arises from the right hepatic artery in 63-92.5% of cases.[7-9] However, it can sometimes originate from other arteries such as the common hepatic artery, hepatic artery proper, left hepatic, middle hepatic, gastroduodenal, retroduodenal, superior pancreaticoduodenal, right gastric, celiac trunk, or superior mesenteric artery.[6-8,10] The occurrence of the cystic artery arising from the superior pancreaticoduodenal artery is less than 0.3%.[7,9] The incidence of dual cystic arteries, where the superficial and deep branches have separate origins, ranges from 2.94-25% in various studies.[8,11,12] Typically, these dual cystic arteries originate from the right hepatic artery.[12] In some cases, the deep cystic artery may arise from the right hepatic artery, while the superficial branch comes from a different source, resulting in dual blood supply to the gallbladder, or both branches may originate from an anomalous source.[8,12]

During development, the extrahepatic biliary system forms from an intestinal diverticulum that is richly supplied with vessels originating from the aorta, celiac trunk, and superior mesenteric artery. As development progresses, most of these vessels are absorbed, resulting in the mature vascular system. Due to the highly variable pattern of absorption, it is not uncommon for the cystic artery and its branches to originate from various nearby arteries.[13]

CASE REPORT

A 45-year-old female patient presented with recurrent right-sided abdominal pain over the past 8 months. The pain was episodic, suggestive of biliary colic, and not associated with other gastrointestinal symptoms such as nausea or vomiting. Physical examination revealed a soft, non-tender abdomen with no palpable masses. There were no signs of guarding or acute abdominal distress. Laboratory tests, including liver function tests, were normal. Abdominal ultrasound showed a 9-millimeter calculus lodged at the neck of the gallbladder, consistent with cholelithiasis.

Given the patient's symptoms and ultrasound findings, a diagnosis of symptomatic cholelithiasis was made. She was scheduled for an elective laparoscopic cholecystectomy. The procedure was performed under general anesthesia two days later. Standard laparoscopic ports were inserted: a 10-mm port at the umbilicus for the camera and 5-mm ports in the epigastrium and right upper quadrant for instrumentation.

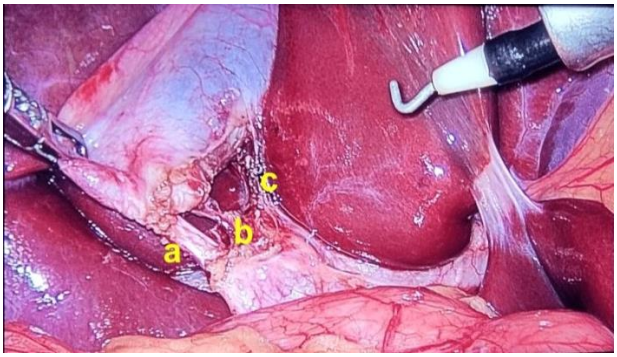

Figure 1: Laparoscopic view of the Calots triangle showing (a) cystic duct, and (b and c) cystic arteries.

Upon dissection of Calot's triangle, an accessory cystic artery was identified, an anatomical variation that increased the risk of vascular injury. Meticulous dissection was carried out, allowing for the safe identification and ligation of both the primary and accessory cystic arteries. The gallbladder was successfully removed without intraoperative complications. The patient tolerated the procedure well, with no intraoperative or postoperative complications. She was discharged on postoperative day two in stable condition, with no signs of infection, bleeding, or bile leakage. Histopathological examination of the gallbladder confirmed normal findings, without evidence of malignancy or other pathology. The patient was scheduled for routine postoperative follow-up.

DISCUSSION

Laparoscopic cholecystectomy is the gold standard operation for gallbladder removal and has become a common surgical procedure; however, it is not without risks. The various anatomical structures that traverse Calot's triangle (defined by the cystic duct, the common hepatic duct, and the inferior surface of the liver) may vary significantly between patients. This is particularly true of the blood supply to the gallbladder. The cystic artery typically arises from the RHA, travels through Calot's triangle, and enters the gallbladder at the junction of its neck and the cystic duct.[5] As it nears the gallbladder, the cystic artery bifurcates into two branches: an anterior superficial branch and a posterior deep branch. The anterior branch runs along the peritoneal surface of the gallbladder, while the posterior branch lies between the gallbladder and its fossa (Figure 2).[6] The surgeon's experience and anticipation of abnormal anatomy are crucial in managing the challenges posed by accessory artery variations. This expertise allows for the identification and safe handling of anatomical anomalies during surgery.

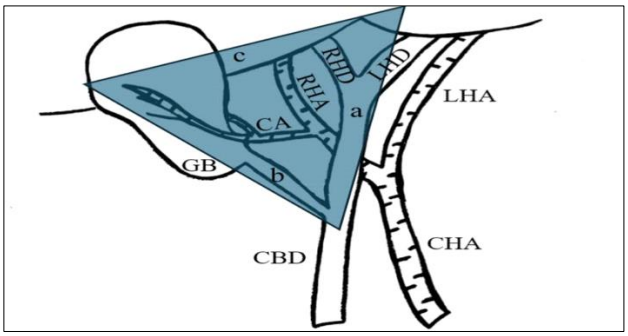

Figure 2: Calot's triangle (colored), as defined by the (a) common hepatic duct, (b) cystic duct, and (c) inferior surface of the liver

LHA: Left hepatic artery; RHA: right hepatic artery; CA: cystic artery; CHA: common hepatic artery; LHD: left hepatic duct; RHD: right hepatic duct; CBD: common bile duct; GB: gallbladder

In addition to the typical anatomy, several arterial variations have been described. The "caterpillar hump" is a well-known example, referring to a long RHA that may be misidentified as the cystic artery, potentially leading to unintentional ligation of the RHA.[7]Additionally, both the RHA and the cystic artery may pass anterior to the common bile duct or hepatic duct. Accessory cystic arteries have also been identified, which can complicate surgery if they bleed. It is important to note that arterial variations are more common than ductal variations.[8]

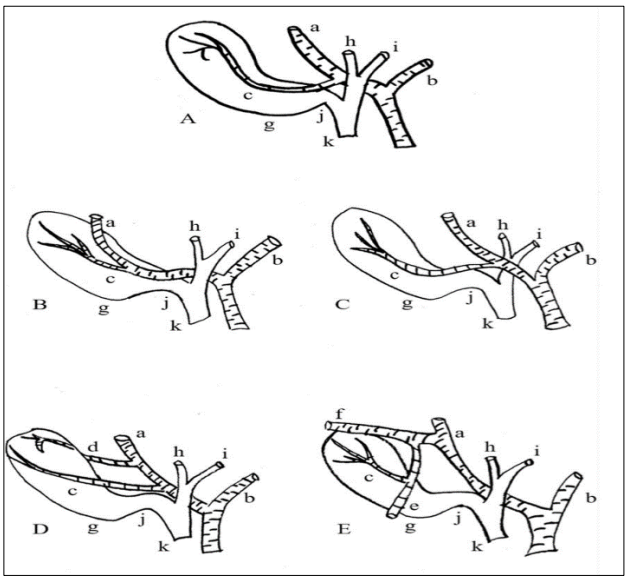

Figure 3: (A) Typical anatomy, (B) "caterpillar's hump", (C) right and left hepatic artery, anterior to the common bile and hepatic duct, (D) accessory cystic artery, and (E) cystic artery from the middle hepatic artery; (a) right hepatic artery, (b) left hepatic artery, (c) cystic artery, (d) accessory cystic artery, (e) middle hepatic artery, (f) anterior branch of the right hepatic artery, (g) gallbladder, (h) right hepatic duct, (i) left hepatic duct, (j) cystic duct, and (k) common bile duct.

The critical view of safety is the primary technique used to perform a safer cholecystectomy. This approach involves three key steps. First, the dissection of Calot's triangle is carried out. Next, the lower third of the gallbladder is exposed to display the relevant anatomical structures in the area. Finally, the cystic duct and the CA are identified, as they are the only tubular structures still connected to the gallbladder. This method offers a clearer view of the structures that need to be ligated and removed, minimizing the risk of mistakenly ligating incorrect structures. For more complex cases, when anatomical structures are difficult to distinguish, a retrograde cholecystectomy can be employed. In this technique, dissection begins at the gallbladder's fundus and proceeds toward the infundibulum, making it easier to identify the structures leading to the gallbladder.

Postoperative radiological investigation to confirm the type of anatomical cystic artery variant is not routinely necessary unless the patient develops complications. However, such imaging can be performed for academic purposes to enhance understanding and documentation.

CONCLUSION

Since deviations from normal anatomy are frequently encountered during surgery, surgeons, especially those who are early in their careers, should exercise caution when managing these variations.

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