Unique origin of the cystic artery

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ABSTRACT

The cystic artery (CA) is known to exhibit variations in its origin and branching pattern. This is attributed to the developmental changes occurring in the primitive ventral splanchnic arteries. During routine dissection of a male cadaver, we observed that the CA originated from the middle hepatic artery (MHA) at a distance of about 1 cm from its origin, and the MHA originated from the right hepatic artery at a distance of 2.1 cm from its origin. The CA traversed for a distance of 1.5 cm, giving off a branch to the cystic duct. It then passed anterior to the cystic duct. The origin of the CA was located to the left of the common hepatic duct, outside the Calot's triangle. The topographical anatomy of the arterial system of the hepatobiliary region and their anomalous origin should be considered during hepatobiliary surgeries. This knowledge is also important for interventional radiologists in routine clinical practice.

Keywords: arteries, bile ducts, gallbladder, hepatic artery, hepatic duct

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INTRODUCTION

The topographic anatomy of the hepatobiliary arterial system and their anomalous origins should be kept in mind during hepatobiliary surgeries such as laparoscopic cholecystectomy. Prior knowledge of any rare anomaly is essential for reducing the incidence of intraoperative complications. During laparoscopic surgery, inadvertent injury to the vessels may lead to open surgery.[1] The cystic artery (CA) is known to exhibit variations in its origin and branching pattern. It is used as an arterial branch patch to overcome the arterial diameter discrepancy in living related liver transplantation.[2] It is also the main artery in which dye is injected for determining the surgical margin in advanced gallbladder carcinoma.[3] When the CA arises from an artery other than its commonest origin, its relation to the nearby structures and Calot's triangle would be altered. This report aims to highlight a case of rare anomalous origin of the CA and its relation to the cystic duct, common hepatic duct (CHD) and Calot's triangle.

CASE REPORT

An unclaimed male cadaver was dissected in the region of liver and gallbladder in order to explore the arterial pattern of the hepatobiliary region. Firstly, the coeliac trunk and its three branches were identified. Secondly, the course of the common hepatic artery and its branches was traced to the hilum of the liver. The hilum area was then carefully dissected to explore the CA and the neighbouring structures. We found that the middle hepatic artery (MHA) was a branch of the right hepatic artery (RHA), arising at a distance of about 2.1 cm from the bifurcation of the right and left hepatic arteries (LHA); both were the terminal branches of the common hepatic artery. The CA, which is the sole arterial supply of the gallbladder, arose from the MHA, originating from it at a distance of 1 cm away from the origin of the MHA (Fig. 1). After traversing for about 1.5 cm, the CA gave off its first branch to the cystic duct. The artery continued its course superficially on the gallbladder wall and then divided into two branches to supply it. During its course, the CA passed anterior to the cystic duct and CHD. The origin of the CA was at the left of the CHD, outside the Calot's triangle. After giving off the CA, the MHA then traversed for 2.7 cm and ended in the quadrate lobe of the liver.

DISCUSSION

The Calot's triangle is bound by the cystic duct, the CHD and the inferior border of the liver.[4,5] It is an important landmark for identifying the origin of the CA during laparoscopic cholecystectomy.[5] The commonest origin of the CA is the RHA, which lies on the right side of the CHD, in the Calot's triangle.[4,5] Michels proposed the term 'middle hepatic artery', which is the extrahepatic branch of the RHA or LHA that supplies the caudate and quadrate lobes of the liver (segment IV).[5] Approximately 1% of aberrant CA have been found to arise from the MHA.[5] In Chen et al's study, the CA arose from the RHA in 76.6% of their Chinese cohort.[6] Variant origins of the CA include origins from the left hepatic (4%), gastroduodenal (1.4%), coeliac (1.4%), common hepatic (2.8%), proper hepatic (4%), superior mesenteric (1.4%), retroduodenal and superior pancreaticoduodenal (1.4%) arteries.[6,7]

In the present case, the CA originated from the MHA, which was an extrahepatic branch of the RHA.

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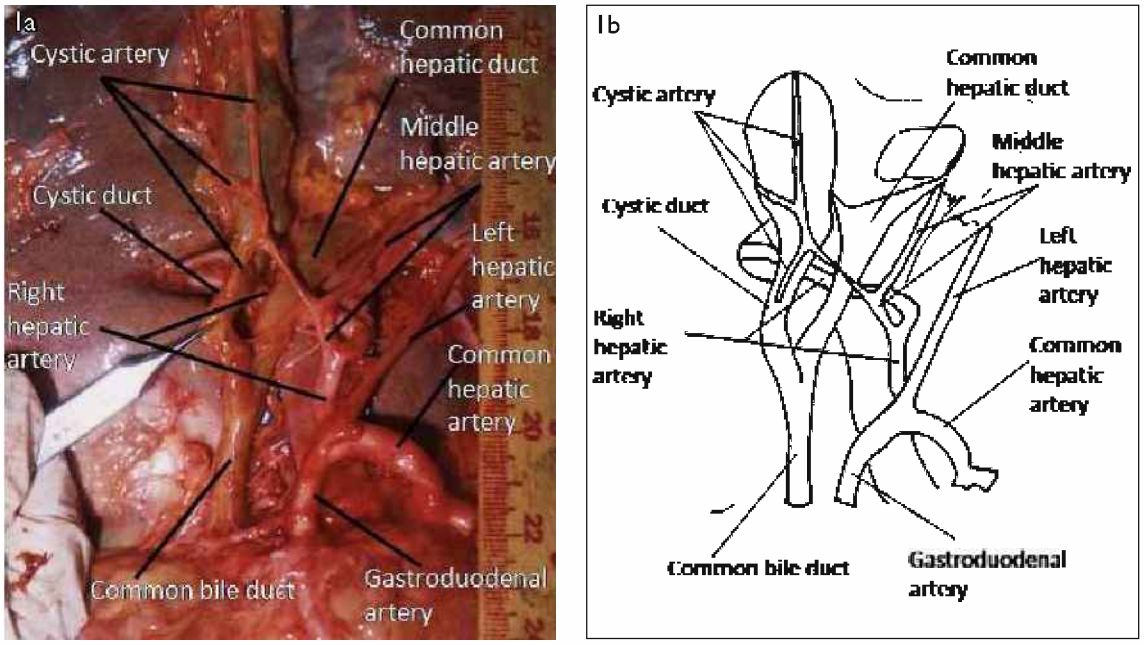

Fig. 1 (a) Photograph and (b) illustration show the anomalous origin of the cystic artery, which lies outside the Calot's triangle.

The origin of the CA was present on the left of the CHD, and thus, lay outside the Calot's triangle. The CA usually traverses the Calot's triangle posterior to the CHD if the origin is the RHA.[1,4,6] 13% of CAs arising from the artery other than the RHA traverse anterior to the CHD and are thus outside the Calot's triangle.[1,6] Similarly, in our case, the CA arose from the MHA and passed anterior to the CHD, and its origin was outside the Calot's triangle.

The source of troublesome haemorrhage during surgery may stem from a rare anomalous artery.[8,9] One effective way to cease haemorrhage during a surgical procedure is to clamp or compress the injured vessel at the site of origin. Knowledge of arterial variations can be applied to identify an injured artery arising from an uncommon origin. Awareness of the origin of the anomalous CA and its relation to the extrahepatic biliary tree is also essential to a surgeon performing laparoscopic cholecystectomy. The high incidence of conversion to open surgery is attributed to haemorrhage from anomalous vessels.[1] An artery arising from an unusual origin would alter its relation with neighbouring structures. Such alterations can initiate injury to the biliary tree and result in bile leakage, eventually leading to formation of pseudoaneurysms in neighbouring blood vessels.[10] Our present findings highlight the relationship between the anomalous CA and the CHD that lies posterior to the CA. The identification and selection of a specific artery is important for interventional radiologists who perform angiogram, arterial embolisation and chemoperfusion for unresectable hepatic tumours. Nonselective embolisation may lead to gallbladder infarction after hepatic artery embolisation for inoperable hepatic tumours.[11,12]

We conclude that the awareness of arterial anomalies can prevent potential intra- and postoperative complications. Knowledge of rare origins of the CA and its relation to the hepatic duct system is important and beneficial to both surgeons who perform laparoscopic cholecystectomy and interventional radiologists in routine clinical practice.

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