

Case Report: Variation of the Gallbladder Vasculature Including Double Cystic Arteries

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ABSTRACT

Acquaintance with the different anatomical variations of the arterial supply of the gallbladder is of great importance in hepatobiliary surgical procedures. A rare variation of the hepatobiliary arterial system was found during anatomical dissection of a female Iranian cadaver. Two cystic arteries were present, the first arising directly from the right hepatic artery and the second from the gastroduodenal artery. Knowledge of the different anatomical variations of the arterial supply of the gallbladder is of great importance in hepatobiliary surgical procedures.

1. Introduction:

The cystic artery is a single vessel that usually originates from the right branch of the proper hepatic artery [1]. This artery passes through the hepatobiliary triangle or Calot's triangle in 75–80% of reported cases [2]. Calot's triangle, which is a landmark for intraoperatively location of the cystic artery, is bounded superiorly by the inferior surface of the liver, inferiorly by the cystic duct and medially by the common hepatic duct [1]. On approaching the gallbladder, the cystic artery divides into superficial and deep branches that run on the anterior and posterior facets of the gallbladder. The two arteries anastomose and small branches enter the gallbladder parenchyma. Variations of the origin and course of the cystic artery are very common. Therefore, since laparoscopic cholecystectomy became the gold standard for treatment of cholelithiasis,

awareness of anatomical variations of the hepatobiliary arterial system has gained in importance. Blood vessel damages during laparoscopic cholecystectomy, including cystic artery hemorrhage, result in conversion to open surgery in up to 1.9-% of cases, causing mortality of about 0.02-% [3]. Awareness of other possible variations in this region is of paramount information for safe cholecystectomy. We report a case in which two cystic arteries are present, originating from the right hepatic artery and gastroduodenal artery.

2. Case report

During anatomical dissection of the abdominal cavity of a female Iranian cadaver in the Medical Faculty of Tehran University of Medical Sciences, an anatomical variation of the hepatobiliary arterial system was recognized. The common hepatic artery took its origin from a coeliac trunk. After giving rise to the gastroduodenal artery, it travelled to the porta hepatis as the proper hepatic artery,

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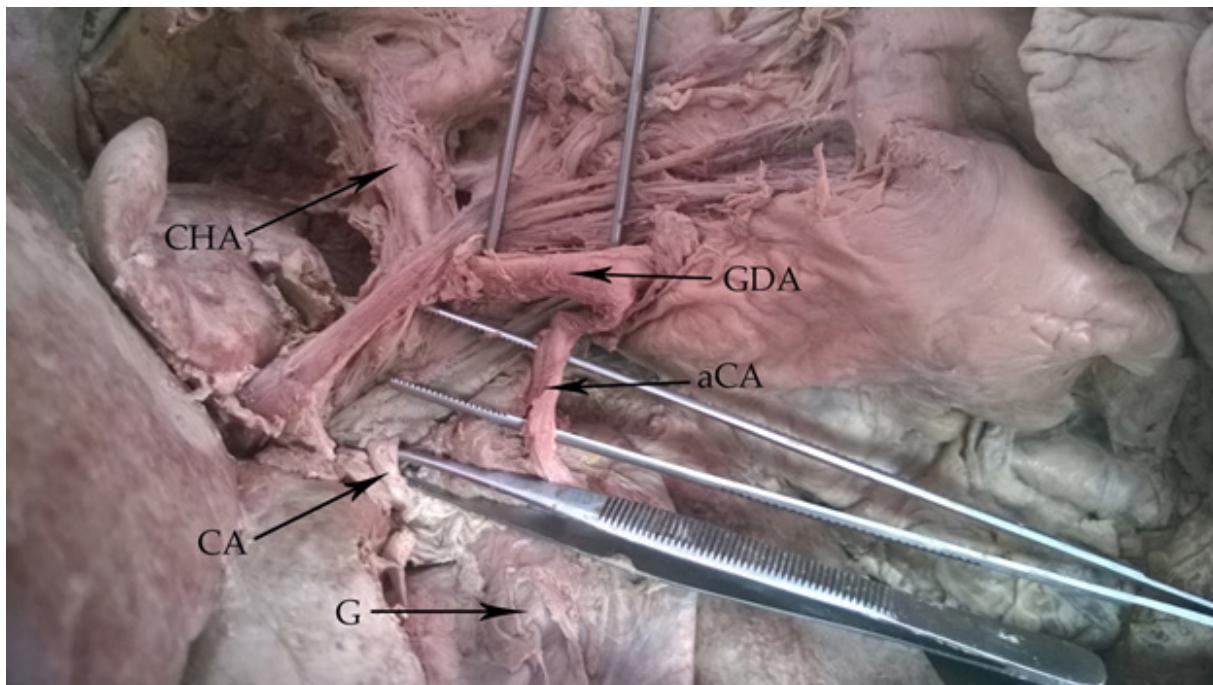


Figure 1. Structures of the hepatobiliary region. CHA common hepatic artery, GDA gastroduodenal artery, CA cystic artery, aCA accessory cystic artery, G gallbladder.

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where it bifurcated into right and left branches (Figures 1, 2). At the level of the junction of the common hepatic duct with the cystic duct, the right hepatic artery gave rise to the cystic artery.

The cystic artery travelled in front of the bile duct and then through the hepatobiliary triangle to the region below the neck of the gallbladder. Afterwards, it divided into superficial and deep branches. The gastroduodenal artery travelled inferiorly. Approximately two centimeters lower than the beginning of the gastroduodenal artery; it gave rise to the accessory cystic artery (Figures 1, 2). The accessory cystic artery ascended superolaterally, coming from the middle part of the gallbladder. Then, it bifurcated into superficial and deep branches. The accessory cystic artery did not cross through the Calot's triangle, coursing inferiorly and parallel to the cystic duct without crossing it. In this case, the blood supply to the gallbladder was supplied by two arteries (the cystic artery arising from the right hepatic artery and accessory cystic artery arising from gastroduodenal artery).

3. Discussion

According to Anson the cystic artery originates from the following sources: right hepatic artery (63.9-%), common hepatic trunk (26.9-%), left hepatic artery (5.5-%), gastroduodenal artery (2.6-%), superior pancreaticoduodenal artery (0.3-%), right gastric artery

(0.1-%), celiac trunk (0.3-%), and superior mesenteric artery (0.8-%) [4]. The incidence of double cystic artery ranges from 2 to 25-%, but its occurrence varies among different populations [3] [5] [6]. It is frequently associated with congenital absence of the deep branch of the cystic artery [7]. Double cystic artery can be divided depending on position with respect to the hepatobiliary triangle, bile ducts and portal vein [3] [6] [7].

Ding et al. named cases where the cystic arteries existed not only in the hepatobiliary triangle, but also outside it. In their research, only 3 of 600 (0.5-%) Chinese patients had a cystic artery travelling through the Calot's triangle, superficial to the cystic duct, with the accessory cystic artery approaching the gallbladder outside the triangle [3]. The same pattern was present in 13 (5.3-%) of 244 Japanese patients operated by Suzuki et al., who generally reported occurrence of double cystic artery in 27 cases (11.1-%) [6]. Zubair et al. recognized this type in 5.46-% of 220 Pakistani patients who underwent laparoscopic cholecystectomy. In spite of that, the most common variation, which was seen in 26 (11.8-%) cases, was the double cystic artery passing through the hepatobiliary triangle [8]. On the other hand, in a study reported in Pakistan by Talpur et al., double cystic artery was present in only 3 of 300 cases (1-%) [9].

Saidi et al., in 102 Nairobi liver dissections, found double cystic artery in 8 cases (7.8-%) [5], and Futara et al. reported a frequency of 10-% in Ethiopians [10].

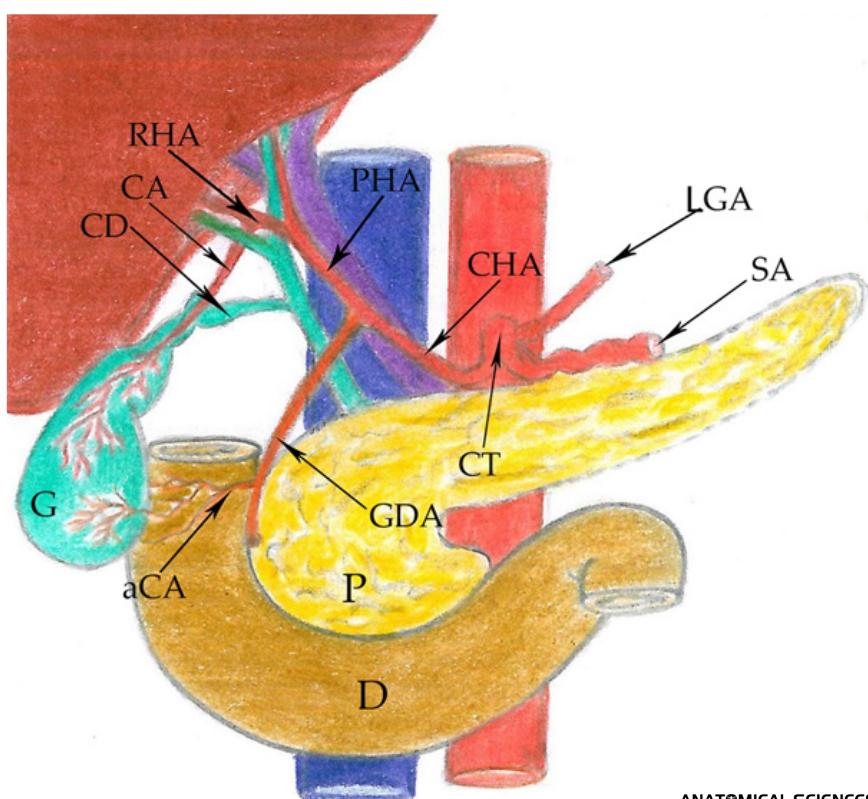
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Figure 2. Schematic drawing of structures of the hepatobiliary region. CT coeliac trunk, LGA left gastric artery, SA splenic artery, CHA common hepatic artery, PHA proper hepatic artery, RHA right hepatic artery, CA cystic artery, CD cystic duct, GDA gastroduodenal artery, aCA accessory cystic artery, G gallbladder, P pancreas, D duodenum.

In European populations of Slovenians, double cystic artery was reported in 13.6 and 5.5% cases [7] [11]. About the origins of double cystic arteries, they arise from the right hepatic artery or its branches [6] [11]. On the contrary, the most common origins for aberrant cystic arteries consist of the left, proper or common hepatic arteries, the gastroduodenal artery, the superior pancreaticoduodenal artery and the superior mesenteric artery [12]. A cystic artery starting from the gastroduodenal artery or from its branches is called a low-lying cystic artery. The prevalence of this anatomic variation ranges from 1 to 30% [1] [7] [12].

All the aforementioned variations usually occur separately. Cases of variations with double cystic artery associated with variation in hepatic arteries are very rare. Bincey and Somayaji reported a case of 2 cystic arteries that both arose from proper hepatic artery just after the former gave rise to the accessory left hepatic artery [13]. Loukas et al. described double cystic arteries arising from both the right hepatic artery and the posterior superior pancreaticoduodenal artery coexisting with an accessory left hepatic artery arising from a left gastric

artery [14]. Kano et al. described that injury to the bile duct is the most common major complication of laparoscopic cholecystectomy. They also stated that exposure of the cystic duct and cystic artery in the same field of vision is important for preventing such injury [15].

In conclusion, haemorrhage and bile leakage are the most common cause for conversion to open surgery during laparoscopic cholecystectomy and usually occur due to variants of structures of the hepatobiliary triangle [15] [16]. Preoperative diagnosis of these variants by means of routine investigations is difficult and seen only in exceptional cases [9]. Knowledge of the different anatomical variations of the arterial supply of the gallbladder is of great importance in hepatobiliary surgical procedures. Then, for safe and uneventful cholecystectomy, particularly by means of laparoscopic techniques, it is essential to be familiar with anatomic variations in the hepatobiliary arterial system, even if they are very scarce, like the one described in this report.

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