

Dual Cystic Arteries in Association with Caterpillar Hump of Right Hepatic Artery- A Case Report and its Surgical Relevance

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ABSTRACT

A rare variation was seen in the arterial supply of liver and gall bladder during dissection of an adult female cadaver. The right hepatic artery was having a tortuous course with double loops and cystic artery was arising from the distal loop within the hepatobiliary triangle. There was an accessory cystic artery arising from the superior pancreaticoduodenal artery outside the hepatobiliary triangle which ascended anterior to the common bile duct and cystic duct towards the gall bladder. The knowledge of these vascular variations is very much essential owing to increase in surgical interventions involving the biliary tract. Recognition of such vascular variations is essential for laparoscopic surgeons to reduce complications like uncontrolled intraoperative bleeding, iatrogenic extrahepatic biliary injuries and conversion to open cholecystectomy. This report emphasizes the necessity of all surgeons being well aware of vascular variations and anomalies to be able to accomplish safe and uneventful hepatobiliary surgeries.

Keywords: Accessory cystic artery, Cholecystectomy, Moynihan's hump, Superior pancreaticoduodenal artery

CASE REPORT

During routine dissection of abdomen in an adult female cadaver, dual cystic arteries and tortuous right hepatic artery were seen in the same cadaver [Table/Fig-1]. The right hepatic artery arose from hepatic artery proper and then took a tortuous course towards the right lobe of the liver presenting with double loops. The proximal loop was directed upwards as it crossed the portal vein. It then passed behind the common hepatic duct to enter the hepatobiliary triangle where it formed the distal loop with convexity towards the right after which it entered the right lobe of liver. This caterpillar hump of right hepatic lied partly outside (proximal loop) and partly inside the hepatobiliary triangle (distal loop). A short cystic artery was given by the proximal part of the distal loop of right hepatic artery within the hepatobiliary triangle which supplied the visceral surface of the gall bladder. There was an additional long cystic artery arising outside the hepatobiliary triangle from the proximal part of superior pancreaticoduodenal branch of gastroduodenal artery. It crossed the common bile duct anteriorly and was lying superficial to the

cystic duct up to the neck of the gall bladder beyond which it was related to the peritoneal surface of the gall bladder supplying it.

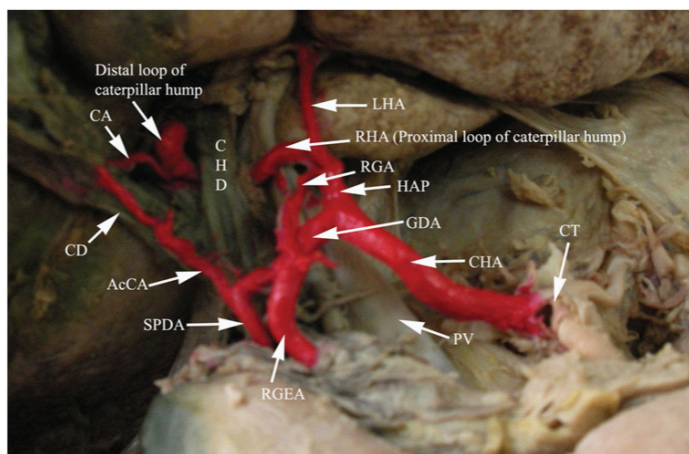
DISCUSSION

The right hepatic artery after its origin from hepatic artery proper crosses anterior to the portal vein and then passes behind the common hepatic duct to enter the Calot's triangle (bounded by cystic duct, common hepatic duct and lower edge of the liver). As it approaches the cystic duct, it gives off the cystic artery and then turns upwards, behind (and between) the right hepatic and the cystic duct to the right lobe of the liver. The cystic artery normally arising from the right hepatic within the triangle, passes in the triangle towards the neck of gall bladder where it typically divides into two branches one of which runs on the attached surface of the gall bladder and the other on its peritoneal surface [1].

Cystic artery commonly arises from right hepatic artery in 63-92.5% of cases [2-5]. Sometimes cystic artery can also arise from common hepatic artery, hepatic artery proper, left hepatic, middle hepatic, gastroduodenal, retroduodenal, superior pancreaticoduodenal, right gastric, celiac trunk or superior mesenteric artery [2,3,6]. Cystic artery from superior pancreaticoduodenal as seen in present case is seen in less than 0.3% [2,4]. Incidence of dual cystic arteries in various studies was 2.94-25% [1,3,6]. Dual cystic arteries typically represent separate origins of the superficial and deep branches of this artery from right hepatic artery [1]. Sometimes the deep cystic arises from right hepatic and superficial branch from some other source resulting in dual blood supply to gall bladder or both may arise from an anomalous source [1,3].

During development, the extrahepatic biliary system arises from an intestinal diverticulum, which carries a rich supply of vessels from aorta, celiac trunk and superior mesenteric artery. Later most of these vessels are absorbed leaving in place the mature vascular system. As the pattern of absorption is highly variable, it is not unusual for the cystic artery and its branches to derive from any other artery in the vicinity [7].

Tortuous right hepatic artery also called caterpillar hump or Moynihan's hump is rare but dangerous anomaly the incidence of which ranged between 1-12.9% [8-11]. Both inside and outside



[Table/Fig-1]: Showing tortuous right hepatic artery giving origin to cystic artery and accessory cystic artery arising from superior pancreaticoduodenal artery. (CT-celiac trunk, CHA-common hepatic artery, HAP- hepatic artery proper, RGA- right gastric artery, LHA- left hepatic artery, RHA-right hepatic artery, GDA-gastroduodenal artery, CA-cystic artery, AcCA- accessory cystic artery, SPDA-superior pancreaticoduodenal artery, RGEA-right gastroepiploic artery, CHD- common hepatic duct, CD-cystic duct, PV- portal vein)

the Calot's triangle, the right hepatic often makes a characteristic caterpillar like loop, convexity of which points downward, upward, to the right or to the left [3]. The tortuous artery may pass dorsal or ventral to the common hepatic duct, but former is more common [3,9,12]. The hump may have single or double loop, double loop is commoner. In double looped hump, cystic artery can arise either from proximal or distal loop, origin from latter is more frequent [9,12]. Cystic artery arising from the proximal loop is long and crosses over the tortuous right hepatic artery to reach gall bladder while that arising from distal loop is very short owing to loop's proximity to the gall bladder [12].

Surgical significance

In presence of dual cystics, identification and ligation of both these arteries is necessary during cholecystectomy [13]. After ligating or clipping one artery, surgeon must search carefully for possibility of another supply which may have any source of origin and if not identified, may be torn and bleeding may obscure the operating field [10]. Uncontrolled bleeding from cystic artery is a serious problem which can lead to intraoperative injuries to vital vessels and biliary tract. The resulting haemorrhage and bile leakage usually constitute the most common causes of conversion of laparoscopic cholecystectomy to open cholecystectomy and mortality rate due to blood vessel injury is 0.02% [5,14,15]. A cystic artery arising from gastroduodenal artery or its branches is called low lying cystic artery and such an artery does not pass through hepatobiliary triangle but approaches the gall bladder beyond it and is seen inferior to cystic duct in open cholecystectomy but usually localises superficially and anterior to cystic duct from laparoscopic view point [14]. Cystic artery arising outside the hepatobiliary triangle usually passed ventral to common hepatic duct and in some cases may be inferior to cystic duct thus becoming the first structure to be encountered in dissection of inferior border of Calot's triangle by laparoscopy and has a chance of accidental injury [16]. Too proximal ligation of such a cystic artery would endanger the common bile duct. Perforations of duodenal ulcers on posterior wall may involve the cystic artery from gastroduodenal artery. In an anterior perforation where the gall bladder mass lies on the wall of the duodenum, it may involve the main trunk or its branches. During pancreatic transplantation or operations involving head of pancreas and terminal part of hepatopancreatic duct system, the position of this variation should be kept in mind [17].

Identification of such variations has immense importance in radiological practice and helps the radiologists who perform intraoperative cystic angiogram during hepatobiliary surgeries [7]. Identification and selection of specific artery is important for interventional radiologists who perform arterial embolization and chemoperfusion of unresectable hepatic tumours. Non selective embolization may lead to gall bladder infarction after hepatic artery embolization for inoperable hepatic tumours [18].

Caterpillar hump of right hepatic artery invariably leads to abnormalities of cystic artery formation which can result in its injury during regional surgeries. Since the cystic artery arising from the loop is typically short, it may get easily avulsed from the hepatic artery producing brisk bleeding [9,10]. Chance of avulsion of right hepatic artery is also high if excessive traction applied on the gall bladder or during hooking and ligation of the short cystic artery.

Sometimes tortuous right hepatic artery does not give a single cystic artery but supplies the gall bladder with several small twigs. The right hepatic artery is injured while securing them. Injury to right hepatic artery can be fatal in presence of impaired liver function [10,12]. The tortuous right hepatic artery lies in close proximity to the gall bladder and cystic duct and so it may be mistaken to be cystic artery and inadvertently ligated during surgical procedures like cholecystectomy and liver transplantation [9,10,12].

CONCLUSION

During classical as well as laparoscopic procedures involving the biliary tract, sudden anatomical variations can be a cause of concern for surgeons. A sound knowledge of such vascular variations is essential for surgeons to prevent iatrogenic injuries in this region and conversion of laparoscopic to open cholecystectomy thus reducing mortality and morbidity due to intra and postoperative complications. Simultaneous occurrence of dual cystic arteries with the accessory cystic arising from superior pancreaticoduodenal and caterpillar hump of right hepatic is a very unique event not reported till date to the best of my knowledge and hence this case is reported to benefit both surgeons and interventional radiologists in routine clinical practice.

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