

Cystic Artery: Incidental Variation of Origin

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ABSTRACT

On the basis of origin, variation of cystic artery is commonly found. Commonly, cystic artery originates from the right hepatic artery and rare condition from celiac trunk. The position of the cystic artery possesses extraordinary importance for the surgeon during cholecystectomy, because the cystic artery is the primary structure to be clipped or tie up during cholecystectomy. In this study, during cadaveric dissection incidentally found rarest condition that cystic artery originating from celiac trunk. These anatomical findings are much important for surgical and radiological aspect and may be helpful for surgeons during the performance of surgeries involving hepatic and biliary apparatus.

Keywords: Calot's triangle, Celiac trunk, Origin of cystic artery, Right hepatic artery

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INTRODUCTION

The cystic artery is the foremost structure to be clipped or ligated during cholecystectomy so that position of the cystic artery possesses extraordinary importance for the surgeon during cholecystectomy surgery. During routine dissections of cadavers and during surgeries, the possibilities of occurrence of variation in the origin of cystic artery are commonly encountered. This variation is usually encountered at the level of origin, course, and relations to the biliary ducts. All these variation is the center of attraction for surgeons, radiologists, and anatomists and motivates to do study frequently.

The upper part of the cystic duct is supplied by cystic artery, and cystic artery usually derived from the right hepatic artery (RHA) to the right of common hepatic duct in Calot's triangle. Cystic artery passes downward and to the right behind the common hepatic or right hepatic duct and lies posterior-superior to the cystic duct. At the neck of the gallbladder, it divides into superficial and deep branches. The superficial branch is supply to peritoneal covered inferior surface and the deep branches ramify in the loose areolar tissue between the liver and the superior surface of the gallbladder.^[1]

Calot's triangle is a space bordered by the inferior surface of segment V of the liver superiorly, medially common hepatic duct and inferiorly by the cystic duct.^[2] This space contains the cystic artery with its variable disposition. The cystic artery is mentioned in relation to Calot's triangle. In 1891, J. F. Calot described Calot's triangle as a triangular area comprised the cystic duct, right hepatic duct, and lower edge of the liver.^[3] In 1981, possible variation in the region of calot's triangle is described by Rocko *et al.* Hugh *et al.* suggested that Calot's triangle should be renamed as hepatobiliary triangle in 1992, the small cystic artery branches supplying the cystic duct being called Calot's arteries.^[4] The purpose of this study is to record and explore the variant anatomy of origin of cystic artery.

MATERIAL AND METHODS

Material

Instruments required for cadaver dissection:

1. Forceps- Artery, Blunt, Toothed, and allies
2. Scalpel
3. Scissors
4. Retractor

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Methods

1. The detailed description regarding anatomical variation of cystic artery's origin is reviewed by medical text books and journals.
2. Cadaveric dissection of abdomen has been performed as per "cunninghum's manual of practical anatomy."

Case Study

Study has been performed in the Department of Anatomy of Pt. K. L. Sharma Govt. (Auto.) Ayurveda Collage and Institute Bhopal, Madhya Pradesh. During routine dissection of formalin fixed cadaver of a 56-years-old male, the subhepatic region of the abdomen was exposed by separating the lesser omentum with gross dissection followed by fine dissection to visualize the cystic artery. It was observed that the cystic artery is taking origin from celiac trunk (CT) instead of its normal origin from the RHA [Figure 1].

After arising from CT, it was passing posterior to common hepatic duct and anterior to cystic duct and in due course reaches the neck of gallbladder. The further course and branching pattern is normal. CT is very distinctly seen giving origin to splenic, left gastric, common hepatic artery, and cystic artery. Common hepatic artery continues toward right and gives origin to the

right gastric and gastroduodenal artery and, further, continues as hepatic artery proper. Further, course and branching of hepatic artery proper was as usual. The cystic artery certainly outside the limits of Calot's triangle [Figure 2].

DISCUSSION

Various numbers of variations in the origin of cystic artery described in texts books. The cystic artery originates from the RHA (63.9%), hepatic trunk (26.9%), left hepatic (5.5%), gastroduodenal artery

(2.6%), superior pancreaticoduodenal artery (0.3%), right gastric (0.1%), CT (0.3%), and superior mesenteric artery (0.8%).^[5] In 1994, Harris and Pellegrini showed that cystic artery was originating from the RHA (75%).^[6] Other sources found were left hepatic artery (6.2%), hepatic artery proper (2.2%), common hepatic artery (0.6%), and superior pancreaticoduodenal artery (0.2%). Double cystic artery in Calot's triangle existed in 5.55%.^[7] As described earlier, the cystic artery originates mostly from the RHA (63.9% of population) and rarely from CT (0.3 % of population). During cadaveric dissection was it observed that the cystic artery is taking origin from CT instead of its normal origin from the RHA. After arising from CT, it was passing posterior to common hepatic duct and anterior to cystic duct and in due course reaches the neck of gallbladder and the cystic artery certainly outside the limits of Calot's triangle. These uncommon findings are fore most important for surgeons during cholecystectomy surgery. Furthermore, findings are much important for radiologist in radiological aspect. Terminal segment of cystic artery is also important as it has to be manipulated first and is also susceptible to injury and hemorrhage during dissection of the peritoneal folds connecting the hepatoduodenal ligament to Hartmann's pouch of the gallbladder.^[8]

Table 1 shows variation in source of origin of the cystic artery according to different authors. Maximum authors described cystic artery originate from the RHA and only Daseler *et al.* mentioned that in 0.3% of population cystic artery originate from CT.

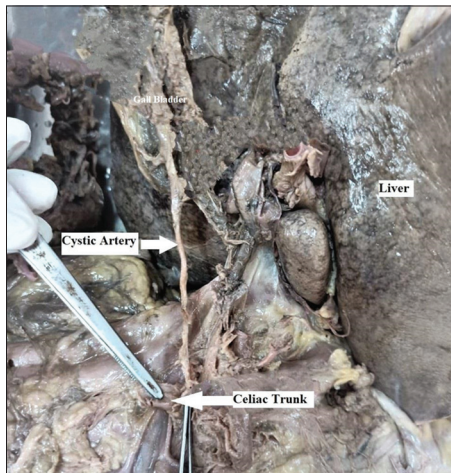


Figure 1: Origin of cystic artery from celiac trunk

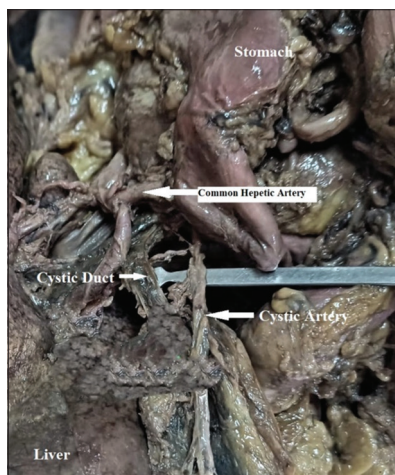


Figure 2: Routing of cystic artery

Embryological View

Variations in the cystic artery may be attributed to the developmental pattern of the biliary system. Liver and biliary apparatus develop from endodermal hepatic duct. The hepatic buds arise as an outgrowth from the ventral wall of terminal part of foregut.^[17] Foregut endodermal hepatic diverticulum usually carries a rich supply of vessels from the abdominal aorta and its initial branches. Most of the vessels raise from the abdominal aorta during development and degenerate residue in place the developed vascular system. This pattern of degeneration is highly variable, so the origin and branching pattern of the vessels to these organs also vary considerably (Hiatt *et al.*, 1994).^[18]

The first arteries to appear in the embryo are the right and left primitive aortae. They are continuous with the two endocardial heart tubes. After the fusion of the two endocardial tubes, the two ventral aortae partially fuse to form the aortic sac, the unfused parts remaining as the right and left horns of the sac. Hence, the descending aorta is derived from the left dorsal aorta, below the attachment of fourth arch artery, along with the fused median

Table 1: Variation in source of origin of the cystic artery according to different authors

Studies	RHA	ARHA	HAP	CHA	LHA	MHA	GDA	SMA	CT
Michels ^[9]	77.5	12	0	1.5	5	0	4	0	0
Saidi <i>et al.</i> ^[10]	92.2	0	7.8	0	0	0	0	0	0
Pushpalatha and Shamasundar ^[11]	54	2	22	12	0	0	8	2	0
Johnston and Anson ^[12]	85.7	14.3	0	0	0	0	0	0	0
Tejaswi <i>et al.</i> ^[13]	92	4	2	0	1	0	1	0	0
Daseler <i>et al.</i> ^[14]	71.7	16.1	0	2.8	6.3	0	2.6	0.1	0.3
Bhardwaj ^[15]	75	0	0	0	5	13.3	6.7	0	0
Gawali ^[16]	90	3.3	0	0	3.3	0	3.3	0	0
Dandekar and Dandekar ^[3]	79.3	12.1	3.7	2.5	1.2	1.2	0	0	0

RHA: Right hepatic artery, ARHA: Aberrant right hepatic artery, HAP: Hepatic artery proper, CHA: Common hepatic artery, LHA: Left hepatic artery, MHA: Middle hepatic artery, GDA: Gastroduodenal artery, SMA: Superior mesenteric artery, CT: Celiac Trunk

vessels.^[19] It is easy to perceive the high degree of arterial variation within this vascular system as described by Daseler *et al.*^[20]

CONCLUSION

Knowledge of the different anatomical variations of the arterial supply of the gallbladder, liver, and stomach is of great importance in hepatobiliary and gastric surgical procedures.^[20,21] Many of variations are found in the cystic artery as origin, relation with biliary duct, branching, Calot's triangle, etc.

It is to be conclude that cystic artery originates mostly from the RHA (60–90% of population) and rarely from CT (0.3% of population). During cadaveric dissection was it observed that the cystic artery is taking origin from celiac trunk instead of its normal origin from the right hepatic artery. Findings supports above most rare condition that cystic artery can also originate from celiac trunk. Present findings may be helpful for surgeons during the performance of surgeries involving hepatic and biliary apparatus and also keep significant role for radiological aspect.

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