

The Prevalence of Double Cystic Artery: A Cadaveric Study

Kiran Sidana*, H.R.Jadav **, Bharat G. Patel***

Abstract :

Introduction: The cystic artery is main source of blood supply to gallbladder and cystic duct. The cystic artery usually arises from the right hepatic artery. It divides into superficial and deep branches at the neck of the gallbladder. The superficial branch ramifies on the inferior aspect of the gallbladder body, the deep branch on the superior aspect. The cystic artery gives rise to multiple fine branches which supply the common and lobar hepatic ducts and upper part of the common bile duct. **Objective:** The present study was conducted to find out the prevalence of double cystic arteries. The recognition of this variation is important to avoid intraoperative bleeding during cholecystectomy. **Materials & Methods:** The study was carried out on 100 adult human cadavers in different medical colleges of Gujarat region. The variations of present number of cystic artery were observed, if found then documented and photographed. **Result:** Out of 100 specimens in 12(12%) specimens present the double cystic arteries. Out of 12 specimens in 10 specimens the cystic artery arises from right hepatic artery and in 2 specimens cystic artery arises from segmental branch of right hepatic artery. **Conclusion:** This study is emphasis the importance of a thorough knowledge of anatomy and recognition of variations of cystic artery are essential pre-requisites for safe and uneventful laparoscopic cholecystectomy and can reduce uncontrolled intraoperative hemorrhage and extrahepatic biliary injury.

Key words: Cystic artery, Cholecystectomy, Gallbladder

Introduction :

The cystic artery 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.⁽¹⁾ The liver and gallbladder and biliary duct system arise as a ventral outgrowth-hepatic diverticulum- from the caudal or distal part of the foregut early in the 4th week of gestation.

The hepatic diverticulum enlarges rapidly and divides in to two parts as it growth between the layers of ventral mesogastrium. The larger cranial part of the hepatic diverticulum is the primordium of the liver. The proliferating endodermal cells give rise to interlacing cord of hepatocytes and to epithelial lining of the intrahepatic part of the biliary apparatus.

The small caudal part of the hepatic diverticulum becomes the gallbladder and the stalk of the diverticulum

forms the cystic duct.

Initially the extrahepatic biliary apparatus is occluded with epithelial cells, but it is later canalized because of vacuolation resulting from degeneration of these cells. The stalk connecting the hepatic and cystic ducts to the duodenum becomes the bile ducts.⁽²⁾ The variations in anatomy of cystic artery based on its origin position and number are well described in various studies because of its importance in avoiding inadvertent bleeding and its consequences. The reported incidence of these variations is from 25% to 50%.⁽³⁾ The cystic artery usually arises from the right hepatic artery (RHA). It usually passes posterior to the common hepatic duct and anterior to the cystic duct to reach the superior aspect of the neck of the gallbladder. It divides into superficial and deep branches. The superficial branch ramifies on the inferior aspect of the gallbladder body, the deep branch on the superior aspect. These arteries Anastomoses over the surface of the body and fundus. An accessory cystic artery may arise from the common hepatic artery or one of its branches and the cystic artery often bifurcates close to its origin, giving rise to two vessels which approach the gallbladder. Multiple fine arterial branches may arise from the parenchyma of

* Assistant Professor, Department of Anatomy,

*** Professor & Head, Department of Anatomy,
GCS Medical College, Ahmedabad.

** Professor & Head, Department of Anatomy,
GMERS Medical College, Sola, Ahmedabad.

Correspondence to : k.sidana@yahoo.com

segments IV or V of the liver and contribute to the supply of the body, particularly when the gallbladder is substantially intrahepatic. This makes the gallbladder relatively resistant to necrosis during inflammation which otherwise occludes the cystic artery. The cystic artery gives rise to multiple fine branches which supply the common and lobar hepatic ducts and upper part of the common bile duct. These fine branches form a network which anastomoses with the vessels ascending around the common bile duct and with the vessels from the liver parenchyma which descend with the right and left hepatic ducts.⁽⁴⁾

Materials and Methods:

The present study is a cross sectional study. The approval of the study was also taken from Ethical committee of GCS Medical College, Ahmedabad. The study conducted on liver specimens with intact gall bladder and extrahepatic duct system of human cadaver in the department of Anatomy in various medical colleges in Gujarat region.

The data are collected by dissection of 100 cadavers of both sexes in department of Anatomy of various medical colleges of Gujarat region from December 2012 to August 2015. Abdomen opened as per Cunningham's maneuver the dissection included proper exposure of area by cutting right costal arch up to the fifth intercostal space. The lesser omentum attached to lesser curvature of stomach is cut and taking care not to include the hepatoduodenal ligament. Cystic duct, right and left hepatic duct, common hepatic duct, common bile duct traced and dissected out. Boundaries of calot's triangle identified. Right gastric artery identified and traced to the common hepatic artery. The common hepatic artery dissected till the gastroduodenal given off and the proper hepatic artery defined. The right and left hepatic arteries identified and traced cystic artery. Identified the cystic artery and observed the variations.⁽⁵⁾ If variation was found were documented and photographed.

Inclusion Criteria:

- Liver specimens with intact Gall bladder with its arteries.
- Specimens with intact extra hepatic duct system.

Exclusion Criteria:

- Injured or lacerated liver and gall bladder.
- Liver specimen with absent gall bladder.

Result:

In present study, 100 cadavers were dissected and liver specimens with intact extrahepatic duct system were retrieved. Out of 100 specimens, double cystic arteries were present in 12 specimens. The double cystic arteries were identified as CA-1 (Cystic Artery 1) and CA-2 (Cystic Artery 2); shown in Figure-2. Out of 12 specimens, both the cystic arteries were present within the Calot's triangle in 7 specimens; in 3 specimens both arteries were outside the Calot's triangle & in 2 specimens one artery was inside the Calot's triangle & the other one was outside it.

Table- 1: Prevalence of number of cystic artery

Total no. of specimens	Single cystic artery	Double cystic artery
100	88	12

Table-2: Variation in the source of origin of the cystic artery

S. No.	Source of origin	Number of cases	Percentage
1	Right hepatic artery	10	83.33%
2	Segmental branch of right hepatic artery	2	16.66%

Out of 100 specimens double cystic artery was present in 12 specimens (12%) as shown in Table-1 and noted as CA-1 and CA-2.

Out of 12 specimens in 10 specimens (83.33%), cystic artery originated from right hepatic artery and in 2 specimens (16.66%) the cystic artery arose from segmental branch of right hepatic artery as shown in Table-2.

Table-3: Mode of termination

Sr. No.	Mode of termination	No. of specimens
1	CA-1 & CA-2 Both terminated in to Superficial & Deep branch	3(25%)
2	CA- 1terminate in to Superficial & Deep branch & CA-2 Continues as superficial branch	7(58.33%)
3	CA- 1terminate in to Superficial & Deep branch & CA-2 Continues as Deep branch	2(16.66%)

Mode of termination is shown in table-3. Out of 12 specimens, CA-1 was divided into superficial & deep branch and CA-2 continued on superior surface in 7 specimens (58.33%).

CA-1 and CA-2 both are terminated by dividing into superficial and deep branch in 3 specimens (25%).

CA-1 is divided into superficial and deep branch and CA-2 is continuing on inferior surface of gall bladder in 2 specimens (16.66%).

Discussion:

Most errors in gall bladder surgery result from failure to appreciate the common variations in the anatomy of the biliary system. The success and safety of laparoscopic cholecystectomy depend on a high regard for an accurate knowledge of the anatomy and some of the common embryologic anomalies of the biliary tree. The blood supply, ductal variations, and gallbladder anatomy of this area are often the source of major challenge to unprepared and unaware surgeons.

Table- 4: Level of Termination

Sr. No.	Level of termination	No. of specimens
1	CA-1 & CA-2 Both terminated at the neck of gall bladder	11 (91.66%)
2	CA- 1 terminated at the neck of gall bladder & CA-2 terminated at fundus of gall bladder	1(8.33%)

Both the cystic artery CA-1 and CA-2 terminated at the level of neck of gall bladder in 11 specimens (91.66%).

CA-1 terminated at the level of neck and CA-2 terminated on fundus of gall bladder in 1 specimens (8.33%) shown in table-4.

Recognition of cystic artery anatomy and its variations can reduce likelihood uncontrolled intraoperative hemorrhage and extrahepatic biliary injury and conversion to open cholecystectomy.⁽⁶⁾

Fig.1- Showing single cystic artery. CA-cystic artery, RHA- Right hepatic artery, GB- Gall bladder. (Normal Pattern)

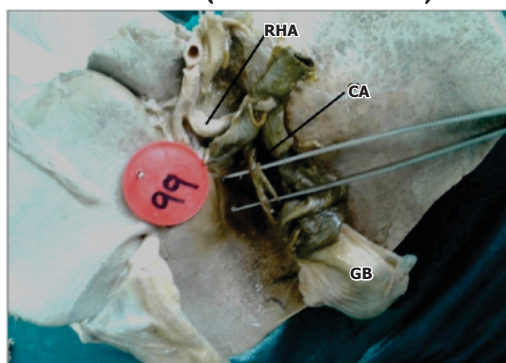


Fig.2- Showing Double cystic artery. CA-1: cystic artery-1, CA-2: cystic artery-2 RHA- Right hepatic artery, GB-Gall bladder.

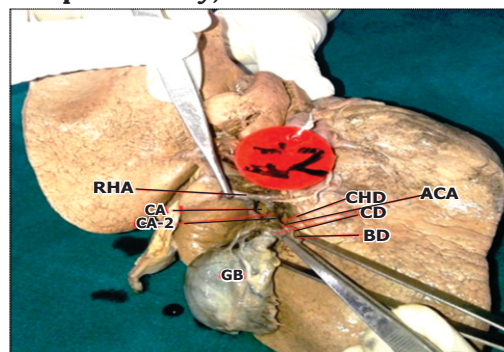


Table-5: Comparison of presence of Double Cystic Artery with other studies

Sr. No.	Studies	No. of Specimens	Single Cystic Artery	Double Cystic Artery
1	Michel NA (1951) ⁽⁷⁾	200	150 (75.00%)	50 (25.00%)
2	Gammon K Jacob (1976) ⁽⁹⁾	33	26 (78.80%)	7 (21.20%)
3	Balija M. et al. (1999) ⁽³⁾	200	169 (84.50%)	31 (15.56%)
4	Mlakar B. et al. (2003) ⁽⁸⁾	81	70 (86.00%)	11 (14.00%)
5	Muhammad Zubair et al. (2012) ⁽⁶⁾	220	166 (75.45%)	26 (11.82%)
6	Present Study (2015)	100	88 (88.00%)	12 (12.00%)

In the present study the double cystic artery observed in 12 % specimens but the study done by Michel NA ⁽⁷⁾ he found the presence of double cystic artery in 25% cases, this is higher than present study. The result of present study is nearby similar to work done by above mentioned authors in table5, Balija et al. ⁽³⁾ (15.56%), Mlakar B et al. ⁽⁸⁾ (14%), Muhammed Zubair et al. ⁽⁶⁾ (11.82%). But this is lower than findings of Gammon K Jacob ⁽⁹⁾ (21%).

The cystic artery presents an unusually high degree of variability not only in its origin or number but also in its course to gallbladder. It has surgical importance as it is always ligated during cholecystectomy irrespective of its origin and number. When the artery is ligated there is always a possible risk of injury to the ducts. If multiple cystic arteries are not identified, they may be torn or causes bleeding in the operative area. ⁽¹⁰⁾

Conclusion:

Laparoscopic cholecystectomy has been accepted as the preferred method of treatment of gallbladder stones in healthy individuals. During laparoscopic cholecystectomy, dissection of a limited field is visualized on the video monitor for detailed anatomical variations of cystic artery. The present study helps to recognition of such type of variations which has surgical importance and requires special attention in gallbladder surgeries and also helpful to radiologist to perform an intraoperative cystic angiogram during hepatobiliary surgery and pre-requisites for safe and uneventful laparoscopic cholecystectomy and can reduce uncontrolled intraoperative hemorrhage and extrahepatic biliary injury.

References:

- Hlaing K P , Thwin S , Shwe N. Unique origin of the cystic artery Singapore Med J. 2011; 52(12) : e263.
- Keith, L.M. and T.V.N. Persaud. The developing human clinically oriented embryology, 8th ed. Elsevier. 2008; 218-220.
- Balija M . Huis M , Nikolic V , Stulhofer M , Laparoscopic visualization of the cystic artery anatomy World J Surg 1999; 23:703-7.
- NR: Gallbladder and biliary tree. In Standring S (Ed.): Gray's anatomy, the anatomical basis of clinical practice. 40th ed. Edinburgh. Elsevier Churchill and Livingstone. 2008; pp: 1177-1181.
- Cunningham's Textbook of Anatomy, 9th edition p. 129. Ed. J. C. Brash. (1951) London: Oxford University Press.
- Muhammad Zubair, Lubna Habib, et.al. Anatomical Variations of Cystic Artery: Telescopic Facts. Med J Malaysia. 2012; Vol 67 No 5- 494-496.
- Michels NA. The hepatic, cystic and retroduodenal arteries and their relations to the biliary ducts: with samples of the entire coeliac blood supply. Ann Surg: 1951; 133:503-24.
- Mlakar B, Gadzije EM, Ravnik D, Hribernik M. Anatomical variations of the cystic artery. Eur J Morphol. 2003; Feb; 41(1): 31-4.
- Gammon K and Jacob M. The right hepatic artery, the cystic artery and the extrahepatic biliary apparatus. Indian J Surg. 1976; 326-331.
- Pai Veena, Lakshmi prabha subhash, Anupama D, Nagaraj D.N. Dual cystic artery- A case report. Anatomica Karnataka 2011; Vol-5,(2)page 52-54.