

The Anatomical Study of Cystic Artery in Calot's Triangle

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Abstract: The cystic artery is the key structure to be ligated during laparoscopic or conventional cholecystectomy. The possible complications like hemorrhage or hepatobiliary injury are always centered on the search, dissection, and ligation of the cystic artery, many a time because of possibility of variations in its course and relations to the hepatic ducts. This study was carried out to document the normal anatomy and variations of the cystic artery in relation to calot's triangle to improve surgical safety. This study conducted on 50 adult human cadavers shows. the arteries approached the gall bladder anterior to common hepatic duct in 5 cadavers out of the 50, that is 10% of cases.

Key words: cystic artery, calot's triangle, hepatic ducts, cystic duct

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I. Introduction

It was observed that in the present times laparoscopic procedures have become common therapeutic methods. Since the laparoscopic surgeons have to work in a limited space, it is all the more important for him to be aware of the possible variations. Keeping this in view the author made an attempt to look for variations of the cystic artery in relation to calot's triangle in the cadavers available. The gallbladder, cystic duct, common hepatic duct and upper part of common bile duct are supplied by cystic artery. It is a branch of right hepatic artery. It arises within the calot's triangle. Calot's triangle is a space bounded by common hepatic duct medially, and by the cystic duct inferiorly, and by the inferior surface of liver superiorly. The main content of this triangle is cystic artery.

II. Material And Methods

The present study was done on 50 embalmed cadavers during routine dissection practices for undergraduates in the dissection hall of Gandhi Medical College, Secunderabad. Abdominal cavity was opened. The structures at the porta hepatica were exposed and common hepatic duct was identified and traced downwards. Gall bladder and cystic duct were identified and traced till the union of cystic duct with common hepatic duct. Cystic artery traced, its relation with Calot's triangle was observed. Artery, Gall bladder, ducts painted, photographs taken and labelled.

III. Observations

Normally the cystic artery arises from the right hepatic artery outside the calot's triangle, and it runs posterior to common hepatic duct divides into superior and inferior branches and supplies the respective surfaces of gall bladder. In 45/50 (90%) of cases the cystic artery arose from right hepatic artery. In 5/50 (10%) cases in the present study we observed cystic artery arose from the right hepatic artery and runs anterior to the common hepatic duct divides into branches and supplies the gall bladder. It runs posterior to common hepatic duct in 45/50 (90%) of cases. Observations are depicted in fig.1, 2

IV. Discussion

According to Hugh TB et al¹² in 1992 a "normal" cystic artery was found in only 72% of patients and an artery that ran inferior to the cystic duct in 6%. In present study normal cystic artery was found in 90% cases. According to Chen X et al⁵ in 1996 in separating the Calot's triangle, blunt dissection should be used to avoid burning the extrahepatic bile duct (EHBD), and blind hemostasis should be avoided. If the cystic artery lies in the upper part and the back of the cystic duct, the cystic duct should be dissected out, clipped and cut first, then the cystic artery be dealt with.

Baliya M et al³ in 2001 studied on 1000 cholecystectomies and named variations of the terminal part of the cystic artery. Group I comprises the five variations of the cystic artery within the hepatobiliary triangle: (a) "normal" position; (b) frontal cystic artery; (c) backside; (d) multiple; (e) short cystic artery that arises from an

aberrant right hepatic artery. Group II consists of variations of the cystic artery that approach--the gallbladder beyond the hepatobiliary triangle: (a) "low-lying"; (b) transhepatic; (c) "recurrent" cystic artery. BalijaMet al² in 2001 present an original classification of the anatomic variations of the cystic artery into two main groups based on our experience with 200 laparoscopic cholecystectomy normally lying cystic artery, found in 147 (73.5%) patients. present study correlates with this study

Chen THet al⁵ in 2000 studied in 72 autopsies. The cystic artery arises from many possible origins; the right hepatic artery is the most common origin (76.6%).100% of the cystic arteries originating from the right hepatic artery coursed through the Calot triangle .72.7% of the cystic arteries that originated from the right hepatic artery ran beneath the common hepatic duct as they entered the Calot triangle; the others ran anterior to the common hepatic duct.present study nearly correlates with this study

Futara Get al¹⁰ in 2001 investigated in 110 postmortem and cadaveric subject anatomy of the hepatic and cystic arteries The cystic artery mainly arose from the right hepatic artery (75.5%).When the cystic artery is to the left of the common hepatic artery at its origin (39.1%), it crossed from left to right anterior to the common hepatic duct (28.2%) or posterior to the duct (10.9%). Irrespective of its relationship with the common hepatic duct, the cystic artery passed in the triangle of Calot in 89 cases

Flisiński Pet al⁹ in 2004 studied cystic artery variations in origin, course and number and its importance to recognise it during operative procedure The purpose of this investigation was to determine the origin of the cystic artery and its relation to Calot's triangle in human foetuses It arose most often (82.34%) from the right proper hepatic artery, rarely from its trunk (8.82%) or its left branch (5.88%) and most rarely (2.94%) from the gastroduodenal artery The cystic artery most frequently (67.66%) runs behind the common hepatic duct, rarely (29.40%) over the common hepatic duct and most rarely (2.94%) on the left side of the cystic duct.

Ignjatović Det al¹⁴ in 2006 studied on Cadaver material was used and corrosion casting and postmortem arteriography were employed. Three types of cystic artery were devised according to the results. Type 1 normal anatomy. Type 2 more than one artery in Calots triangle and Type 3 no artery in Calotstrain.Only 40% of the second cystic artery is present in Calots triangle. When there is no artery in Calots triangle its origin unusual, and the artery is either on the postero-lateral side of the cystic duct or it approaches the gallbladder through hepatic tissue which is not seen in present case

Ding YM et al⁸ in 2007Six hundred patients treated with laparoscopic cholecystectomy from June 2005 to May 20 Anatomic structures of cystic artery and conditions of Calot's triangle under laparoscope were recorded respectively studied with 600 laparoscopic cholecystectomies presented a new classification of anatomic variations of the cystic artery, which can be divided into three groups: (1) Calot's triangle type, found in 513 patients (85.5%); (2) outside Calot's triangle, found in 78 patients (13%); which correlates with present study (3) compound type, observed in 9 patients (1.5%).Saidi H et al¹⁵ in 2007 studied The pattern of arterial blood supply of 102 gallbladders was studied by gross dissection. The cystic artery originated from the right hepatic artery in 92.2% of cases which correlates with present study. Most of the arteries approached the gallbladder in relation to the common hepatic duct (anterior 45.1%, posterior, 46.1%). The other vessels passed anterior to common bile duct (2.9%), posterior to common bile duct (3.9%), or were given off in Calot's triangle.

Sugita R et al¹⁶ in 2008 retrospectively assess 64-detector row computed tomography (CT) in the preoperative depiction of the cystic duct and cystic arteries in and around the Calottriangle.A total of 245 consecutive patients (133 men, 112 women), including 48 patients who subsequently underwent cholecystectomy, were examined. The cystic arteries were delineated in 234 of the 245 patients. Both the Calot triangle and the cystic arteries were delineated in 223 patients. One cystic artery was seen in the Calot triangle in 173 patients, and two cystic arteries were seen in the Calot triangle in 12.double which was not seen in present study

Hlaing KP et al¹² in 2011 During routine dissection of a male cadaver observed that cystic artery originated from the middle hepatic artery at a distance of about 1 cm from its origin. The origin of the cystic artery was located to the left of the common hepatic duct, outside the Calot's triangle which was not observed in present case

Hasan M Met al¹¹ in 2013 studied Two hundred and fifty diagnosed patients o. cholelithiasis undergoing routine cholecystectomy were assessed for anatomical and congenital anomalies of extra hepatic biliary system as well as vascular anomalies. Laparoscopic cholecystectomy was done in 157 patients and 93 patients were treated by open procedure including conversion case .variations in 38 cases (15.2%) mainly involving cystic artery.

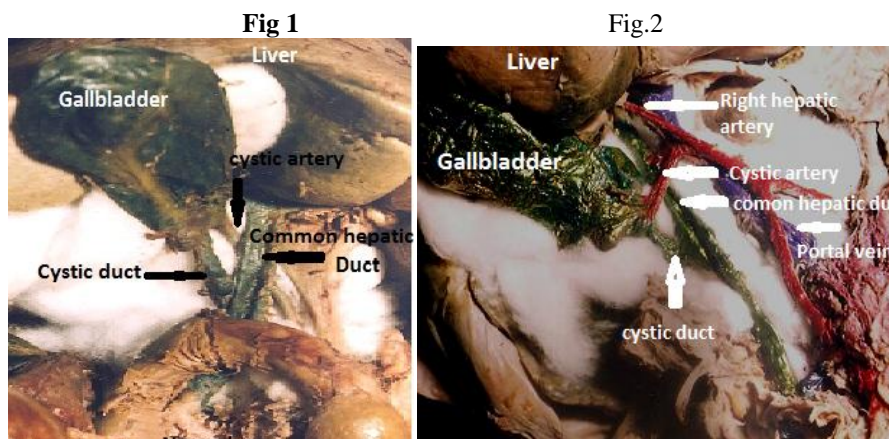
Xia J et al¹⁷ in 2015 depicted the anatomical variation between cystic arteries among patients using 64-detector row spiral computed tomography (CT) prior to laparoscopic cholecystectomy. A total of 78 patients (31 men, 47 women) who underwent cholecystectomy were examined preoperatively using 64-detector row spiral CT between April 2012 and June 2013 The cystic arteries were delineated by CT in 73 of the 78 patients. The relationship between the cystic arteries and the Calot triangle was identified in 71 of the 78 patients. One cystic

artery was found in 53 (73%) of the 73 patients, while two cystic arteries were found in 20 (27%) of the patients. A total of 55 (60%) of the 91 cystic arteries passed through the Calot triangle. The remaining 36 cystic arteries (40%) passed anterior, posterior, or inferior to the cystic duct. Andall RGet al¹ in 2015 PubMed, Medline, Cochrane Database of Systematic Reviews, and Google Scholar databases were searched to conduct a review of the existing English literature on the clinically important cystic artery variations. The cystic artery originated typically from the right hepatic artery (79.02 %) and was found in the hepatobiliary triangle in only 5427 of 6661 (81.5 %) cases. Clinically important cystic artery variations are (1) the cystic artery located anterior to the common hepatic duct or common bile duct found in 485 of 2704 (17.9 %) and 228 of 4202 (5.4 %) of cases, respectively, (2) the cystic artery located inferior to the cystic duct found in 38 of 770 (4.9 %) of cases, (3) short cystic arteries found in 98 of 1037 (9.5 %) cases and (4) multiple cystic arteries found in (8.9 %) of cases. B KK⁴ in 2015 encountered a rare variation 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

Dandekar U et al⁷ in 2016 studied on the normal anatomy and different variations of the cystic artery to contribute to improve surgical safety. study conducted on 82 cadavers revealed the origin of cystic artery from celiac right hepatic artery was found in 79.3% and in the remaining 20.7% it was replaced. Single cystic artery was present in 72% and double cystic artery in 28%. Considering the site of origin of the cystic artery with reference to Calot's triangle, it was observed within the triangle in 62.2% and outside it in 37.8%. present study shows Comparison of cystic artery origin from Rt. Hepatic artery, relation to common hepatic duct of various studies was shown in the below Table1, 2 and chart 1.

V. Conclusion

After an attempt to study the variations of the cystic artery and its relation to calots triangle was made by the author. Information about the work done on the it by other scientists was got by reviewing the available literature. It was observed that the findings were variable when compared with the earlier studies. Variations in the relation of cystic artery with the common hepatic duct were found. However, the incidence of this was observed to be low in comparison with the past study. The author is of the opinion that the variations observed could definitely be useful to surgeons and radiologists



COMPARISION OF CYSTIC ARTERY ORIGIN FROM RT. HEPATIC ARTERY OF VARIOUS STUDIES :Table 1

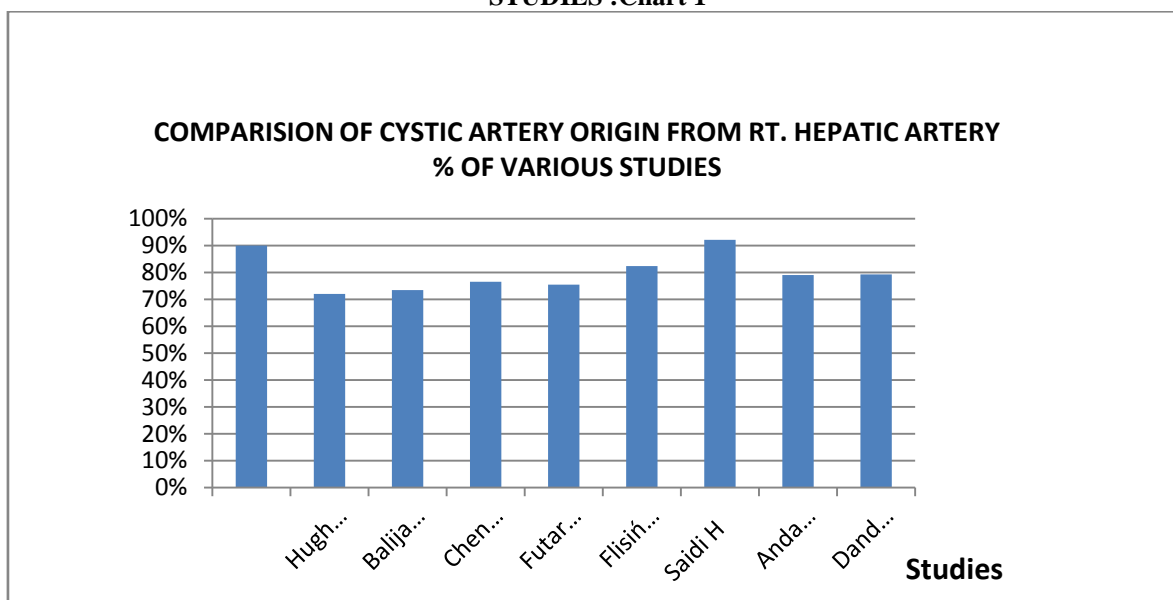
S. No.	Name of Author	Cystic artery origin from Rt. Hepatic artery %
1	Present study	90%
2	Hugh TB et al	72%
3	Balija M et al	73.5%
4	Chen TH et al	76.6%
5	Futara G et al	75.5%
6	Flisiński P et al	82.34%
7	Saidi H et al	92.2%
8	Andall RG et al	79.02 %
9	Dandekar U et al	79.3%

COMPARISION OF CYSTIC ARTERY TO COMMON HEPATIC DUCT OF VARIOUS STUDIES

:Table 2

S. No.	Name of Author	Cystic artery related anterior to common hepatic duct %	Cystic artery related posterior to common hepatic duct %
1	Present study	10%	90%
2	Chen TH et al	72.7%	23.3%
3	Futara G et al	28.2%	80.9%
4	Flisiński P et al	29.40%	67.66%
5	Ding YM et al	13%	85.5%
6	Saidi H et al	45.1%	46.1%
7	Andall RG et al	17.9%	81.5%
8	Dandekar U et al	37.8%	62.2%

COMPARISION OF CYSTIC ARTERY ORIGIN FROM RT. HEPATIC ARTERY OF VARIOUS STUDIES :Chart 1



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