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A STUDY OF AN ANOMALOUS ORIGIN OF CYSTIC ARTERY AND ITS RELATION WITH CALOT'S TRIANGLE – CADAVERIC STUDY

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ABSTRACT

Introduction: The Cystic artery is the main blood supply of cystic duct and gall bladder. If there is damage to the cystic artery during surgery may lead to serious complications, hence the origin and the course of cystic artery is important.

Objective: To evaluate the variations in origin of cystic artery, relation with the Calot's triangle, common hepatic duct and cystic duct.

Method: It is cross-sectional study was conducted over a period of 2 years on 40 Indian formalin fixed cadavers from Departments of Anatomy.

Result: Out of 40 cadavers, cystic artery (CA) was found to be originating from the right hepatic artery in 28 cases (70%), from the left hepatic artery in 2 cases (5%), from gastro duodenal artery in 4 cases (10%), from proper hepatic artery in 3 cases (7.5%), from Superior mesenteric artery in 2 cases (5%), 1 case from right gastric artery (2.5%). It was found that in all cadavers cystic artery and cystic lymph node was found as a content of Calot's triangle. In 54 cases (90%) cystic arteries were posterior to common hepatic duct and in (10%) it was anterior to the common hepatic duct. In two cases (3.33%), cystic arteries were found anterior to the cystic duct. Superficial and deep branch of the cystic artery was found in one case.

Conclusion: Anatomical knowledge of cystic artery is necessary to prevent any iatrogenic complications during surgery.

Key Words: Cystic artery, Calot's triangle, Hepatic duct

INTRODUCTION

The chief source of blood supply to the gallbladder and the cystic duct is the cystic artery. Cystic artery commonly arises from the right hepatic artery in the angle between the common hepatic duct and cystic duct. Cystic artery may arise from left hepatic artery, the proper hepatic artery, the common hepatic artery, the gastro duodenal artery, the superior pancreaticoduodenal artery and the superior mesenteric artery.[1] The cystic artery after taking origin it passes through the Calot's triangle in 75–80% cases. Calot's triangle is a triangular space, bounded by the cystic duct, the common hepatic duct and inferior surface of the liver. The most important content of the triangle is the cystic artery and cystic lymph node.[2] Knowledge of normal anatomy and its variations in the cystic artery and relation with common hepatic duct and cystic duct is important during excision of the gallbladder.[3] When cystic artery is outside the Calot's triangle and it crosses anterior to common hepatic duct it may create complications during surgery. Awareness of anatomical variations of the hepatobiliary arterial system is essential to avoid complication within that surgical field. Blood vessel damages during laparoscopic cholecystectomy, including cystic artery hemorrhage or bile leakage results in open surgery in up to 1.9% of cases,[4] and causing mortality 0.02%.[5]

Anatomical variations of the cystic artery and cystic duct are common and these variations have always attracted both the anatomists and surgeons.

METHOD

This is cross sectional study carried out on 40 embalmed cadavers of Indian origin over a period of 2 years in the department of anatomy. The study is approved by ethical committee. By using dissecting instruments (scissors, forceps, scalpel, etc) the abdomen was opened & then the fat in the

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liver, gall bladder and duodenum cleared .We defined the boundaries of Calot's triangle then traced the origin & course of cystic artery and variations were noted. Statistical analysis done and percentage calculated. In this study we noted the following parameters,

1 Source of origin of the cystic artery.
2 Relations of the cystic artery to the Calot's triangle (inside/outside).
3 Relations of the cystic artery to the cystic duct and common hepatic duct noted. (Anterior/ Posterior/ Not related).
4 Content of Calot's triangle.

RESULT

A total of forty cadavers were observed to study anatomical variations. The Calot's triangle was bounded by the Common hepatic duct medially, cystic duct laterally and liver superiorly.

1. Variation in the origin of the cystic artery:

Out of 40 cadavers, cystic artery (CA) was originating from the right hepatic artery in 28 cases (70%), from the left hepatic artery in 2 cases (5%), from gastro duodenal artery in 4 cases (10%), from proper hepatic artery in 3 cases (7.5%) , from Superior mesenteric artery in 2 cases (5%), 1 case from right gastric artery (2.5%).

2. Number of cystic artery and its branches:

The single cystic artery was found in 39 cases. In one case, a branch of cystic artery (superficial and deep branch) was found. In one case, we observed double origin of cystic artery, one from right hepatic artery and other from proper hepatic artery.

3. Relation of the cystic artery to the Calot's triangle:

Cystic artery was found to be inside the Calot's triangle in 38 cases (95%) while in 2 cases (5%) it was outside the Calot's triangle (Fig. 2).

4. Relation of the cystic artery to the common hepatic duct: (Table: 1)

5. Relation of the cystic artery to the cystic duct:

Out of 40 cadavers, cystic artery was found to be passing anterior to the cystic duct in 2 cases (5%) and in remaining cases it was not related to the cystic duct.

6. Content of calots triangle:

In each case, we had noted the cystic lymph node as a content of calots triangle along with cystic artery.

DISCUSSION

The performance of a safe cholecystectomy depends on thorough knowledge about the normal anatomy and anatomical variations that may contribute to the occurrence of major postoperative complications. The famous triangle originally described by Calot's in 1891.[6] It contain the branch of right hepatic artery , the cystic artery, the cystic lymph node, connective tissue and lymphatic. During cholecystectomy this triangle is dissected to identify the cystic artery and cystic duct before ligation and division.

The explanation for the variations in the cystic artery is found in the developmental pattern of the biliary system. Embryologically, the simple branching pattern of the gastro duodenal and hepatobiliary vasculature is profoundly altered by the growth of the liver and pancreas and by the assumption of a curved form in the stomach and duodenum. These factors operate to complicate the branching of the coeliac axis and proximal segment of the superior mesenteric artery. Considering that the liver is derived from a portion of the primitive duct supplied primordially by the coeliac and mesenteric arteries, it may receive rami from both of these sources. The same is true from the gallbladder. The liver and gallbladder develop from a foregut endodermal hepatic diverticulum, which usually carries a rich supply of vessels from the abdominal aorta and its initial branches. Most of the vessels picked up from the abdominal aorta during development degenerate leaving in place the mature vascular system. Because the pattern of degeneration is highly variable, the origin and branching pattern of the vessels to these organs also vary considerably.[7] Considering the complexity of this developmental scheme it is easy to understand the large degree of arterial variations within this vascular system.[8] 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.[9]

In the present study cystic artery was found to be originating from the right hepatic artery in 28 cases (70%), from the left hepatic artery 2 cases (5%), proper hepatic artery 3 cases (7.5%) and gastro duodenal artery in 4 case (10%) and superior mesenteric artery 2 cases (5%), right gastric artery in one case (2.5%). Findings of the present study were compared with values given by other co-worker, (Table: 2)

In our study we found that single cystic artery in 39 cases and double cystic artery in one case. Similarly, double cystic artery was found by Balija[13] in 21.1% cases and by Suzuki[14] in 11.1% cases. Bincy M. George et al[15] reported a case of double cystic artery and both arteries arose from the hepatic artery proper.

In our study in one cadaver we noted that the superficial and deep branches of cystic artery in Calot's triangle, and similar findings by Khalilur Rahman.[16]

Saidi et al[17] in 102 Nairobian liver dissections, found double cystic artery in 8 cases (7.8%) and Futara et al.[18] reported a frequency of 10 % in Ethiopians. Loukas et al[19] 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. But in our study we found out double origin of cystic artery one from right hepatic artery and other from proper hepatic artery**.**

Comparison of presence of cystic artery within or outside the Calot's triangle by other authors; (Table: 3)

Variation in relation of cystic artery anterior or posterior to common hepatic duct (Table: 4)

In our study we found that anterior relation of cystic artery to cystic duct in 2 cases (5 %), Flinsky[10] found anterior relation to cystic duct in 2.94% and by Desler et al[8] 1%,Gawali et al[12] (10%).

In every cases there is a lymph node termed as Calot's node was found in the Calot's triangle. Lymph node was also found by Sujuki[14]. Hemorrhage and bile leakage are the most common causes for conversion of laparoscopic to open surgery and usually occur due to variation of structures of the hepatobiliary triangle.[21]

CONCLUSION

The success of laparoscopic, open cholecystectomy and other procedures are depending upon the anatomical knowledge of cystic artery and billiary duct system and it is necessary to prevent any iatrogenic complications during surgery.

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Table 1: Relation of the cystic artery to the common hepatic duct

	Cystic artery specimen no (n=40)	Percentage
Crossing posterior to CHD	36	90%
Crossing anterior to CHD	4	10%

Table 2: Comparison of Origin of cystic artery:

Sr no	Authors name	Origin of cystic artery (in percentage)								
		RHA	PHA	LHA	CHA	GDA	SMA	RGA	CT	AB RHA
1	Present study	70	7.5	5	0	10	5	2.5	0	0
2	Daseler et al[8]	71.7	0	6.2	2.7	2.6	0.35	0	0.1	16
3	Flint ER et al[9]	98	0	1.5	0	0.5	0	0	0	0
4	Flisinski et al[10]	82.3	8.8	5.8	0	2.9	0	0	0	0
5	Michels et al[11]	77.7	0	5	1.5	4	0	0	0	12
6	Gawali et al[12]	90	0	3.33	0	3.33	0	0	0	3.33

Table 3: Comparison of presence of cystic artery within or outside the Calot's triangle by other authors;

Authors name	Presence of cystic artery (in percentage)	
	Within Calot's triangle	Outside the Calot's triangle
Present study	95%	5%
Futura et al[18]	89	11
Michels NA et al[11]	81	19
Flisinski et al.[10]	97.6	2.94
Desilva et al.[20]	86	14
Gawali et al[12]	90	10

Table 4: Variation of cystic artery in relation to to common hepatic duct

Sr. no	Authors name	No of cadevers	Relation of cystic artery to common hepatic duct (in percentage)	
			Anterior	Posterior
1	Present study	40	10	90
2	Daseler et al.[8]	580	21.2	2
3	Flisinsky Et Al.[10]	34	29.4	66.7
4	Gawali et al[12]	30	46.66	50

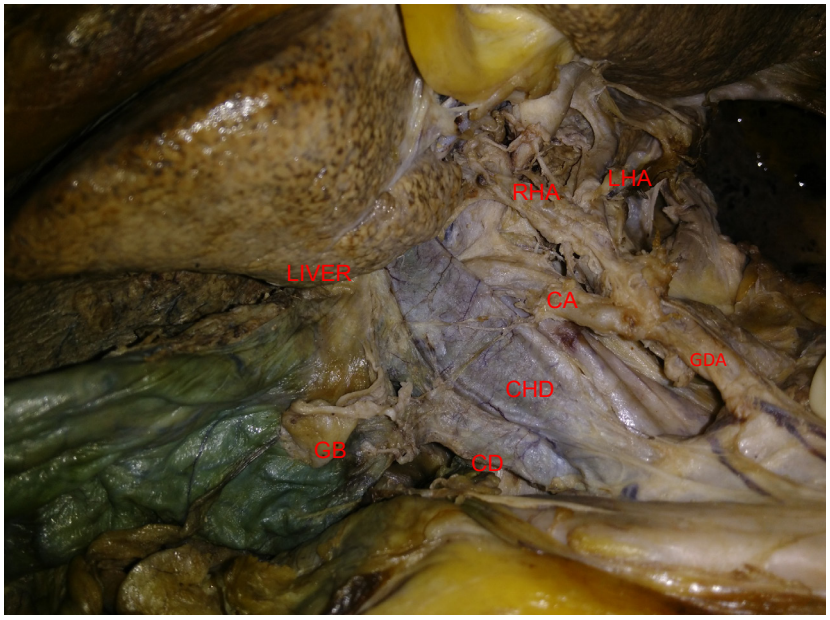

Figure 1: Origin of cystic artery from gastro duodenal artery and running posterior to CHD.

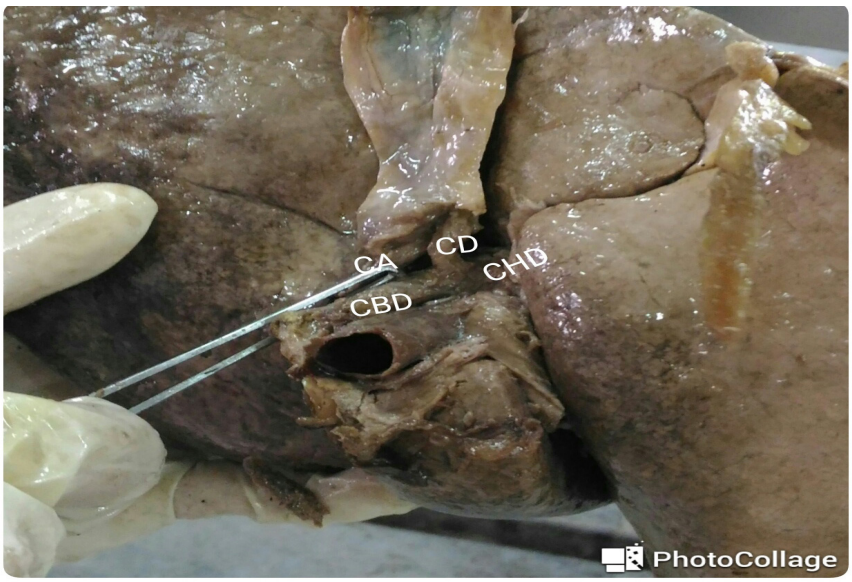

Figure 2: Cystic artery outside the Calot's triangle.

Abbreviations:

Cystc artery : CA

Right hepatic artery: RHA

Left hepatic artery: LHA

Gastro duodenal artery: GDA

Proper hepatic artery: PHA

Superior mesenteric artery: SMA

Right gastric artery : RGA

Common Hepatic Artery: CHA

Aberrant Right Hepatic Artery: AB RGA

Celiac trunk : CT

Common Bile Duct: CBD

Cystic duct: CD