

**ORIGIN OF CYSTIC ARTERY AND ITS POSITION IN RELATION TO BILIARY DUCTS AND CALOT'S TRIANGLE**Md. Khaleel Ahmed<sup>1</sup>, Sarita Sylvia<sup>2</sup>**HOW TO CITE THIS ARTICLE:**

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**ABSTRACT:** The knowledge of cystic artery anatomy and its variations gains its importance owing to the increase in the surgical intervention of extrahepatic biliary system. In this present study 60 human cadavers were studied to know the origin of cystic artery and relation of the latter to the biliary ducts. In 57 cases the cystic artery originated from right hepatic artery, in 2 cases from accessory hepatic artery and in 1 case from gastroduodenal artery. In 1 case doubling of cystic artery was observed. Cystic artery crossed common hepatic duct in 46 cases (38 – posterior; 8 – anterior), right hepatic artery crossed common hepatic duct in 11 (6 – posterior; 5 – anterior). Cystic artery originating from gastroduodenal artery crossed bile duct from anterior aspect. Alteration of the absorption pattern of vessels during development is the main reason behind these variations. The present study will be of help for surgeons and radiologists in addition to adding information to the present anatomical knowledge about cystic artery.

**KEYWORDS:** cystic artery, calot's triangle, cystic duct, cholecystectomy, gall bladder.

**INTRODUCTION:** Cystic artery is the chief arterial supply for the gallbladder. It is most commonly a branch of right hepatic artery and arises in the triangle between common hepatic duct, cystic duct and the visceral surface of the liver-the cystohepatic triangle (of Calot).<sup>1</sup> The anatomy of cystic artery is very variable creating potential problems during surgery.

The Calot's triangle (cystohepatic triangle), is an important imaginary referent area for biliary surgery. This famous triangle was described by Calot in 1891 as bounded by cystic duct, common hepatic duct/bile duct, and cystic artery in its original description. But in its present interpretation the triangle is bounded by cystic duct, common hepatic duct/bile duct and inferior surface of liver. Its contents usually include the right hepatic artery, cystic artery, cystic lymph node (of Lund), and lymphatic.<sup>2</sup>

Early exploration of Calot's triangle during cholecystectomy safeguards cystic artery, cystic duct and common hepatic duct if there are any anatomical variations. Knowledge of the variations in arterial and ductal anatomy as they relate to the triangle is of considerable importance during excision of gallbladder.

**MATERIAL AND METHODS:** In the present study a total number of 60 human livers with hepatoduodenal ligaments, duodenum, abdominal aorta with celiac trunk and superior mesenteric artery were removed en mass from the cadavers of both sexes. Age ranging from 25 – 75 years. Specimens were procured from M. R. Medical College, Gulbarga, between 2003 – 2010. All the specimens were studied by careful gross and fine dissection to observe the origin of cystic artery and its relation to the biliary ducts.

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**OBSERVATION:** In the present study of 60 specimens, cystic artery originated from right hepatic artery in 57 specimens, from accessory right hepatic artery in 2 specimens and from gastroduodenal artery in one specimen. The site of origin of cystic artery varied. Some originated outside the Calot's triangle and some within it. But all the cystic arteries coursed through the triangle before they reached the gallbladder. Depending on the site of origin, the course and relation of cystic artery to common hepatic or bile duct was different.

Out of 57 specimens, where the cystic artery originated from right hepatic artery, the site of origin was outside the Calot's triangle in 46 specimens and within the triangle in 11 specimens. In 38 specimens cystic artery passed posterior and in 8 specimens it passed anterior to common hepatic duct to enter the triangle. On reaching the neck of the gall bladder it divided into superficial and deep branches.

In one specimen, two cystic arteries were originating from right hepatic artery within the triangle. Both the arteries coursed through the triangle parallel to each other to reach the neck of the gallbladder. One supplied the superficial and the other deep surface.

In 2 specimens, the cystic artery originated from accessory right hepatic artery within the triangle. The accessory right hepatic artery originated from the superior mesenteric artery, ascended in the free border of lesser omentum behind portal vein and bile duct. And then, passed behind the common hepatic duct to enter the right lobe of liver. In 1 specimen, cystic artery originated from gastro duodenal artery, just distal to its point of origin from common hepatic artery outside the triangle. It then ascended upwards crossing the bile duct anteriorly to enter the triangle. The site of origin and relation of cystic artery to the common hepatic or bile duct is shown in table-1.

**DISCUSSION:** Cystic artery is usually a branch from right hepatic artery. In addition to gall bladder cystic artery gives numerous small branches to the common and lobar hepatic ducts and upper part of common bile duct.<sup>3</sup> In the present study, the cystic artery was arising from right hepatic artery in 57 specimens [95%], from accessory right hepatic artery in 2 specimens [3.3%] and from gastroduodenal artery in one specimen [1.66%]. Double cystic artery was seen only in one specimen. Table-2 shows the origin of cystic artery in the present study and is compared with previous studies.

Baliya M et al<sup>4</sup> studied the cystic artery in 200 laparoscopic cholecystectomies and classified the cystic artery into 2 groups. It is shown in table-3 and is compared with the present study.

Chen T H et al<sup>5</sup> studied the origin and course of cystic artery in relation to Calot's triangle in 72 autopsies. They found that all the cystic arteries which originated from right hepatic artery coursed through the triangle, which was same in our study. Furthermore they found 72.7% of cystic arteries that originated from right hepatic artery ran posterior and others ran anterior to common hepatic duct as they entered the triangle and in cases where cystic artery arose from locations other than right hepatic artery, 29.4% ran posterior and 11.8% ran anterior to common hepatic duct. In our study, we found 63.33% of cystic arteries that originated from right hepatic artery ran posterior and 13.3% ran anterior to common hepatic duct. In 2 specimens, the cystic artery arose from accessory right hepatic artery within the triangle. The accessory right hepatic artery passed posterior to common hepatic duct. They found none of the cystic arteries which originated from gastro duodenal, celiac, superior mesenteric and superior pancreaticoduodenal artery passed through the triangle. But in our study, cystic artery which originated from gastroduodenal artery ran through the triangle after crossing the bile duct anteriorly.

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The extra hepatic biliary system develops from an intestinal diverticulum. This diverticulum in the initial stages is supplied by dorsal aorta. As growth progresses it is supplied by branches from celiac and superior mesenteric arteries. Maturation of vascular system involves the process of absorption of blood vessels to form a novel vessel. The variation in the vasculature is mainly due to the altered absorption pattern.<sup>6</sup>

Knowledge of relationship of cystic artery to the biliary duct is very important while performing biliary surgeries. Variations in the origin of cystic artery, its branches and relations with biliary structures and blood vessels emphasize the importance of arterial dissection in biliary surgery. Blood vessel injuries during cholecystectomy carry a mortality of 0.02%. In 1.9% cases the laparoscopic surgeries require conversion into open surgery because of injury to cystic artery.<sup>4</sup>

In view of the vascular complications associated with the surgeries of extra hepatic biliary system especially in the laparoscopic procedure the knowledge of these variations of cystic artery will be helpful to surgeons.

**ABBREVIATIONS:** RHA – right hepatic artery, LHA – left hepatic artery, HAP – hepatic artery proper, GDA – gastroduodenal artery, SPA – superior pancreaticoduodenal artery, ARHA – accessory right hepatic artery, CHD – common hepatic duct, BD – bile duct, CT – celiac trunk, SMA – superior mesenteric artery, CA – cystic artery, ReHA – replacing hepatic artery

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Origin	Site of origin	Relation to CHD/BD	Specimens
RHA [57] 95%	Outside the triangle 46 specimens	CA crossing the CHD	Posterior - 38[63.33%] Anterior - 8[13.3%]
	Within the triangle 11 specimens	RHA crossing the CHD	Posterior - 6 [10%] Anterior - 5[8.33%]
ARHA [2] 3.33%	Within the triangle 2 specimens	ARHA crossing the CHD	Posterior - 2[3.33%] Anterior - 0
GDA [1] 1.66%	Outside the triangle 1 specimen	CA crossing the BD	Posterior - 0 Anterior - 1[1.66%]

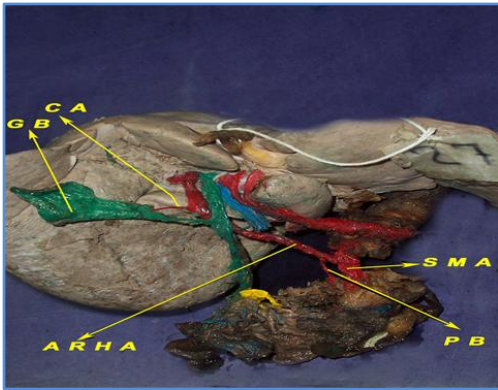
Table 1

	Anson <sup>7</sup> (676)	Bakheit <sup>8</sup> (106)	Futura <sup>9</sup> (110)	Khalil <sup>10</sup> (60)	Pushpalatha <sup>11</sup> (30)	Present (60)
RHA	61.3 %	78%	75.5%	90 %	54%	93.3%
Doubling	-	-	-	-	-	1.66%
ARHA	10.2%	-	-	-	2%	3.33%
GDA	2.5 %	3%	7.3%	2%	8%	1.66%
LHA	5.9 %	2%	4.5%	3%	-	-
CHA	-	17%	-	2%	12%	-
HAP	3.4 %	-	-	-	-	-
SMA	0.9 %	-	-	-	-	-
CT	0.9 %	-	-	-	-	-
Bifurcation of RHA & LHA	11.5 %	-	-	2%	-	-
SPA	0.9 %	-	-	2 %	-	-
ReHA	3.5 %	-	-	-	-	-

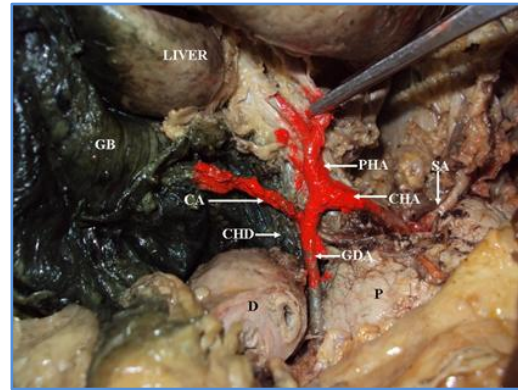
Table 2

Groups	No. of cases	Present study
<b>Group I (within Callot's triangle)</b>		
1 - Normal lying cystic artery	147 [ 73.5%]	56[93.3%]
2 - Doubling	31 [15.5%]	1[1.66%]
3 - Origin from aberrant/accessory right hepatic artery	11 [5.5%]	2[3.33%]
<b>Group II (Outside Callot's triangle)</b>		
1 - Origin from gastro duodenal artery	9 [4.5%]	1[1.66%]
2 - Origin from left hepatic artery	2 [1%]	-

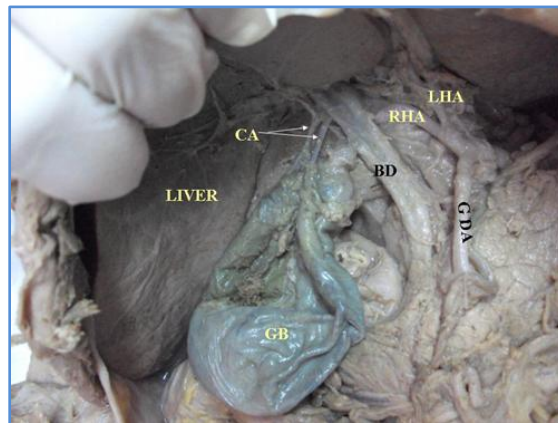
Table 3



**Fig. 1: Cystic artery (CA) originating from Accessory right hepatic artery (ARHA)**



**Fig. 2: Cystic artery (CA) arising from gastroduodenal artery (GDA)**



**Fig. 3: Showing doubling of the Cystic artery (CA), both arising from right hepatic artery (RHA)**

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