

A study to evaluate morphological variations of the cystic artery to improve surgical safety

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Received: 12-11-2021 / Revised: 18-12-2021 / Accepted: 10-01-2022

Abstract

Background: Cystic artery is a key anatomical structure usually isolated and ligated during conventional cholecystectomy or laparoscopic cholecystectomy. The present study was conducted to evaluate morphological variations of the cystic artery to improve surgical safety. **Materials & Methods:** 40 human liver specimens with intact gallbladder and extrahepatic duct in the regular dissection were fixed in 10% formalin and were finely dissected. The specimens were observed for parameters like the origin of the CA, its length and diameter, mode and level of termination, and its relation to the Calot's triangle, and the variations were noted, photographed, and studied. **Results:** Cystic artery of origin was right hepatic artery in 84%, persistent hypoglossal artery in 2%, left hepatic artery in 1%, gastroduodenal artery in 2%, common hepatic artery in 1% and aberrant right hepatic artery in 10%. The vascular relations of cystic artery was anterior to cystic duct in 4%, posterior to cystic duct in 6%, anterior to CHD in 2%, posterior to CHD in 12%, anterior to CBD in 1% and no relation in 75%. Site of origin of CA was inside Calot's triangle in 70% and outside calot's triangle in 30%. The difference was significant ($P < 0.05$). **Conclusion:** In maximum cases cystic artery of origin was right hepatic artery and in maximum cases its origin was in calot's triangle.

Key words: Cystic artery, calot's triangle, persistent hypoglossal artery

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Introduction

Cystic artery is a key anatomical structure usually isolated and ligated during conventional cholecystectomy or laparoscopic cholecystectomy. There is possibility of haemorrhage from cystic artery during surgery[1]. Injuries to the duct when in close proximity can also occur in hepatobiliary surgeries. Cystic artery most commonly arises from right hepatic artery which is a branch of hepatic artery proper. Hepatic artery proper is a branch of common hepatic artery which arises from coeliac trunk[2]. It is the major artery supplying gallbladder. Cystic artery usually pass posterior to the common hepatic duct and anterior to the cystic duct. It divides into superficial and deep branches at superior surface of neck of gallbladder. The superficial branch lies on the inferior surface of body of gallbladder and deep branch on the superior surface[3]. The most common variation of CA is, when it originates from the common hepatic artery (CHA) and when its origin is in the lower down, sometimes from the left hepatic or gastroduodenal artery (GDA), and rarely from the superior pancreaticoduodenal, celiac, right gastric, or superior mesenteric arteries[4]. In these cases, it crosses anterior (or less commonly posterior) to the common bile duct (CBD) or CHD to reach the gallbladder. An accessory CA may arise from the CHA or one of its branches.

The CA when presents as double, it often bifurcates close to its origin, giving rise to two vessels before approaching the gallbladder[5]. The present study was conducted to evaluate morphological variations of the cystic artery to improve surgical safety.

Materials & Methods

The present study comprised of 40 human liver specimens with intact gallbladder and extrahepatic duct in the regular dissection. The study was approved from ethical committee. The specimens obtained were fixed in 10% formalin and were finely dissected. The specimens were observed for parameters like the origin of the CA, its length and diameter, mode and level of termination, and its relation to the Calot's triangle, and the variations were noted, photographed, and studied. Results thus obtained were subjected to statistical analysis. P value less than 0.05 was considered significant.

Results**Table I Assessment of cystic artery of origin**

Origin artery	Percentage	P value
Right hepatic artery	84%	0.01
Persistent hypoglossal artery	2%	
Left hepatic artery	1%	
Gastroduodenal artery	2%	
Common hepatic artery	1%	
Aberrant right hepatic artery	10%	

Table I, graph I shows that cystic artery of origin was right hepatic artery in 84%, persistent hypoglossal artery in 2%, left hepatic artery in 1%, gastroduodenal artery in 2%, common hepatic artery in 1% and aberrant right hepatic artery in 10%. The difference was significant ($P < 0.05$)

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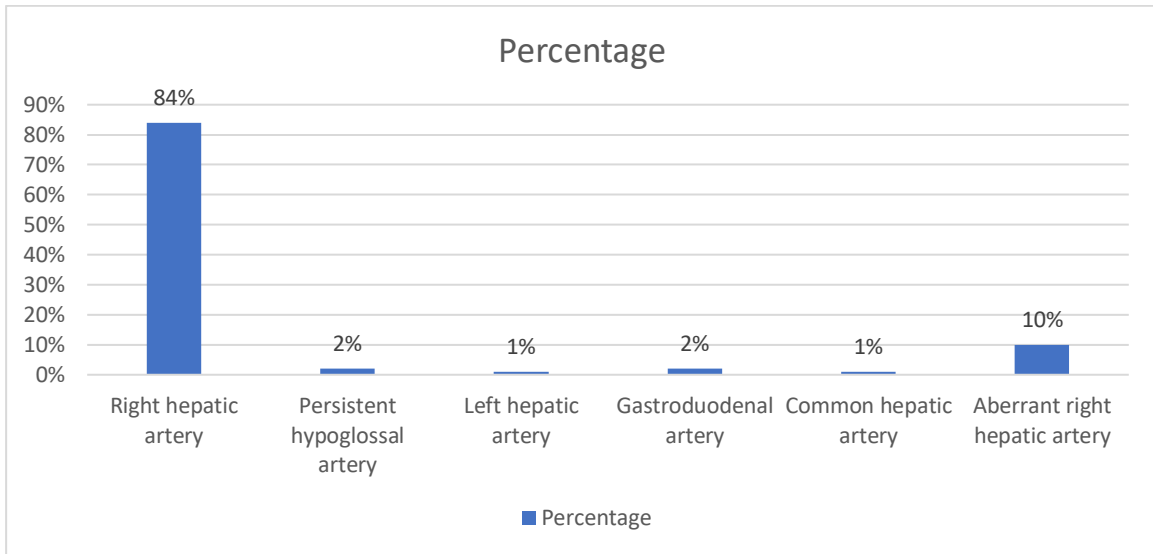


Figure I Assessment of cystic artery of origin

Table II Assessment of parameters

Parameters	Variables	Percentage	P value
Vascular Relations of cystic artery	Anterior to cystic duct	4%	0.01
	Posterior to cystic duct	6%	
	Anterior to CHD	2%	
	Posterior to CHD	12%	
	Anterior to CBD	1%	
	No relation	75%	
Site of origin of CA	Inside Calot's triangle	70%	0.01
	Outside Calot's triangle	30%	

Table II, graph II shows that vascular relations of cystic artery was anterior to cystic duct in 4%, posterior to cystic duct in 6%, anterior to CHD in 2%, posterior to CHD in 12%, anterior to CBD in 1% and no relation in 75%. Site of origin of CA was inside Calot's triangle in 70% and outside calot's triangle in 30%. The difference was significant ($P < 0.05$).

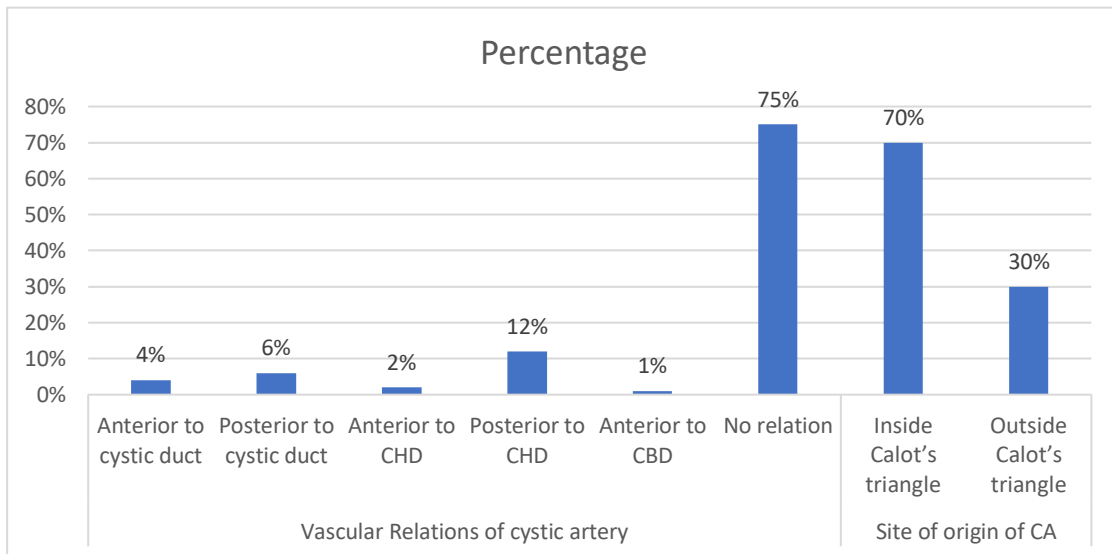


Figure II Assessment of parameters

Discussion

Cystic artery gives fine branches which supply common and lobar hepatic ducts and upper part of common bile duct where they anastomose[6]. In 25 % of subjects, the superficial and deep branches of the cystic artery have separate origins and Michels called them

double cystic artery[7]. Variations in the origin and course of cystic artery is commonly seen and encountered during hepatobiliary surgeries as well as in cadavers. Following variations are seen[8]. Calot's Triangle is a triangular space formed between the cystic duct, the common hepatic duct, and inferior surface of segment v of liver

referred to as Calot's triangle or cystic triangle. Cystic artery passes through this triangle[9]. The Calot's triangle presents the following surgical hazards: 1) A fissured area supplied by a long cystic-like artery 2) Two large hepatic branches of the right hepatic artery, the lower giving off the superficial cystic artery which leaves the triangle, the upper giving off the deep cystic artery which is largely hidden 3) An accessory hepatic duct which crosses the lower branch of the right hepatic artery at a higher point but is crossed by the deep cystic artery. Various origins of cystic artery and its course with respect to hepatobiliary triangle require attention of surgeons in order to avoid iatrogenic injury of bile duct and vessels[10]. The present study was conducted to evaluate morphological variations of the cystic artery to improve surgical safety.

In present study, cystic artery of origin was right hepatic artery in 84%, persistent hypoglossal artery in 2%, left hepatic artery in 1%, gastroduodenal artery in 2%, common hepatic artery in 1% and aberrant right hepatic artery in 10%. Ramakrishna et al[11] in their study 50 human liver specimens with intact gallbladder were fixed in 10% formalin and were finely dissected. Origin of the cystic artery was normal in 92% of cases and variations were seen in approximately 8% cases. The most common origin of the cystic artery was from the right hepatic artery, which was in 92% of the cases. In the present study, in 97% cases the cystic artery terminated by dividing into the superficial and deep branches. In the rest, the artery continued as a superficial branch, the deep branch being replaced by the accessory cystic artery. In 64% cases, the cystic artery was seen within the Calot's triangle, and in 36% of cases, it was outside the Calot's triangle. In 67% cases, the cystic artery was medial to the cystic duct, in approximately 63% cases the cystic artery was lateral to the common hepatic duct, and in 30% of the cases the cystic artery passed anterior to the cystic duct. Incidence of accessory cystic arteries in the present study was approximately 4%.

We found that vascular relations of cystic artery was anterior to cystic duct in 4%, posterior to cystic duct in 6%, anterior to CHD in 2%, posterior to CHD in 12%, anterior to CBD in 1% and no relation in 75%. Site of origin of CA was inside Calot's triangle in 70% and outside Calot's triangle in 30%. Thampi S et al¹² found that more than 90 percent of the cystic artery originates from the right hepatic artery in both sexes. Cystic artery originated from left hepatic artery in 4 cases, common hepatic artery in 5 cases and from middle hepatic artery in 1 case. The cystic artery within Calot's triangle was observed in 41%. Right hepatic artery was content in 29.9%. Both the arteries were content in 19%. Cystic artery and accessory hepatic duct were content of Calot's triangle in 2.2%. Double cystic artery was content of the triangle in 1 cadaver. Artery or duct was seen outside the Calot's triangle in 16 cadavers.

Conclusion

Authors found that in maximum cases cystic artery of origin was right hepatic artery and in maximum cases its origin was in Calot's triangle.

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Conflict of Interest: Nil Source of support: Nil