

Anatomical Variations of the Cystic Artery among Sudanese Populations in Khartoum State - Sudan

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ABSTRACT

Misinterpretation of the anatomical variations in the origin of cystic artery can contribute to a major intraoperative and postoperative surgical complications during cholecystectomy, the incidence being higher with laparoscopic cholecystectomy. The topographical anatomy of the arterial system of hepatobiliary region and their anomalous origin should be considered during surgeries and interventional radiology in routine clinical practice to minimize invasive surgical errors. The cystic artery is recognized for its variable origin and branching pattern. When it arises from an artery other than its most common origin, its relationship to adjacent structures and Calot's triangle can be affected.

The data in this study was collected by careful observation of the biliary blood supply focusing on the cystic artery origins in relation to Calot's triangle from the available dissected cadavers in Khartoum University and images from radiologic centers in Khartoum state using transabdominal doppler ultrasound imaging and CT angiography together with questionnaires. All the collected data was analyzed using SPSS program. Then the results were compared with relevant studies.

In this study a total of 48 subject (44 males and 4 female) were included for cadaveric and radiological images. Most of the subjects were between 40 to 60 years old. All subjects in this study were within Calot's triangle, with no sample outside this area. The major primary origin of the cystic artery in 45 subjects (93.8 %) was the right hepatic artery, while in three subjects (6.2 %) it originated from the left hepatic artery. A double cystic artery was observed in five samples (10.4%). No arteries were found originating from the gastroduodenal artery, superior mesenteric artery or any other source. This study is one of the limited research projects conducted on Sudanese individuals and its findings cannot be extended to all Africans.

Keywords: Anatomical variation; Calot's Triangle; Cystic artery origin; Laparoscopic cholecystectomy

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INTRODUCTION

Cystic artery (CA) is the artery that provide blood supply to the gall bladder. It has different origins within and outside Calot's triangle [1-4]. Calot's triangle is bound by the cystic duct, the common hepatic duct (CHD) and the inferior border of the

liver [5]. It is an important landmark for identifying the origin of CA during laparoscopic cholecystectomy. The commonest origin of the CA is the right hepatic artery the (RHA), which lies on the right side of the CHD in the Calot's triangle.

However, the cystic artery exhibits significant variability in its origin. It may arise from RHA, left hepatic artery (LHA), superior mesenteric artery (SMA), gastroduodenal artery (GDA), or in some cases, aberrantly from the accessory hepatic artery [6-13].

Recognizing the origin of the CA is essential during laparoscopic cholecystectomy. Failure to properly clear and free the artery from adhesions can cause significant bleeding during surgery. This risk is also present with rare anomalous arteries [14]. Surgeons must be aware of the anomalous

MATERIALS AND METHOD

This descriptive study was conducted at the College of Medicine in Khartoum University and radiologic centers in Khartoum state after obtaining approval from these institution board. The materials were collected using a combination of both cadaveric dissections and radiological imaging.

Cadaveric Samples: A total of 36 cadavers were dissected carefully to identify the variations in cystic artery origins. The cystic artery was exposed in the dissection room by expert anatomists. The cystic artery was traced by following extrahepatic biliary system in Calot's triangle to identify the artery then traced to its origin. The findings were recorded using a standardized checklist.

Radiological Samples: A total of 12 radiological images, collected using transabdominal doppler ultrasound imaging and CT angiography to identify variations in cystic artery origins. The images were retrieved from the hospital's recent picture archiving and communication system (PACS) and analyzed by radiologist and reconstructed in multiple planes (Axial sections, Coronal and sagittal multiplanar reformations (MPR) and Three-dimensional volume rendering (3D VR). The course of the cystic artery was traced on each

artery's origin and its relationship to extrahepatic biliary tree, as an artery from an unusual origin can change its relationship with nearby structures, potentially injuring to the biliary tree and resulting in bile leakage, [15-17].

For interventional radiologists, selecting the correct artery is vital during procedures such as angiogram, arterial embolisation and chemoperfusion for unresectable hepatic tumors. Nonselective embolisation can result in gallbladder infarction following hepatic artery embolization for inoperable hepatic tumors [18-23].

image, and variations were recorded using a standardized checklist.

Then the collected data from both cadaveric and radiological images were manually entered, computerized and analyzed using SPSS program version 23.

RESULTS AND DISCUSSION

This study involved 48 subjects (44 males and 4 female) which were examined using cadaveric and radiological imaging. (Figures 1 and 2). The subjects were categorized into age groups, with exclusion criteria for those under 20 years of age. Most of the age group was between 40 to 60 years. Data was collected from radiological images through transabdominal doppler ultrasound imaging and CT angiography. The cadaveric cases were dissected to identify the liver, gallbladder, the cystic duct, common bile duct in relation to the common hepatic artery and the inferior surface of the liver. Then the cystic artery was traced from the neck of the gallbladder to its origin.

All subjects in the study were within Calot's triangle, no sample outside this area. The primary origin of the cystic artery was from the right hepatic artery in 45 subjects (93.8%). In three samples (6.3%), the cystic artery originated from the left hepatic artery (Tables 1 and 2).

Additionally, a double cystic artery was observed in five samples (10.4%) in those cases originating from RHA (Table 4, Figures 3 and 4). No arteries were found originating from the gastroduodenal artery, superior mesenteric artery, or any other region.

The subjects were categorized into age groups, with none under 20 years old. The distribution was as follows; 14 subjects (29.2%) were between 20 and 40 years old, 24 subjects (50%) were between 41 and 60 years old, and 10 subjects (20.8%) were over 60 years old (Table 3). All the subjects were within the Calot's triangle, unlike Zubair et al. [16] which divided the specimens into three groups. In Zubair's et al. [16] study, group1 (Cystic artery or arteries seen in Calot's triangle and no other source of supply) was observed in 87.27% of patients, with 75.45% having a single artery and 11.82% had double arteries.

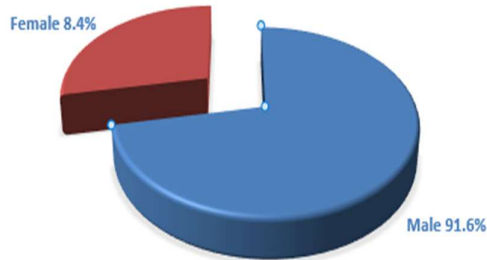


Figure 1: The distribution of the data according to the gender.

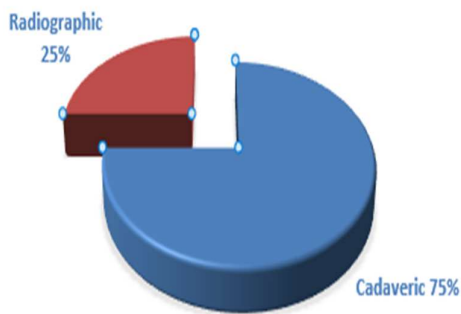


Figure 2: The distribution of the data according to the specimen.



Figure 3: Double CA originated from the RHA.

		Origin of the cystic artery from right hepatic artery		
		Yes	No	Total
Gender	Male	41	3	44
	Female	4	0	4
Total		45	3	48

Table 1: Origin of the cystic artery from right hepatic artery according to gender.

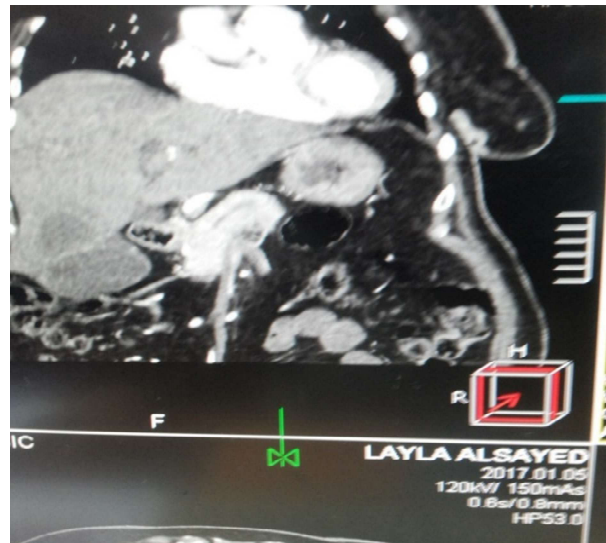


Figure 4: CT scan showing the origin of CA from the RHA.

		Origin of the cystic artery from right hepatic artery		
		Yes	No	Total
Specimen	Cadaver	33	3	36
	Radiological	12	0	12
Total		45	3	58

Table 2: Origin of the cystic artery from right hepatic artery according to the specimen.

		Origin of the cystic artery from right hepatic artery		
		Yes	No	Total
Age (In years)	20-40	12	2	14
	41-60	23	1	24
	>60	10	0	10
Total		45	3	48

Table 3: Origin of the cystic artery from right hepatic artery according to age.

		Number of cystic arteries		
		Single	Double	Total
Gender	Male	39	5	44
	Female	4	0	4
Total		43	5	48

Table 4: Number of cystic arteries according to the gender.

In current study, the cystic artery primarily originated from the right hepatic artery (RHA) in 93.8% of subjects, which supports many previous research. In Ahmed K and Sylvia [15] study the cystic artery arose from the RHA in 57 cases of a total of 60 specimens. Similarly, Bakheit MA [17] also reported that the cystic artery originated from the right hepatic artery in 78% of cases.

In three samples (6.3%) the cystic artery originated from the LHA, which is consistent with the study of Bakheit MA [17] where the CA arose from the LHA in 3% of the cases, and from the common hepatic artery in 17%.

In the current study, double cystic artery was observed in five samples (10.4%). In three of these samples both arteries originated either from right hepatic (RHA) or the left hepatic artery (LHA). In one sample, the double cystic arteries, one originated from the RHA and the other from the common hepatic artery (CHA). No artery was observed originating from the GDA or SMA or other source.

CONCLUSIONS

This study is one of the few studies in Sudanese people and cannot be assumed to apply to all Africans. In this study the cystic artery was found

to be originating mostly from the RHA with no variation between male and female. The cystic artery was also found originating from common hepatic and left hepatic arteries, also double cystic artery seen in a number of cases, but no artery was seen to originate from other source than these. No artery was found originating from outside the Calot's triangle in single or double manner.

Troublesome hemorrhage during surgery can result from an anomalous artery. Clamping or compressing the injured vessel at its origin is an effective way to stop bleeding. Surgeons performing laparoscopic cholecystectomy need to be aware of arterial variations to prevent injury to the biliary tree and subsequent complications like bile leakage and pseudoaneurysms. Knowledge of these anomalies is also crucial for interventional radiologists performing procedures like angiograms and embolization. Awareness of arterial anomalies can help prevent intra- and postoperative complications.

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