Variations of Cystic Artery as Viewed During Laparoscopic Cholecystectomy: A Review of 400 Cases from Pakistan in Light of Ding's Classification

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Abstract

Objective: To evaluate the variations of cystic artery during laparoscopic cholecystectomy.

Methods: The study was conducted in Services Hospital Lahore from1st January, 2018 to 31st December, 2019. After taking approval from hospital ethical committee 400 patients fulfilling the inclusion criteria were recruited from OPD of Department of Surgery, Services Hospital, Lahore. Informed consent was taken and demographic information (name, age, sex, contact) was obtained. All cases in the study were operated under general anesthesia by a single surgical team. Anatomy of the Calot's triangle was noted as per the proposed classification by Ding the findings were noted and classified. The data was entered in SPSS version 20 and was analyzed through it. Mean and standard deviation were calculated for age. Frequency and percentage were calculated for gender and variation of cystic artery. Data was stratified for male and female. Variation of cystic artery was compared in both genders by using chi-square test taking p-value<0.05 as significant.

Results: Out of 400 patients included in our study Group 1 (cystic artery in the Calot's Triangle) was seen in 84.75% (339/400), Group 2 (Cystic artery found outside the Calot's Triangle) in 14 %(57/400) and Group 3 (compound type) in only 1 %(4/400) which is similar to the original observations by Ding in their study of 600 cases with 85.5% patients being in Group 1 , 13% in Group 2 13% and 1.5% in Group 3.

Conclusion: On the basis of our results we conclude that the classification proposed by Ding is valid in our patients undergoing laparoscopic cholecystectomy.

Keywords: cystic artery, variation, ding's classification, laparoscopic.

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Introduction

Calot's triangle is the most important anatomical landmark during cholecystectomy. Jean-François Calot first described it in his doctoral thesis in 1891.[1] The cystic artery supplies the gall bladder. Awareness of anatomy and variations present in Calot's triangle is essential while performing open or laparoscopic cholecystectomy.[2] Laparoscopic Cholecystectomy has greatly evolved over the last 35 years. It has become a well-established and routinely performed procedure now. However a significant morbidity was seen when the procedure was first introduced, perhaps due to the new orientation via the laparoscopic view. Clear identification of anatomy of Calot's triangle before clipping and cutting of the cystic duct and artery remains one of the most crucial steps of laparoscopic cholecystectomy.[3] Anatomical variations can cause difficulties while dissecting the Calot's triangle. Literature has reported that there is discrepancy in anatomical variation of cystic artery.[4] It has been speculated that there may be variations in anatomy depending upon the race.[5] A new classification was proposed by Ding in 2007 for laparoscopic surgery where they divided the anatomy of the Calot's triangle into three groups depending upon the position and number of the cystic artery in relation to the cystic duct and its origin.[6] In group 1 cystic artery passes through the Calot's triangle which is the most common group and was reported in 85% cases by Ding. It was subdivided in two groups. If the cystic artery arose from the right hepatic artery within the Calot's triangle it was known as classical single

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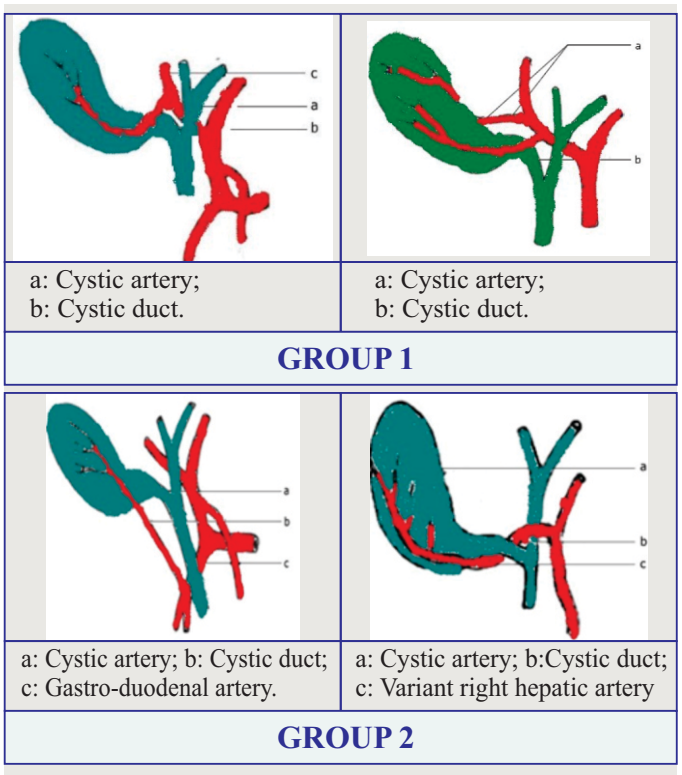
cystic artery while if it divides into two branches , anterior and posterior after arising from the right hepatic artery it is called double cystic artery. In group 2, the cystic artery lies outside the Calot's triangle and is not encountered in the triangle during dissection. This group is subdivided into 4 types depending upon the origin of cystic artery which can be from one of the following: gastro-duodenal artery, variant right hepatic artery, left hepatic artery or directly from liver parenchyma. Group 3 is also known as the compound cystic artery group. In it the cystic artery arises from more than one source.

Table 1: *Summary of Results Obtained by Ding in his 2007 Study*

Group 1	
Sub group A Classical	73.3%
Subgroup B	12.2%
Group 2	
Gastro duodenal artery Origin	7.5%
Variant right hepatic artery origin	3%
Liver parenchyma origin	2.5%
Left hepatic artery	0%
Group 3	
	1.5%



a: Cystic artery; b: Cystic duct.

a: Cystic artery; b: Cystic duct.

GROUP 1

a: Cystic artery; b: Cystic duct; c: Gastro-duodenal artery.

a: Cystic artery; b:Cystic duct; c: Variant right hepatic artery

GROUP 2

Figure 1: *Pictorial representation of Ding's classification groups. (Group 3 is a combination of both)*

The aim of our study was to correlate Ding's classification with our population because limited such studies have been carried out. Although Ultra-sound may pick up on anatomic variations of the biliary tree its ability to pick up vascular variations is limited. The preoperative workup before laparoscopic cholecystectomy is not focused on the variations in the arterial supply of the gallbladder, which may therefore lead to an intra-operative surprise. Ding's classification takes into consideration and elaborates the common vascular variations that a surgeon may encounter during surgery thus leading to a safe cholecystectomy. The rationale of this study is to determine the anatomic variations of the cystic artery during laparoscopic cholecystectomy based on the above proposed classification in our population. On the basis of the results we may thus validate Ding's findings in our population and provide evidence for the usage of Ding's classification during laparoscopic cholecystectomy in our population.

Materials and Methods

We carried out a prospective descriptive study in Surgical Unit I, Department of Surgery, Services Hospital Lahore over a period of 2 years from 1st January, 2018 to 31st December, 2019. A total of 400 cases were included in this study. Sampling was non-Probability, Purposive Sampling. All patients with ages between 20-60 year undergoing laparoscopic cholecystectomy were included in this study. The cases which required conversion to open before Calot's triangle was dissected out were excluded from the study.

After taking approval from hospital ethical committee 400 patients fulfilling the inclusion criteria were recruited from OPD of Department of Surgery, Services Hospital, Lahore. Informed consent was taken and demographic information (name, age, sex, contact) was obtained. All cases in the study were operated under general anesthesia by a single surgical team. As per the proposed classification by Ding the findings of anatomy of the Calot's triangle were noted and classified. Gall bladder dissection was done by a hook, spatula or scissors with the help of diathermy depending on individual surgeon's preference. All the data was recorded in especially designed proforma.

The data was entered in SPSS version 20 and was analyzed through it. Mean and standard deviation were calculated for age. Frequency and percentage were calculated for gender and variation of cystic artery. Data was stratified for male and female. Variation of cystic artery was compared in both genders by using chi-square test taking p-value$\leq$0.05 as significant.

Results

Out of 400 patients included in our study Group 1 (cystic artery in the Calot's Triangle) was seen in 84.75% (339/400), Group 2 (Cystic artery found outside the Calot's Triangle) in 14 %(57/400) and Group 3 (com-

pound type) in only 1%(4/400) which is similar to the original observations by Ding in their study of 600 cases with 85.5% patients being in Group 1 , 13% in Group 2 13% and 1.5% in Group 3.

The results of the study are summarized **(Fig-1, Table2-3)**

Total number of cases = 400

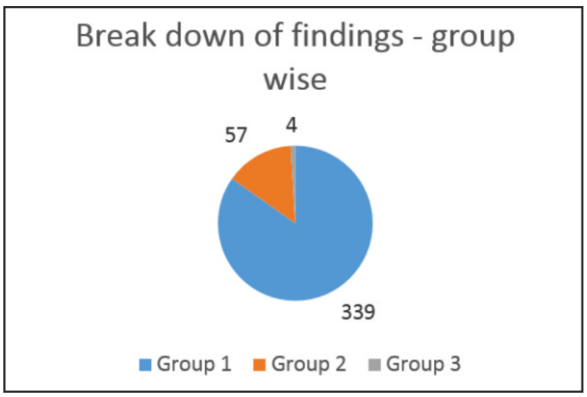


Figure-1: *Breakdown of Cases according to Groups*

The two-tailed P value equals 1.0000. The association between rows (groups) and columns (outcomes) is considered to be not statistically significant.

Discussion

Table 2: *Break Down According to Gender*

	Male	Female	Total
Group 1	47	292	339
Group 2	4	53	57
Group 3	1	3	4

Table 3: *Break down According to Groups Total Cases n=400*

Group 1		
Sub group A Classical	287	71.75%
Subgroup B	52	13%
Group 2		
Gastro duodenal artery Origin	43	10.75%
Variant right hepatic artery origin	11	2.75%
Liver parenchyma origin	3	0.75%
Left hepatic artery	0	0%
Group 3		
	4	1%

Awareness of the anatomy and variations of cystic artery is important because it can have variable origin and presentation thereby leading to difficulty during surgery.[7] The cystic artery most commonly takes origin from the right hepatic artery. Passing behind the common hepatic and cystic duct within in Calot's triangle it arrives at the upper surface of the gallbladder usually at the neck. It here divides into deep and superficial branches.[8] Variation may however be present with the cystic artery taking origin from the hepatic artery or gastro-duodenal artery.[8-10] Recognition of the arterial anomalies is critical as it can lead to bleeding with increased risk of iatrogenic injury, conversion to open or may even lead to life threatening hemorrhage. Incidence of conversion to open is such cases has been reported to be 1.9% with mortality of 0.02%.[11]

As laparoscopic cholecystectomy has become very wide spread so have the complications caused by it.[12] A new classification especially keeping in mind the laparoscopic approach had been proposed by Ding in 2007.[6] We decided to evaluate this in our population since it afforded a very practical approach during surgery, enabling a safe completion of the surgery.

We evaluated the laparoscopic anatomy of Calot's triangle in 400 patients undergoing surgery at our department. The majority of patients undergoing surgery were females (348–87%). This female preponderance has also been reported by others.[13] In our study, the classical single cystic artery in Calot's triangle was observed in 71.75%(287/400) cases. Double cystic artery was seen in 13%(52/400) cases. These two groups are considered as Group 1. In group 2 we had 10.75% cases of cystic artery arising from the gastro duodenal artery and lying superficially and anterior to the cystic duct. 2.75 % (11/400) cases had a cystic artery that originated from the Variant Right hepatic artery. Only 0.75 %(3/400) cases had a cystic artery that originated from the liver parenchyma directly with no other artery. Although reported in literature we didn't find any artery arising from the left hepatic artery. In 1%(4/400) compound cystic artery was seen. The difference between both genders was observed to be insignificant ($p \geq 0.05$). Our findings are similar to those seen by Ding. Ding reported 85.5% cases being in Group 1, 13% in Group 2 and 1.5% in Group 3 in his original study of 600 cases while we noted 84.75% cases in group 1, 14% cases in group 2 and 1% cases in group 3 in this study of 400 cases.

Zubair carried out a study of 220 patients undergoing laparoscopic cholecystectomy and found results similar to Ding[17] while another study carried out in the subcontinent showed almost similar results to Ding.[18] A recent study done by Farooq on 400 cases undergoing laparoscopic cholecystectomy showed that mostly the cystic artery was single (92.25%), originating from right hepatic artery (90.25%) and crossing cystic duct anteriorly (72.75%). Anatomical variations were seen in 10% cases.[19] However Taimoor et al., reported that in 91% cases, there was a single cystic artery which is much higher than what we found.[20] Although most of these researchers have documented the variations in the anatomy of cystic artery none of them made specific

use of the classification as proposed by Ding. Despite an extensive literature review we were unable to find any such local study.

We found results very similar to Ding and therefore believe that the classification thus proposed is effective for use during laparoscopic cholecystectomy.

Conclusion

On the basis of our results we conclude that the classification proposed by Ding is valid in our patients undergoing laparoscopic cholecystectomy.

Conflict of Interest

None

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Authors Contribution

UM: Conceptualization of Project
FT: Data Collection
BIU: Literature Search
KHW: Statistical Analysis
AM: Drafting and Revision
BUS: Writing of Manuscript