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FREQUENCY OF THE ANATOMIC VARIATIONS OF THE CYSTIC ARTERY DURING LAPAROSCOPIC CHOLECYSTECTOMY

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Abstract

Introduction: *The hepatic artery proper, the left branch of the hepatic artery, the celiac plexus, and the gastric duodenal artery can all exhibit variations in their origin points. Understanding these variances is crucial to preventing unintentional bleeding during laparoscopic cholecystectomy.*

Objectives: *To determine the prevalence of cystic artery anatomic changes during LC.*

Study type: *Cross-sectional*

Setting: *Department of Surgery, Services Hospital, Lahore.*

Study duration: *29th June 2022 to 28th December 2022.*

Materials & Methods: *There were 180 patients, both male and female, between the ages of 18 and 60, who were having laparoscopic cholecystectomy because they had gallstones. Patients with gallbladder cancer, laparoscopic cholecystectomy, or stones in the CBD were not included. Number (single, double, absent), origin (right, left, gastroduodenal, and common hepatic arteries), length (short, medium, and long), and course (inferior to the cystic duct, anterior to the common bile duct, posterior to the cystic duct, and anterior to the common hepatic duct) were recorded for every patient.*

Results: *With origins from the right hepatic artery (85.56%), left hepatic artery (11.67%), GDA 0%, CHA 2.78%, and short length (20.56%), medium (46.11%), long (33.33%), crossing the cystic duct anteriorly (78.33%), posteriorly (13.33%), anterior to CHD 2.78%, and inferior to CD 5.56%, the most common anatomical findings in my study were single (90.0%), double (10.0%), and absent 0%.*

Conclusion: *According to the study's findings, anatomical changes in the cystic artery during laparoscopic cholecystectomy are very prevalent.*

INTRODUCTION

Advances in videoscopic technology, surgical procedures, and instrumentation have led to the evolution of minimally invasive surgery since the introduction of laparoscopic cholecystectomy in the past 20 years. The gold standard for treating cholelithiasis is now generally acknowledged to be laparoscopic cholecystectomy.[1]

The laparoscopic surgeon must therefore cope with the novel anatomical views and be cognizant of the potential biliary and arterial variants. However,

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bleeding from cystic arteries and iatrogenic damage to the bile duct were frequent in the early days due to the absence of laparoscopic anatomy. Subsequently, the Calot region's variances were expanded upon.[2] The lower liver surface, common hepatic duct (CHD), and cystic duct are the Calot triangle's boundaries.[3]

Calot's triangle must be thoroughly understood for both laparoscopic and traditional cholecystectomy procedures. For biliary surgery, Calot's triangle is a crucial hypothetical referent location. Rocko (1981) noted possible differences in the area of Calot's triangle, which is surrounded by the cystic duct, the common hepatic duct, and the bottom edge of the liver. In 1992, Hugh proposed that the diminutive branches of the cystic arteries supplying the cystic duct be designated as Calot's arteries, and that Calot's triangle be redefined as the hepatobiliary triangle.[4] Finding the cystic artery is an important part of dissecting the Calot triangle during a laproscopic cholecystectomy.[4] The gall bladder and its duct are supplied by the cystic artery. It must be trimmed during the procedure. However, insufficient management of the cystic artery might lead to extensive bleeding, making the operating field hazy.[5] A situation like this may force a surgeon to go from laproscopic to open cholecystectomy. The patient's risk of morbidity rises as a result of this conversion.[6]

According to a number of studies, blood vessel damage can increase the 1.9% conversion rate from laparoscopic to open cholecystectomy.[7] However, the documented linked mortality rate for this conversion is 0.02%.[8] The varied structure of the cystic artery in the Calot triangle is largely to blame for this problem.[9] The RHA is typically where cystic arteries originate.[10] The hepatic artery proper, the left branch of the hepatic artery, the celiac plexus, and the gastric duodenal artery can all exhibit variations in their origin points.[11] Understanding these variances is crucial to preventing unintentional bleeding during laparoscopic cholecystectomy.[12]

Therefore, the current study intends to assess the prevalence of cystic artery anatomic alterations during LC.

METHODOLOGY:

The Surgery Department at Services Hospital in Lahore conducted this descriptive cross-sectional study between July and December of 2022. After the institutional ethical review committee gave its approval, 180 patients who satisfied the inclusion criteria were selected via non-probability sequential sampling. The informed consent of each patient will be sought. A 95% confidence level, a 2.5% margin of error, and a 3% assumption that the cystic artery originated from the common hepatic artery were used to determine the sample size of 180 cases.[13] Regardless of gender, all patients aged 18 to 60 who had cholelithiasis that lasted longer than four weeks and were having a laparoscopic cholecystectomy were included. Patients who had stones in their common bile duct, had a preoperative diagnosis of gall bladder cancer, or had switched from a laparoscopic operation to an open cholecystectomy were excluded. After being informed of the study's objectives, the included patients were requested to sign an informed consent form. Laparoscopic surgeons used the 4 port approach to accomplish a laparoscopic cholecystectomy. The cystic artery was visible while the patients were under general anesthesia. The tilt angle of the laparoscope was 300. A patient's length (short, medium, long), course (inferior to the CD, anterior to the CBD, posterior to the CD, and anterior to the CHD), number (single, double, absent), and origin (right, left, gastroduodenal, and common hepatic arteries) were recorded.

The statistical program SPSS v.17 will be used to evaluate the gathered data. Frequencies and percentages were used to illustrate the patient demographics, including age, gender, and anatomic variants of cystic artery. Additionally, mean ± SD will be used to represent the average age of the patients. Frequencies and percentages were displayed for the anatomical findings of number (single, double, absent), origin (right, left, gastroduodenal, and common hepatic arteries), length (short, medium, and long), and course (inferior to the CD, anterior to the CBD, posterior to the CD, and anterior to the CHD).

RESULTS:

Mean age was 40.27 ± 8.34 years. According to Table I, the majority of the patients, 114 (63.33%), were between the ages of 18 and 40. As illustrated in Figure I, of the 180 patients, 117 (65.0%) were

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female and 63 (35.0%) were male, with a male to female ratio of 1:1.9.

The most frequent anatomical findings in my study were single (90.0%), double (10.0%), and absent (0%), originating from the right hepatic artery (85.56%), left hepatic artery (11.67%), GDA 0%, CHA 2.78%, short length (20.56%), medium (46.11%), long (33.33%), crossing the cystic duct anteriorly (78.33%), posterior (13.33%), anterior to CHD 2.78%), and inferior to CD 5.56% (Table II).

Table-I: Age distribution (n=180).

Age (in years)	Number	%age
18-40	114	63.33
41-60	66	36.67
Total	180	100.0

Figure-I: Distribution of patients according to gender (n=180).

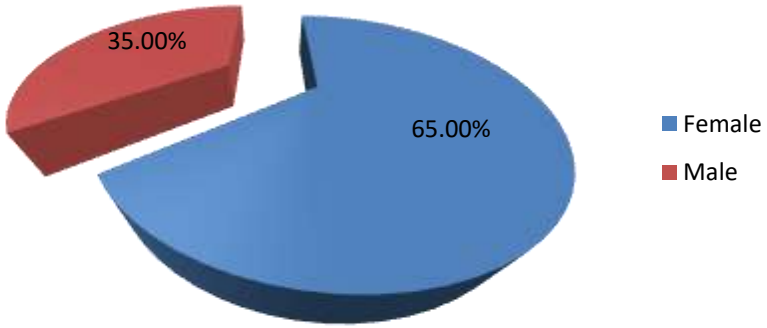

Table II: Anatomic variations of the cystic artery (n=180)

Anatomic variations		Frequency	%age
Number	Single	162	90.0
	Double	18	10.0
	Absent	00	0.0
Origin	RHA	154	85.56
	LHA	21	11.67
	GDA	00	0.0
	CHA	05	2.78
Length	Short	37	20.56
	Medium	83	46.11
	Long	60	33.33
	Anterior to CD	141	78.33
	Posterior to CD	24	13.33

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Course	**Anterior to CHD**	05	2.78
	Anterior to CBD	00	0.0
	Inferior to CD	10	5.56

DISCUSSION:

Every laparoscopic surgeon should be aware of the anatomical differences between the gallbladder's vascular supply and the extrahepatic biliary tree. It is challenging to determine the cystic artery's potential anatomic location and variations prior to surgery. They were only discovered when the gallbladder and Calot's triangle were separated. One could think of the laparoscopic anatomy of the cystic artery as a prerequisite for carrying out safe laparoscopic operations. Because of the variability in cystic arteries, surgeons frequently make mistakes and abscise wrongly, which might result in a hemorrhage. Conversion to an open cholecystectomy is unavoidable when bleeding cannot be stopped.[14]

The purpose of this study was to ascertain how frequently anatomical changes in the cystic artery occur following laparoscopic cholecystectomy. With origins from the RHA (85.56%), LHA (11.67%), GDA 0%, CHA 2.78%, and short length (20.56%), medium (46.11%), long (33.33%), crossing the cystic duct anteriorly (78.33%), posteriorly (13.33%), anterior to CHD 2.78%, and inferior to CD 5.56%, the most common anatomical findings in my study were single (90.0%), double (10.0%), and absent 0%. In their study of anatomical variance in 400 Pakistani laparoscopic patients, Farooq et al.[15] discovered that the prevalence of acute cholecystitis was 33.25%, chronic cholecystitis was 52.75%, and acute on chronic cholecystitis was 14%. Additionally, the most frequent anatomical findings in cystic arteries were single (92.25%), double (7.7%), and absent (0%), originating from the RHA (90.25%), LHA (6.75%), GDA 0%, CHA 3%, and length of 2-3 cm (68%), crossing the cystic duct anteriorly (72.75%), posteriorly 12%, anterior to CHD 3%, and inferior to CD 9.75%.

A number of earlier studies have examined the variations in the anatomy of the cystic artery. Many well-known and significant research on this subject date from a time when laparoscopy was uncommon and CT and MR imaging were not frequently used.[16,17] In a study, the superomedial position of the cystic artery was shown to be the most common (88%), whereas the posterior position (3%) and anterior position (6%) were the least common. M. Ayyaz et al.[19] found that 15% of patients had a cystic artery in the front. These investigations show that the anterior region has a much higher frequency than our own investigation. Our study, however, utilized a similar sample size and a larger population.

In their thorough meta-analysis,[20] examined 9800 cases and reported their findings regarding cystic artery variance. The positional variance was not characterized according to the laparoscopic perspective. But they found that the cystic artery was missing in 0.34% of cases and numerous times in 8.9% of cases. In 4.9% of cases, the cystic artery was identified below the CD, and in 5.9% of cases, it was found in front of the CBD.

A noteworthy contrast is the variant where the cystic artery sits anterior to the CD, which is the least common variation in our sample (only 2.9%) and has been reported by Andall et al. to be 33.8%. In our study, all patients (100%) had cystic arteries during laparoscopic cholecystectomy; conversely, 3% of patients in a study by Hasan MA had none.[21] Three percent of the cases in a different study by Taimur M et al. had no cystic artery.[22] In our study, 90.0% of patients had a single cystic artery, while 10.0% had two. 95.5% of patients by Hasan MA had a single cystic artery.[21] However, in a research by Hugh TB et al., 22% of patients who underwent laparoscopic cholecystectomy experienced doubling of the cystic artery.[23] 15.5% of patients had twin cystic arteries, according to a different study by Balija M et al.[24] 91% of patients in a research by Taimur M et al. had a single cystic artery.[22]

Talpur KA et al. reported that 1% of individuals had twin cystic arteries and 2.33% had aberrant cystic arteries.[25] Our study found that 85.56% of all cystic arterial origins found during laparoscopic cholecystectomy came from the right hepatic artery, with the left hepatic artery coming in second at 11.67%. Hasan MA's study indicated that the cystic artery stemmed from the RHA in 95.5% of patients, the superior mesenteric artery in 1.34% of patients, and the origin was not clear in 1.5% of patients.[21]

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Taimur M et al. did another investigation that indicated that 96% of cystic arteries were from the RHA.[22] Badshah M et al. observed that the cystic artery came from the RHA in 92.4% of patients in one study.[26]

The common hepatic artery was the source of the cystic artery in 2.78% of the individuals in our study. According to a study by Balija M et al., 5.5% of patients' cystic arteries originated from aberrant hepatic arteries, 4.5% from gastroduodenal arteries, and 1% from left hepatic arteries.[24] In a different investigation, Taimur M et al. found that in 1% of patients, the cystic artery originated from the superior mesenteric artery.[22]

According to a study, 85% of patients had normal cystic arteries, 5.16% had short ones, and 8.16% had long ones.[21] Another study by Taimur M et al. found that 82% of patients had a normal-length cystic duct, 7% had a short one, and 8% had a long one.[22] A research found that 1.67% of cases had a short cystic artery.[25] The cystic artery in our study crossed the cystic duct anteriorly (78.33%), posteriorly (13.33%), anteriorly to CHD (2.78%), and inferiorly to CD (5.56%). Six percent of patients in a research by Hugh TB et al. had a cystic artery that was inferior to a cystic duct.[23]

In a different study by Suzuki M et al., 76.6% of patients had cystic arteries running anteriorly and medially to the cystic duct.[27] A study by Taimur M et al. found that in 88% of cases, the cystic artery was above and to the inside of the cystic duct, and in 3% of cases, it was in front of the cystic duct.[22] Talpur KA et al. found that the cystic artery was in front of, behind, and to the right of the cystic duct in 2.67%, 1.33%, and 0.67% of instances, respectively.[25] Abeysuriya V et al. conducted a study revealing that 89% of the cystic arteries traversed laterally to the common hepatic duct, 5% anteriorly, and 1% superiorly.[28]

CONCLUSION:

According to the study's findings, laparoscopic cholecystectomy frequently results in anatomic alterations in the cystic artery. Therefore, in order to avoid bleeding issues during laparoscopic cholecystectomy, we advise all surgeons to be aware of these variances. Understanding these differences will reduce these patients' morbidity, conversion, and re-exploration.

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