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Anatomical Variations of Cystic Artery During Laparoscopic Cholecystectomy; An Audit Of 400 Cases of Laparoscopic Surgery for Gall Bladder Pathologies at a Tertiary Care Unit

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ABSTRACT

Objective: To assess the frequency of anatomical variations of cystic artery in patients undergoing laparoscopic cholecystectomy. **Study design:** Prospective observational study. **Settings:** Department of Surgery, Al-Bukyriah General Hospital, Al-Bukayriah, Alqaseem Kingdom to Saudi Arabia. **Duration:** 01 June 2012 to 07 December 2016. **Introduction:** Traditionally, open cholecystectomy can manage overwhelming hemorrhage efficiently but being the gold standard and carries rewards of abbreviated incisions, laparoscopic cholecystectomy has to ensure absolute hemostasis and for it, understanding of blood vessels anatomy and their variations is crucial. **Methodology:** 400 patients with symptomatic gall bladder pathologies. The patients were evaluated clinically and radiologically (ultrasound) for the gall bladder pathologies and underwent laparoscopic cholecystectomy. During procedure, the origin, number, length and course of cystic artery was noted. **Results:** There were 62 (15.5%) men and 338 (84.5%) women with a mean age of 38.98+7.68 years (Range: 27-65 years). There were 133 (33.25%) patients with acute cholecystitis, 211 (52.75%) with chronic cholecystitis and 56 (14%) patients with acute on chronic chlecystitis. The most common anatomical findings noted in cystic artery during laparoscopic were that it was single (92.25%), originating from right hepatic artery (90.25%), crossing cystic duct anteriorly (72.75%) and of 2-3cm in length (68%). **Conclusion:** anatomical variations in cystic artery are not uncommon and this awareness will augment the harmless laparoscopic cholecystectomy.

Keywords: Cystic artery, Laparoscopic cholecystectomy, Gall bladder pathologies.

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INTRODUCTION

Stones in the gall bladder (cholelithiasis) is one of the well-recognized and popular health problems globally. Its prevalence spectacles a substantial topographical and local disparities. Approximately 10-15% of population in America has cholelithiasis and the incidence of gall stones is also high in Pakistan.[1,2]

Removal of the gallbladder (cholecystectomy) is as common in elective surgery as appendectomy in emergency. Approximately 300,000 cholecystectomies executed per year in America. The benefits of laparoscopy are well understood now a days.[2] Reduced pain, less medication required for pain, quick recovery, less visible abdominal scars, shorter hospital stay, earlier return to full activity and work are the advantages of laparoscopy surgery. Cholecystectomy is considered a relatively safe procedure, but like all operations there is a small risk of complications.[3] Bleeding is the non-biliary complication of cholecystectomy. The incidence of hemorrhage that requiring transfusion and reoperation is 0.1% in patients undergoing laparoscopic cholecystectomy.[1,4] The taste of laparoscopic cholecystectomy become bitter when it is converted into open surgery. The rate of conversion of laparoscopic cholecystectomy to open is approximately 5-10%.[2,5] Circumstances that may require conversion include intense inflammation and scarring of gall bladder, obscured anatomy of calots`s triangle, biliary injuries, stone in bile duct and excessive hemorrhage. Laparoscopic procedure is abandoned and the operation is completed through a larger incision under the same anesthesia.[6]

Hemorrhage is one of the major complications that is encountered during laparoscopic cholecystectomy and after anesthesia related complications, it is the second commonest cause of mortality in patients undergoing laparoscopic cholecystectomy. The incidence of uncontrollable hemorrhage is 2-10% in laparoscopic cholecystectomy.[4,7] There are many reasons of intra-operative bleeding including vessel injury i.e. aorta, vena cava, superior mesenteric vein, portal vein, right hepatic artery, cystic artery, mesenteric vessels, epigastric vessels or omental vessels or bleeding from liver bed.[8]

Cystic artery along with cystic duct and liver margin contributes in calot`s triangle and this triangle carries significance in safe completion of cholecystectomy. Identification of cystic artery avoids uncontrollable bleeding and prevents unnecessary conversion of laparoscopic cholecystectomy procedure into open surgery. In order to avoid such situations, a complete and comprehensive knowledge of cystic artery anatomical variation is very helpful for the surgeon and off course for the patient too.[9] The purpose of this study was to assess the frequency of

anatomical variations of cystic artery in patients undergoing laparoscopic cholecystectomy.

METHODOLOGY

Study Design: Prospective observational study.
Settings: Department of Surgery, Al-Bukyriah General Hospital, Al-Bukayriah, Alqaseem, Kingdom of Saudi Arabia.
Duration: 01 June 2012 to 07 December 2016.
Methods: 400 symptomatic gall stone`s patient who underwent laparoscopic cholecystectomy. We excluded all the patients below 18 years of age, not fit for general anesthesia and patient with complicated gall stone disease i.e. gangrenous or perforated gall bladder. Demographic, history and physical examination were noted. The patients underwent laparoscopic cholecystectomy after clinical and radiological (ultrasound) evaluation of hepatobiliary system. During surgery, number, origin, length and course of cystic artery was noted. The data was entered into SPSS version 20, computer program and analyzed accordingly. Study variables were analysed by simple descriptive statistics. Mean and standard deviation were calculated for numerical variables (age). Frequency and percentage were calculated for gender, co-morbid conditions, clinical diagnosis, radiological findings, and number, origin, length and course of cystic artery.

RESULTS

Characteristics of patients and gall bladder disease shown in Table I.

Table 1: Characteristics of patients and gall bladder disease

Parameters			Patients (%)
Age (years)	Mean ± SD		38.98±7.68
	Range		27 – 65
Gender	Male		62 (15.5%)
	Female		338 (84.5%)
Co-morbid conditions	Hypertension		187 (46.75%)
	IHD		53 (13.25%)
	Diabetes mellitus		203 (50.75%)
	Others		0 (0%)
Clinical diagnosis	Acute cholecystitis		133 (33.25%)
	Chronic cholecystitis		211 (52.75%)
	Acute on chronic cholecystistis		56 (14%)
USG findings of gall bladder	Gall stones	Single	198 (49.5%)
		Multiple	202 (50.5%)
		Absent	0 (0%)
	Peri-cholecystic fluid		111 (27.75%)
	Gall bladder wall thickness	3-5mm	354 (86.25%)
		6-8mm	46 (11.5%)
		>8mm	0 (0%)
	Dilated biliary channels	Intra-hepatic	0 (0%)
		Extra-hepatic	0 (0%)
	Cholido-cholithiasis		0 (0%)
	Gall bladder polyp		0 (0%)
	Others		0 (0%)

The male to female ratio were 1:5.4. The most common anatomical findings noted in cystic artery during laparoscopic were that it was single (92.25%), originating from right hepatic artery (90.25%), crossing cystic duct anteriorly (72.75%) and of 2-3cm in length (68%). Cystic artery variations are shown in table II.

Table 2: Cystic artery variations

Cystic artery variations		No. of patients (%)
Number	Single	369 (92.25%)
	Double	31 (7.75%)
	Absent	0 (0%)
Origin	Right hepatic artery	361 (90.25%)
	Left hepatic artery	27 (6.75%)
	Gastroduodenal artery	0 (0%)
	Common hepatic artery	12 (3%)
Length	Short (<1cm)	98 (24.5%)
	Medium (2-3cm)	272 (68%)
	Long (>3cm)	30 (7.5%)
Course	Anterior to cystic duct	291 (72.75%)
	Posterior to cystic duct	48 (12%)
	Anterior to common hepatic duct	12 (3%)
	Anterior to common bile duct	10 (0.75%)
	Inferior to cystic duct	39 (9.75%)

DISCUSSION

This was one of the largest clinical trial conducted on the cystic artery variations which included 400 patients. Demographic characteristics were observed. The mean age of patients in our study was 38.98+7.68 years (range: 27 – 65 years). In a study by Taimur M et al, the mean age of patients was 48±13 years (Range:19-88 years).[10] In another study by Badshah M et al, the mean age of the patients was 42.5 years (range: 20-65years).[11] In a study by Talpur KA et al, the mean age of the patients was 39.85 ± 18.82 years.[12]

Female predominance was observed in our study i.e. 84.5% (M:F; 1:5.4). The reason of more female patients with gall bladder stones is that the sex hormones are most likely to be responsible for the increased risk. Female predominance was also reported by Taimur M et al i.e. 98%.[10] However, male predominance was seen in study by Badshah M et al i.e 56%.[11] In a study by Talpur KA et al, there were 85% female and 15% male patients (M:F;1:5.66).[12] In our study, diabetes mellitus was the most common co-morbid condition i.e 50.75% followed by hypertension (46.75%) and ischemic heart disease (13.25%). In our study, 52.75% patients diagnosed clinically with chronic cholecystitis, 33.25% patient with acute cholecystitis and 14% patients with acute on chronic cholecystitis. While in a study by Taimur M et al, biliary colic was the most common clinical diagnosis i.e. 88% and acute cholecystitis was the clinical diagnosis in 7% patients.[10]

In our study, multiple gall stones were observed on ultrasound in 50.5% patients while single gall bladder stone was seen in 49.5% patients. In a study by Talpur KA et al, multiple gall stones were detected on ultrasound in 79.67% and single stone in gall bladder in 20.33% cases.[12] Peri-cholecystic fluid was

noticed on ultrasound in 27.75% patients in our study. Thickness of gall bladder wall on ultrasound was 3 to 5mm in 86.25% patients and 6 to 8mm in 11.5% patients in our study. None of the patient was found with gall bladder wall thickness >8mm on ultrasound in our study. Intra- or extra-hepatic biliary channels dilatation, common bile duct stones and gall bladder poly were not seen in any of patient in our study. In a study by Corr P et al, dilated extra-hepatic channels were detected in 14% patients and cholidocholithiasis in 6% patients on ultrasound when selecting patients for laparoscopic cholecystectomy.[13]

In our study, cystic artery was detected in all patients (100%) during laparoscopic cholecystectomy however, in a study by Hasan MA, it was absent in 3% patients.[14] In another study by Taimur M et al, cystic artery was absent in 3% cases.[10] Cystic artery was single in 92.25% patients and double in 7.75% patients in our study. In a comparative study of 600 patients who underwent laparoscopic cholecystectomy by Hasan MA, cystic artery was single in 95.5% patients.[14] However, in a study by Hugh TB et al, doubling of the cystic artery was seen in 22% patients laparoscopic cholecystectomy.[15] In another study by Balija M et al, double cystic artery was found in 15.5% patients.[16] In a study by Taimur M et al, single cystic artery was recognized in 91% patients.[10] In a study by Talpur KA et al, double and aberrant cystic arteries were found in 1% and 2.33% cases, respectively.[12]

In our study, the most common site of origin of cystic artery that found during laparoscopic cholecystectomy was right hepatic artery i.e 90.25% followed by left hepatic artery i.e 6.75%. In a study by Hasan MA, in 95.5% patients, cystic artery took origin from right hepatic artery, while in 1.34% patients, it was originating from superior mesenteric artery and origin of cystic artery was not visualized in 1.5% patients.[14] In another study by Taimur M et al, right hepatic artery was the origin of cystic artery in 96% cases.[10] In a study by Badshah M et al, cystic artery was originating from right hepatic artery in 92.4% cases.[11] In our study, in 3% patients, cystic artery took origin from common hepatic artery. In a study by Balija M et al, cystic artery took origin from aberrant hepatic artery in 5.5% patients, from gastroduodenal artery in 4.5% and from left hepatic artery in 1% patients.[16] In another study by Taimur M et al, superior mesenteric artery gave origin to cystic artery in 1% cases.[10]

In our study, the length of cystic artery was found normal in 68% patients while it was short in 24.5% patients and long in 7.5 % patients. In a study by Hasan MA, cystic artery was normal in 85% patients, short in 5.16% and long in 8.16% patients.[14] In another study by Taimur M et al, cystic duct was of normal length in 82% cases, short in 7% and long in 8% patients.[10] In a study by Talpur KA et al, short cystic artery was seen in 1.67% cases.[12]

In our study, the course of cystic artery was anterior to cystic duct in 72.75% patients, posterior to cystic duct in 12% patients, anterior to common hepatic duct in 3%, anterior to common bile duct in 0.75% and inferior to cystic duct in 9.75% patients. In a study by Hugh TB et al, cystic artery was found inferior to cystic duct in 6% patients.[15] In another study by Suzuki M et al, cystic artery was coursing anterior and medial to cystic duct in 76.6% patients.[17] In a study by Taimur M et al, cystic artery was detected superior and medial to cystic duct in 88% cases and anterior to cystic duct in 3% cases.[10] In a study by Talpur KA et al, cystic artery was anterior, posterior and right to cystic duct in 2.67%, 1.33% and 0.67% cases.[12] In another study by Abeysuriya V et al, 89% cystic arteries was running posterior to common hepatic duct, 5% cystic arteries anterior to common hepatic duct and 1% cystic arteries run over the cystic duct.[18]

This study has certain limitations. It was a single center study based on experience of single surgeon. Moreover, this requires a larger sample size.

CONCLUSION

It is concluded that anatomical variations in cystic artery are not uncommon and this awareness will augment the harmless laparoscopic cholecystectomy.

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