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Original Research Article

A Clinical Study Assessing the Necessity of Determining the Incidence of Double Cystic Artery: A Retrospective Study

Barun Kumar

Associate Professor, Department of General Surgery, Lord Buddha Koshi Medical College and Hospital, Saharsa, Bihar, India

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Corresponding author: Dr. Barun Kumar
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Abstract

Aim: The present study was conducted to find out the incidence of double cystic arteries.

Methods: The present study was conducted in the Department of Surgery, Lord Buddha Koshi medical College and Hospital, Saharsa, Bihar, India for the period of 2 years and for symptomatic gallstones and other benign gallbladder diseases and underwent laparoscopic cholecystectomy operation were retrospectively analyzed.

Results: A total of 210 patients, 42 males and 168 females were included in the study. The mean age was 50.2±12.80 (25- 81). When the files of the patients were examined, it was found that double cystic arteries were detected during the operation in two male and 8 female patients. Gall bladder polyp was found as an indication for operation in one of 10 patients, while multiple gallbladder stones were found as an indication for operation in the other patients. The mean duration of hospital stay in the patients with double cystic artery was 5.2 (3-11) days and longer compared to the patients without a double cystic artery.

Conclusion: Laparoscopic cholecystectomy has been accepted as the preferred method of treatment of gallbladder stones in healthy individuals. During laparoscopic cholecystectomy, dissection of a limited field is visualized on the video monitor for detailed anatomical variations of cystic artery. As a result, cystic artery variations occur at different rates.

Keywords: Cholecystectomy, Cystic artery, Variation

Introduction

The cystic artery is known to exhibit variations in its origin and branching pattern. This is attributed to the developmental changes occurring in the primitive ventral splanchnic arteries.[1] The liver and gallbladder and biliary duct system arise as a ventral outgrowth hepatic diverticulum- from the caudal or distal part of the forgut early in the 4th week of gestation. The hepatic diverticulum enlarges rapidly and divides in to two parts as it growth between the layers of ventral mesogastrium. The larger cranial part of the hepatic diverticulum is the primordium of the liver. The proliferating endodermal cells give rise to interlacing cord of hepatocytes and to epithelial lining of the intrahepatic part of the biliary apparatus. The small caudal part of the hepatic diverticulum becomes the gallbladder and the stalk of the diverticulum forms the cystic duct. Initially the extrahepatic biliary apparatus is occluded with epithelial cells, but it is later canalized because of vacuolation resulting from degeneration of these cells. The stalk connecting the hepatic

and cystic ducts to the duodenum becomes the bile ducts.[2] The variations in anatomy of cystic artery based on its origin position and number are well described in various studies because of its importance in avoiding inadvertent bleeding and its consequences. The reported incidence of these variations is from 25% to 50%.[3]

In 25% of subjects, the superficial and deep branches of the CA have separate origins and Michels called them double CA.[4] The CA is always mentioned in relation to Calot's triangle which was first described by Calot in 1891 as bounded by the cystic duct (CD), CHD, and the CA. In 1981, Rocko et al. drew attention to possible variations in the region of Calot's triangle and defined a triangle bordered by the CD, CHD, and lower edge of the liver.[5] In 1992, Hugh et al. suggested Calot's triangle should be renamed as the hepatobiliary triangle.[6] Anatomic variations in and around Calot's triangle are frequent. Therefore, careful dissection of Calot's triangle is necessary for both conventional and laparoscopic cholecystectomy. Hemorrhage could be a problem during search of the CA if these variations are overlooked and that increases the rate of conversion to open surgery. It also needs to be kept in mind that, during laparoscopic visualization, anatomical relations are seen differently compared to during conventional cholecystectomy.[7] This emphasizes the importance of cystic arterial dissection and necessity of thorough knowledge of cystic arterial variations for safe performance of cholecystectomy.

The present study was conducted to find out the incidence of double cystic arteries.

Materials and Methods

The present study was conducted in the Department of Surgery, Lord Buddha Koshi medical College and Hospital, Saharsa, Bihar, India for the period of 2 years and for symptomatic gallstones and other benign gallbladder diseases and underwent laparoscopic cholecystectomy operation were retrospectively analyzed.

Inclusion criteria

Gallstones with benign gallbladder diseases, gallbladder polyps (size >1 cm or multiple polyps), previously known gallbladder inflammation, patients without bleeding clotting disorder, being over the age of 18, and patients who can be given general anesthesia induction.

Exclusion criteria

Patients who cannot be given general anesthesia induction, patients with bleeding-clotting disorders, patients with a known malignancy or who have undergone malignancy surgery and who have been followed up in oncology, patients who have undergone hepatobiliary surgery before and under 18 years of age.

Hospitalization indications of all patients included in the study, hepatobiliary ultrasound, additional diseases of patients, other operations performed concurrently with laparoscopic cholecystectomy, complications, reasons for switching from laparoscopy to conventional cholecystectomy and hospitalization times were recorded.

Written consents were obtained from all patients who participated in the study in terms of operation.

Ethical approval was obtained for the study from Clinical Research Ethics Committee of Lord Buddha Koshi medical College and Hospital, Saharsa, Bihar, India.

Distribution of normality of quantitative data was tested using the Shapiro-Wilk test and graphical analyses. Student's t-test was used for inter-group comparisons of normally distributed quantitative data. Categorical data were compared with Pearson chi-square test and Fisher-Freeman-Halton exact test. A p level of <0.05 was considered statistically significant. Statistical analyses were done using number cruncher statistical system (NCSS) 2007 (Kaysville, Utah, USA) program.

Results

Table 1: Descriptive characteristics by groups

		Single cystic Artery (n=200)	Double cystic arteries (n=10)	Total (210)	
Age (in years)	Min.-max. (median)	26-82 (50.1)	29-72 (54.6)	25-81(51.2)	0.630
	Mean±SD (mean)	47.3±14.74	49.2±12.48	50.2±12.8	0.512
Gender	Male	40 (20)	2 (20)	42 (20)	0.640
	Female	160 (80)	8 (80)	168 (80)	0.330
Indication	Multiple stones	200 (100)	9 (90)	209 (99.52)	3.184
	Gallbladder polyp	0 (0)	1 (10)	1 (0.48)	0.052
Switched from laparoscopic to	No	200 (100)	8 (80)	208 (99.04)	3.142
conventional cholecystectomy	Yes	0 (0)	2 (20)	2 (0.96)	0.032
Bile duct injury	No	200 (100)	9 (90)	209 (99.52)	3.170
	Yes	0 (0)	1 (10)	1 (0.48)	0.054
Hospital stay	Days	2.4 (1-4)	5.2 (3-11)	92 (47.7)	0.535
	0.434				

A total of 210 patients, 42 males and 168 females were included in the study. The mean age was 50.2±12.80 (25- 81). When the files of the patients were examined, it was found that double cystic arteries were detected during the operation in two male and 8 female patients. Gall bladder polyp was found as an indication for operation in one of 10 patients, while multiple gallbladder stones were found as an indication for operation in the other patients. The mean duration of hospital stay in the patients with double cystic artery was 5.2 (3-11) days, and longer compared to the patients without a double cystic artery.

Discussion

Success and safety in laparoscopic cholecystectomy are related to the importance given to the knowledge about general embryological anomalies of the biliary tract. Blood flow, ductal variations, and gallbladder anatomy of this region are the major source of difficulty for surgeons. The understanding of cystic artery anatomy and variations may reduce complications such as uncontrolled intraoperative bleeding and extrahepatic biliary injury, thereby reducing the possibility of development to open cholecystectomy.[8] The cystic artery originates by taking 1-3 branches from the hepatic artery and is located within Calot's triangle.[9] The cystic artery shows a high degree of variation. This condition can be seen not only in its origin or number but also in its branches leading to the gallbladder. Regardless of the number and origin, the importance during gallbladder surgery lies in connecting the cystic artery.[10]

A total of 210 patients, 42 males and 168 females were included in the study. The mean age was 50.2±12.80 (25- 81). When the files of the patients were examined, it was found that double cystic arteries were detected during the operation in two male and 8 female patients. Gall bladder polyp was found as an indication for operation in one of 10 patients, while multiple gallbladder stones were found as an indication for operation in the other

patients. The mean duration of hospital stay in the patients with double cystic artery was 5.2 (3-11) days, and longer compared to the patients without a double cystic artery. Michels[11] quoted that, according to Lahey, "cholecystectomy is a dangerous operation unless one realizes that variations are very common." The CA varies in number, origin, course, and its relations to biliary ducts. The explanation for variant CA is found in the developmental pattern of the biliary system. During fetal development, the gall bladder develops from hepatic diverticulum of the foregut which is richly supplied by abdominal aorta and its initial branches. Latermost of these vessels degenerate to form the mature vascular system, because the pattern of degeneration is highly variable, probably resulting in variations of blood supply.[12]

The cystic artery presents an unusually high degree of variability not only in its origin or number but also in its course to gallbladder. It has surgical importance as it is always ligated during cholecystectomy irrespective of its origin and number. When the artery is ligated there is always a possible risk of injury to the ducts. If multiple cystic arteries are not identified, they may be torn or causes bleeding in the operative area.[13] Apart from the double cystic artery, it is essential to connect the cystic artery in laparoscopic cholecystectomy, and some anatomical landmarks should be considered for safe surgery. In conventional and laparoscopic cholecystectomy, it is necessary to know the triangle of Calot's well. The Calot's triangle is an important reference region for cholecystectomy. Rocko described the Calot's triangle formed by the cystic canal, common hepatic canal and lower edge of the liver in 1981. Rocko drew attention to possible variations in this triangle. Hugh renamed the Calot's triangle as a hepatobiliary triangle and named the small cystic artery branches feeding the gallbladder as the arteries of Calot's.[14] Anatomical landmarks in laparoscopic cholecystectomy have been reported mainly as Rouviere's sulcus, cystic lymph nodes, and arteries. Rouviere's sulcus was reported as a correct landmark for the common hepatic canal plane since the dissection of Calot's triangle was safe at the transverse level. When the facial strip in Calot's triangle is flattened, it can be defined as a pulsating structure with the presence of a cystic artery lymph node. In addition, defining the cystic lymph node can help identify the cystic duct and cystic artery structures.[15]

In the study performed by Ding et al in the Chinese people, in 3 of 600 patients (0.5%) double cystic artery approached the gall bladder from the outside of the hepatobiliary triangle.[16] Likewise, in the study of Suzuki et al it was in 13 of 244 patients (5.3%).[17] In the study conducted by Zubair et al on Pakistani population, it was in 26 of 220 patients (11.8%), Talpur et al in his study, the course of the double cystic artery was outside of the hepatobiliary triangle in 3 of 300 patients (1%).[18] All the variations mentioned above generally occur separately. The coexistence of variations in hepatic arteries with cases of variation associated with double cystic artery is very rare. In this regard, Bincy et al reported double cases of a cystic artery arising from the proper hepatic artery, in this case, the proper hepatic artery originated from the accessorial left hepatic artery.[19] Loukas et al reported a double cystic artery arising from the right hepatic artery and posterior superior pancreaticoduodenal artery.[20] In this study, the accessory left hepatic artery originated from the left gastric artery. Polguj et al reported that biliary tract damage is a major complication in laparoscopic cholecystectomy, and they talked about the importance of seeing a cystic duct and cystic artery in the same plan.[21] In our study, the coexistence of epigastric hernia was detected in only one patient, but no research was conducted for vascular variations for other patients.

Conclusion

Laparoscopic cholecystectomy has been accepted as the preferred method of treatment of gallbladder stones in healthy individuals. During laparoscopic cholecystectomy, dissection of a limited field is visualized on the video monitor for detailed anatomical variations of cystic artery. As a result, cystic artery variations occur at different rates. Clarifying the anatomy of Calot's triangle anatomy and ensuring the operation with a safe surgery by paying attention to the anatomical landmarks, reduces complications such as hemorrhage and bile leakage, and prevents the development of conventional cholecystectomy. Recognition of cystic artery anatomy and variations, considering that we may encounter other variations besides cystic artery variations; reduces the risk of uncontrolled intraoperative bleeding and extrahepatic biliary injury.

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