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Prospective Observational Study to Assess the Incidence of Double Cystic Artery

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Abstract

INTRODUCTION

The purpose of this research was to determine the prevalence of double cystic arteries. The research was a 15-month prospective observational study undertaken at the Department of General Surgery at SCB Medical college and Hospital, Cuttack. This study included 520 patients with symptomatic gallstones with benign gallbladder diseases, gallbladder polyps, previously known gallbladder inflammation, patients without bleeding clotting disorder, patients over the age of 18, and patients who could be given general anaesthesia induction and underwent laparoscopic cholecystectomy surgery. The features and consequences of people with twin cystic arteries were documented and investigated.

RESULTS

In one year, 520 laparoscopic cholecystectomy procedures were conducted. The research comprised 129 male and 391 female participants. The average age ranged from 21 to 71 years old (53.26). Four male patients (0.77%) and sixteen female patients (3.07%) had two cystic arteries discovered after surgery. These patients had an average age of 53.410.85. According to ultrasound findings, the rationale for surgery in three of the twenty patients with double cystic arteries was gall bladder polyp, while the remainder of the patients had several stones in the gallbladder. In four individuals who did not have gallstones, an epigastric hernia was discovered, and an epigastric hernia repair was done concurrently laparoscopically. Due to bleeding during operation, 4 of the 20 patients (20%) with double cystic arteries were moved from laparoscopic to traditional cholecystectomy. Patients with a double cystic artery spend an average of 5.9 (4-12) days in the hospital, compared to (3.2 days) for patients without a double cystic artery. The average occurrence of a double cystic artery was determined to be 3.84.

Conclusion

Cystic artery variants may coexist with other abnormalities. Understanding cystic artery differences may help to limit the risk of uncontrolled intraoperative bleeding, extrahepatic biliary damage, and conversion to traditional cholecystectomy.

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Introduction

The cystic artery is the main blood supply to the gallbladder and cystic duct [1]. The cystic artery (CA) is a single channel that branches from the normal hepatic artery (PHA) on the right side. It commonly goes via the hepato-biliary triangle, also known as Calot's triangle, which is formed by the inferior surface of the liver, the cystic duct, and the common hepatic duct [2]. During cholecystectomy, anatomical changes of the cystic artery are typical. The cystic artery comes from the right hepatic artery in around 80% of people. The left hepatic artery, proper hepatic artery, common hepatic artery, gastroduodenal artery, superior pancreatic duodenal artery, and superior mesenteric artery are the additional sources [3]. Calot's triangle is essential for both traditional and laparoscopic cholecystectomy. Calot's triangle is a critical imaginary reference point in biliary surgery. Cystic arterial bleeding is a tiresome complication that raises the risk of conversion to open surgery following laparoscopic cholecystectomy. Injury to the extrahepatic bile duct or intra-abdominal organs may occur if surgery is done poorly [4]. Laparoscopic cholecystectomy is the recommended way of treating gall bladder stones in healthy people all over the globe. Laparoscopic cholecystectomy is being performed at the University Teaching Hospital (UTH) in Zambia to treat cholelithiasis. Complications during cholecystectomy included harm to the liver and surrounding tissues such as the stomach, mistaking the right hepatic artery for a cystic duct, and haemorrhage. It is critical to understand anatomic changes in the hepatobiliary artery system for safe and uneventful cholecystectomy, particularly when using laparoscopic procedures [2]. The cystic artery is often formed by the right hepatic artery (RHA). To reach the upper part of the gallbladder's neck, it normally goes posterior to the common hepatic duct and prior to the cystic duct. It is divided by shallow and deep branches. The superficial branch runs on the inferior side of the gallbladder body, whereas the deep branch runs on the superior side. These arteries connect to the surface of the body and the fundus. An auxiliary cystic artery may develop from the common hepatic artery or one of its branches, and the cystic artery often divides near its origin, giving birth to two arteries that reach the gallbladder. Multiple fine artery branches may develop from the parenchyma of liver segments IV or V and contribute to body supply, especially when the gallbladder is significantly intrahepatic. This renders the gallbladder less susceptible to necrosis during inflammation, which would otherwise obstruct the cystic artery. The cystic artery gives birth to several fine branches that feed the common and lobar hepatic ducts, as well as the upper portion of the common bile duct. These thin branches connect to the capillaries rising around the common bile duct as well as the vessels from the liver parenchyma that descend with the right and left hepatic ducts [5]. The purpose of this research was to determine the prevalence of double cystic arteries.

Material and methods

The research was a prospective observational study that was carried out for 15 months at the Department of General Surgery, SCB Medical college and Hospital, Cuttack with the consent of the protocol review committee and the institutional ethics committee. This study included 520 patients with symptomatic gallstones from benign gallbladder diseases, gallbladder polyps (size >1 cm or multiple polyps), previously known gallbladder inflammation, patients without bleeding clotting disorder, patients over the age of 18, and patients who could be given general anaesthesia induction and underwent laparoscopic cholecystectomy surgery.

Patients who were unable to receive general anaesthesia induction, patients with bleeding disorders, patients with a known malignancy or who had undergone malignancy surgery and had been followed up in oncology, patients who had previously undergone hepatobiliary surgery, and patients under the age of 18 were excluded from the study.

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All patients included in the study had hospitalisation indications, hepatobiliary ultrasound, additional diseases, other operations performed concurrently with laparoscopic cholecystectomy, complications, reasons for switching from laparoscopic to conventional cholecystectomy, and hospitalisation times recorded.

RESULT

In one year, 520 laparoscopic cholecystectomies were done. The research comprised 129 male and 391 female participants. The average age ranged from 21 to 71 years old (53.26). Four male patients (0.77%) and sixteen female patients (3.07%) had two cystic arteries discovered after surgery. These patients had an average age of 53.410.85. According to ultrasound findings, the rationale for surgery in three of the twenty patients with double cystic arteries was gall bladder polyp, while the remainder of the patients had several stones in the gallbladder.

When the patients' extra disorders were evaluated, oral anti-diabetic-regulated diabetes mellitus was found in four female patients and hypertension in three male patients. In four individuals who did not have gallstones, an epigastric hernia was discovered, and an epigastric hernia repair was done concurrently laparoscopically. Due to bleeding during operation, 4 of the 20 patients (20%) with double cystic arteries were moved from laparoscopic to traditional cholecystectomy. The bleeding of the cystic artery located in the posterior of the cystic arteries was detected during the operation, and it was revealed laparoscopically because the hepatic artery could not be distinguished, and cholecystectomy was completed after the cystic artery was found to be double and secretion of the hepatic artery was detected.

Postoperative bile duct damage was discovered in three male patients with a twin cystic artery. The damage was found using MR-cholangiography after a 320 ml bile fistula was discovered in the patient's postoperative drain, and a stent was inserted in the common bile duct using endoscopic retrograde cholangiopancreatography (ERCP).

Patients with a double cystic artery spend an average of 5.9 (4-12) days in the hospital, compared to (3.2 days) for patients without a double cystic artery. The average occurrence of a double cystic artery was determined to be 3.84. (Tables 2 and 3 include demographic data, clinical characteristics of research participants, and study results). There was no mortality in the surgeries on individuals with twin cystic arteries.

Table- 1: Prevalence of number of cystic arteries

Total no. of patients	Single cystic artery	Double cystic artery
520	**500**	**20**

Table 2: Demographic Profile of Patients.

Variables		Single cystic artery (n=500)	Double cystic arteries (n=20)	Total (520)	P value
Age (in years)	Min.-max. (median)	21-71 (48.5)	29-71(55.4)	21-71(53.26)	t:0.655
	Mean±SD (mean)	47.6±15.62	53.4±10.85	44.6±14.12	[a]0.575

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Gender	Male	125(25)	4 (20)	129(24.81)	χ^2:0.521
	Female	375(75)	16 (80)	391(75.19)	[b]0.391

Table 3 Parameter of Single cystic artery and Double cystic arteries

		Single cystic artery (n=500)	**Double cystic arteries (n=20)**	**Total (520)**	**P value**
Indication	Multiple stones	500(100)	17 (85)	517(99.42)	χ^2:3.489
	Gallbladder polyp	0 (0)	3(15)	3 (0.58)	[b]0.047*
Switched from laparoscopic to conventional cholecystectomy	No	500(100)	16(80)	516(99.23)	χ^2:3.985
	Yes	0 (0)	4(20)	4 (0.77)	[b]0.044*
Bile duct injury	No	500(100)	17(85)	517(99.42)	χ^2:3.87
	Yes	0 (0)	3 (15)	3 (0.58)	[b]0.052*
Hospital stays	Days	3.2(1-6)	5.9 (4-12)	---	t:0.503

[a]0.477* aStudent-t test; [b] Pearson Chi-Square test; *p<0,05

Discussion

The cystic artery often arises as a single channel from the right branch of the normal hepatic artery. The hepatobiliary triangle crosses via Calot's triangle in 75-80% of reported instances. The cystic artery divides into superficial and deep branches as it approaches the gallbladder. In the gallbladder parenchyma, these branches create anastomoses. Variations in the origin and course of the cystic artery are common. During laparoscopic cholecystectomy, mortality was 0.02% in 1.9% of patients who had vascular damage. Other probable differences in this area must be known for safe cholecystectomy [6,7]. It happened in four participants in our research who had intraoperative bleeding. However, it is possible that it happened in these cases because the hepatic artery was wounded. When the embryology of the cystic artery was studied, it was shown that developmental alterations in the primitive ventral splanchnic arteries influence the cystic artery's formation and branching. The liver, gallbladder diverticulum from the caudal region of the stomodeum in the fourth week of pregnancy. The hepatic diverticulum divides into two portions between the ventral mesogastrium layers. The primordium of the liver is the greater cranial component of the hepatic diverticulum. It grows between the hepatocyte cords, causing endodermal cell growth and the formation of intrahepatic bile ducts. The gall bladder is formed by the tiny caudal section of the hepatic diverticulum, and the cystic duct is formed by the diverticulum's handle [8]. Apart from the double cystic artery, it is critical in laparoscopic cholecystectomy to connect the cystic artery, and several anatomical markers should be addressed for safe operation. The triangle of Calot's well is required in both conventional and laparoscopic cholecystectomy. The Calot's triangle is an essential landmark in cholecystectomy. In 1981, Rocko defined the Calot's triangle, which is created by the cystic canal, common hepatic canal, and lower margin of the liver. Rocko called attention to the potential variants in this triangle. Hugh termed the Calot's triangle the hepatobiliary triangle and the tiny cystic artery branches supplying the gallbladder the Calot's arteries [9]. Rouviere's sulcus, cystic lymph nodes, and arteries have

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been documented as anatomical markers in laparoscopic cholecystectomy. Since dissection of Calot's triangle proved safe at the transverse level, Rouviere's sulcus was reported as a proper landmark for the common hepatic canal plane. When the face strip of Calot's triangle is flattened, it becomes a pulsing structure with a cystic artery lymph node. Furthermore, characterising the cystic lymph node may aid in the identification of the cystic duct and cystic artery structures [10]. In our investigation, three individuals with a double cystic artery were discovered to have a bile fistula, and it was discovered that the patient had been operated on for acute cholecystitis.

In our research, the average incidence of a double cystic artery was 3.84, although the incidence of a double cystic artery varied from 2 to 25%. However, different values were discovered in other populations. This disease is caused by the congenital lack of the cystic artery's deep branch. Dandekar et colleagues found a single cystic artery in 72% of 82 cadavers and a double cystic artery in 28%. When the origin of the cystic artery was considered in relation to the Calot's triangle, it was discovered that 62.2% were within the triangle and 37.8% were outside. Except for 3.6% of the cases, cystic arteries were found to flow via Calot's triangle. The cystic artery was discovered to travel in front of the common hepatic canal in 26.8% of cases and behind it in 6.1%[11]. All of the double cystic arteries in our study passed via Calot's triangle, however there was no research on the origin of the double cystic artery.

Many research on the prevalence of double cystic arteries have been conducted on cadavers. Ding et colleagues found that in 3 of 600 Chinese patients (0.5%), the double cystic artery contacted the gall bladder from the exterior of the hepatobiliary triangle [12]. Similarly, in Suzuki et al's research, it occurred in 13 of 244 patients (5.3%) [13]. It occurred in 26 of 220 patients (11.8%) in Zubair et al's research on the Pakistani population, while in Talpur et al's study, the path of the double cystic artery was outside of the hepatobiliary triangle in 3 of 300 patients (1%) [14,15]. These studies also show that the prevalence of a double cystic artery varies by area in Pakistan. This suggests that the outcomes of the research may vary since they were conducted retrospectively. According to certain research, the double cystic artery originates from the right hepatic artery. For example, in a study of Futara Ethiopians, 10% of Saidi patients, Balija et al and Mlakar as al found that a double cystic artery formed from the right hepatic artery at rates of 13.6% and 5.5%[16-19].

The largest study of the origin of the double cystic artery was reported by Sarkar et al compiled accordingly, the cystic artery originated from several areas: right hepatic artery (63.9%), common hepatic truncus (26.9%), left hepatic artery (5.5%), gastroduodenal artery (2.6%), superior pancreatic duodenal artery (0.3%), right gastric artery (0.1%), celiac body (0.3%) and superior mesenteric artery (0.8%) [20]. According to this research, the double cystic artery is most often derived from the right hepatic artery. All of the aforementioned variances are common in isolation. It is very unusual for changes in hepatic arteries to coexist with instances of variance related with twin cystic arteries. In this line, Bincy et colleagues described two occurrences of a cystic artery originating from the correct hepatic artery [21]. A twin cystic artery emerging from the right hepatic artery and the posterior superior pancreatic duodenal artery was described by Loukas et al [22]. The auxiliary left hepatic artery was shown to stem from the left gastric artery in this investigation. According to Polguj et al, biliary system injury is a common problem in laparoscopic cholecystectomy, and they stressed the necessity of visualising a cystic duct and cystic artery in the same plan [23].

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Only three individuals in our study had epigastric hernias, but no research was done on vascular changes in the other patients.

CONCLUSION

Cystic artery variants may coexist with other variations. Understanding cystic artery differences may help to limit the risk of uncontrolled intraoperative bleeding, extrahepatic biliary damage, and conversion to traditional cholecystectomy.

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