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VASCULAR VARIATIONS IN THE CALOT'S TRIANGLE SEEN ON LAPAROSCOPIC CHOLECYSTECTOMY

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ABSTRACT

Objectives: To describe the frequency and pattern of vascular variations seen in the Calot's triangle on laparoscopic cholecystectomy.

Study Design: Descriptive study.

Place and Duration: From December, 2008 to February, 2011. Surgical Unit 1, Fauji Foundation Hospital, Rawalpindi.

Patients and Methods: Two hundred patients with a diagnosis of biliary colic, cholelithiasis, acute cholecystitis, empyema gall bladder and mucocele gall bladder were included. Patients with age less than 15 years were excluded. Careful dissection of the Calot's triangle was carried out. The anatomical variations of the cystic artery and other anomalous variations in the region were noted and data analyzed on SPSS 10.

Results: The age range was 19 to 88 years with a mean of 48 years. The majority (88%) of the patients presented with a clinical diagnosis of biliary colic. The cystic artery was single in 91%, branched in 6% and absent in 3% cases. The cystic artery was supero-medial to the cystic duct in 88%, anterior in 6%, and posterior in 3% of the cases. Other arterial variations included Calot's arteries (2%), Moynihan's Hump (3%) and gall bladder arterial supply from liver bed (3%).

Conclusions: Each Calot's triangle differs from the other. Vascular variations are the hallmark of this region and their knowledge is mandatory for a safe laparoscopic cholecystectomy.

Keywords: Cholecystitis,Cholelithiasis, Laparoscopic Cholecystectomy.

INTRODUCTION

The overall prevalence of gallstone disease in industrialized countries appears to be between 10 to 20%[1]. Cholelithiasis is common in Pakistan and Cholecystectomy is one of the commonest operation being performed in hospitals[2]. Laparoscopic cholecystectomy is widely accepted nowadays as the gold standard in the treatment of cholelithiasis[3]. This new technique was initially associated with a significant increase in morbidity, particularly iatrogenic biliary injuries and arterial hemorrhage; perhaps due to the lack of knowledge of the "laparoscopic anatomy" of the Calot's triangle.

The common denominator of vascular injuries during cholecystectomy is a failure to identify the structures in the Calot's triangle. Anomalous variations of the cystic artery and cystic duct are the hallmark of this region. During skeletonization of the cystic duct, the anterior lying artery may be damaged and blind plunges or injudicious use of diathermy current in this region may cause damage to the common bile duct[4]. In the presence of such variations and superimposed inflammation, dissection of the Calot's triangle is the most important step in open as well as laparoscopic cholecystectomy[5].

Extra-hepatic biliary injuries play a major part in the morbidity and mortality associated with laparoscopic cholecystectomy. Such an injury is very likely in the presence of variant anatomy in the Calot's triangle[6]. This study will help surgeons in identifying the variations in the cystic artery, thus reducing complications like iatrogenic injuries and hemorrhage. It will also help decrease the morbidity and mortality associated with laparoscopic cholecystectomy as well as understand how anatomical variations can contribute to complications.

PATIENTS AND METHODS

This was a descriptive study in which the pattern and frequency of vascular variations in the surgical anatomy of Calot's triangle has

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been described. This study was conducted at the Surgical Unit 1 of Fauji Foundation Hospital, Rawalpindi from December, 2008 to February, 2011. A total of 200 patients were included who underwent laparoscopic cholecystectomy done by 3 consultant laparoscopic surgeons. All these patients were admitted either through emergency or surgical out-patient department with the diagnosis of biliary colic, cholelithiasis, acute cholecystitis, empyema gall bladder and mucocoele of gall bladder. Patients of age less than 15 years or having Hepatitis B or Hepatitis C infection were excluded from the study.

Each patient was evaluated by detailed history and thorough physical examination. Complete blood count (CBC), urine analysis, serum urea and creatinine, random blood sugar, liver function tests (LFTs), hepatitis screening and ultrasound abdomen were done. Selective intra-operative cholangiography was used in those patients who had elevated LFTs or a history of jaundice.

We frequently used nasogastric tube decompression of the stomach. In all our cases, pneumo-peritoneum was created by the open technique (Hasson's method) and four ports (umbilical, epigastric, right hypochondrium and right paracolic) were used. The cystic artery was either clipped or coagulated with diathermy depending upon each surgeon's preference. To measure the length of the cystic artery, the tip of a Maryland's forceps was used as a reference which is about 1cm in length.

Dissection of the Calot's triangle was assigned as easy or difficult by the operating surgeon. Gall bladder dissection was done by a hook, spatula or scissors with the help of diathermy depending on each surgeon's preference. The gall bladder was extracted through the epigastric or umbilical port with the help of an extractor, either in a glove pouch or without it, again depending on the surgeon's preference.

Data Collection Technique

Informed consent was obtained from all patients prior to inclusion in the study. Data collection was done on a pre-designated patient proforma. Anatomy of the Calot's triangle was mentioned under the headings of normal and varied anatomy including anomalies of the cystic artery and other anomalies like aberrant Right hepatic artery. The cystic artery numbers (single, double, branched), its length and its origin were noted. Other operative findings included the type of the gall bladder dissection forceps used and the gall bladder extraction port and technique used.

Data Analysis

The data of 200 male and female patients undergoing laparoscopic cholecystectomy was collected on the pre-designated patient proforma and then transferred to the data sheet IV of SPSS 10. This data sheet was then analyzed for median age, mean age, frequency of male and female patients and presentation of symptoms. The frequency calculation for the cystic artery number and position, difficult dissection and miscellaneous variations was performed with the help of descriptive statistics from this data sheet.

Being a descriptive study, there was no hypothesis designed to assess the probability of error / chance findings.

RESULTS

The age range was from 19-88 years (Mean 48±13). Our study was based on non-probability / convenient sampling. Only 4 (2%) patients of our study population were male. The majority of the study population was female i.e. 196 (98%). In our study, the weight of the patients ranged from 38 - 100Kg. (mean65±15). The most common clinical diagnosis was biliary colic seen in 176 patients (88%). Acute cholecystitis was diagnosed in 14 (7%) patients while 4 (2%) patients had an empyema gall bladder and 6 (3%) patients had a mucocele of the gall bladder. A nasogastric tube was used in 164 (82%) patients.

The dissection in the region of Calot's triangle was assigned as easy and difficult. In 18 (9%) patients, the surgeon designated the operation as difficult due to thick adhesions in the Calot's triangle, but was able to dissect the triangle safely. The rest of the cases were designated as easy i.e. 182 (91%) patients.

In 182 (91%) cases, there was a single cystic artery. We found a branched cystic artery in 12 (6%) cases. In 6 (3%) cases, cystic artery was absent and gallbladder was receiving blood supply from liver bed.

In our study, we divided the cystic artery length in three groups i.e. short (< 1 cm), normal (1-3 cm) and long (> 3 cm). The results showed that 164 (82%) patients had a normal length cystic artery (Fig. 1). A short cystic artery was found in 14 (7%) patients and a long cystic artery was present in 16 (8%) patients. Cystic artery was originating from right hepatic artery in 192 (96%) patients. In 2 (1%) cases, the cystic artery was found to have an origin from superior mesenteric artery which is a very rare variation. In 6 (3%) cases, the cystic artery was absent.

We looked for the position of the cystic artery in the Calot's triangle. We found it in 176 (88%) cases in the Calot's triangle, supero-medial to the cystic duct. The most common variation was a cystic artery anterior to the cystic duct in 12 (6%) cases. A cystic artery posterior to the cystic duct was found in 6 (3%) cases while it was absent in 6 (3%) cases (Fig. 2).

Small branches of the cystic artery (Calot's arteries) supplying the cystic duct were noticed as such around the cystic duct in 4 (2%) patients. We found a Moynihan's Hump in 6 (3%) patients in which the right hepatic artery was taking a sharp turn in front of the cystic duct. Aberrant gall bladder blood supply from the liver bed was found in 6 (3%) patients.

Complications

Four patients (2%) out of 200 suffered from intra-operative hemorrhage which required conversion to open operation. One patient had hemorrhage from a supra-duodenal vein injury, which was revealed by about 500 ml. of blood in the drain within 20 minutes of completion of laparoscopic cholecystectomy. The patient was operated on by open technique and bleeding from a supra duodenal vein was controlled by pressure and ligature of the vein. The second patient had a difficult dissection of the gall bladder from its fossa in the liver due to hepatomegaly and an over hanging left lobe, so the procedure was converted to open cholecystectomy. The other 2 patients had bleeding from the cystic artery which required conversion to open surgery.

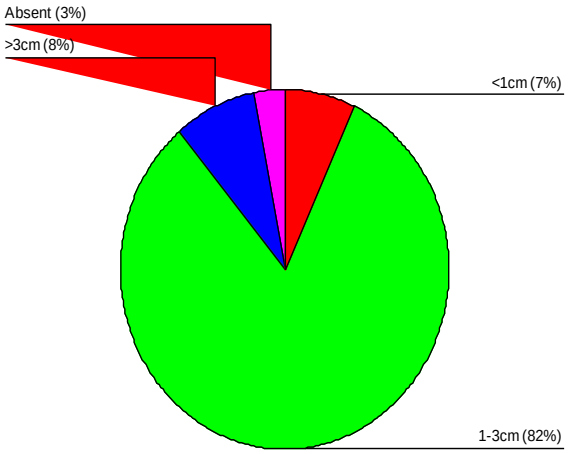

Fig. 1: Variation of cystic length

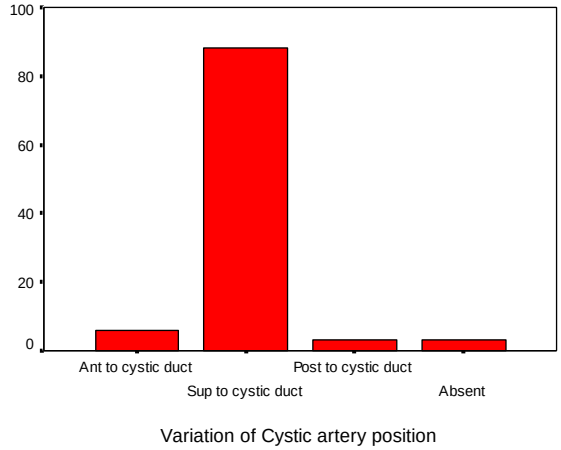

Fig. 2: Variation of cystic artery position.

DISCUSSION

Laparoscopic cholecystectomy is routinely performed at many hospitals in Pakistan[7]. Muhe performed the first laparoscopic cholecystectomy in 1985[8]. Surgeons have been trying ever since to emphasize the importance of safe dissection in the Calot's triangle. Laparoscopic cholecystectomy mandates great attention to the anatomical dissection of the Calot's triangle in order to accurately identify the cystic artery and cystic duct and any other vascular and biliary structures[9].

Cholelithiasis is a disease of the fourth and fifth decades of life. In our study the age range

was 19-88 years which is the same as that of Western population[1]. In our study, the weight range of patients was from 38 to 100 kg. It shows that cholelithiasis occurs mainly in obese patients as described in classical textbooks[10].

In our study 98% of patients were female. The sampling method of our study was non probability / convenient. Only 4 (2%) male patients presented with cholelithiasis during study period and were included in the study as part of our criteria. International data suggests that gallstone disease is 3 to 4 times more common in females than males[11]. A different scenario was reflected by our study population as it was almost exclusively diagnosed in females (98%). However, our hospital mainly treats the families of retired army personnel and the majority of patients are female.

The most common clinical presentation was biliary colic in 88% cases. Acute cholecystitis was seen in 7%, mucocele in 3% and empyema in 2% cases. In his study, Guarya noticed similar results i.e. 476 (86.7%) cases presented with chronic cholecystitis, 63 (11.4%) acute cholecystitis, 6 (1%) mucocele of the gallbladder and 2 (0.4%) had empyema gallbladder[12]. Laparoscopy appears to be a safe and good approach for emergency cholecystectomy in patients with acute cholecystitis[13]. We noted that the gall bladder contained a single calculus in 38 (19%) patients and multiple calculi in 162 (81%) patients on ultrasonography. Hussain noted in his study that pre-operative ultrasound in gall stone disease showed a 92% accuracy when its findings were compared with operative findings[14].

In 182 (91%) patients the dissection was easy while it was difficult in 18 (9%) patients keeping in view that patients with complicated gall stones were included in the study. Kwon and colleagues performed laparoscopic cholecystectomy in 440 patients and encountered difficult dissection of the Calot's triangle due to severe adhesions in 10.9% cases[15]. Maudar also assessed patients for difficult dissection in the region of the Calot's triangle. Among the difficult cases, they found Mirrizzi's syndrome in 17%, shrunken gall bladder in 32% and a frozen Calot's triangle 51%[16]. A surgeon performing laparoscopic cholecystectomy can expect a difficult case after every eighth or ninth laparoscopic cholecystectomy.

In our study, we looked for the position of the cystic artery in the Calot's triangle. We found it in 176 (88%) of the cases in the Calot's triangle, supero-medial to the cystic duct. This variation is reported by Suzuki and colleagues in 76.6%[17] of their cases and by Hugh and colleagues in 76% of their cases[18].

The most common variation was a cystic artery anterior to the cystic duct in 12 (6%) cases. Ayyaz and colleagues reported an anterior cystic artery in 15% of cases[4]. This anomaly is dangerous because during skeletonization of the cystic duct, the anterior lying artery may be damaged and blind plunges or injudicious use of diathermy current in this region may cause damage to the common bile duct. A cystic artery posterior to the cystic duct was found in 6 (3%) cases.

In our study, the cystic artery was absent in 6 (3%) cases while there was a single cystic artery in 182 (91%) cases. Hugh and colleagues reported a single cystic artery in 76% of their patients[18]. In 12 (6%) cases, we found a branched cystic artery. Ayyaz and colleagues noticed a branched cystic artery in 20% of their cases[4]. A large study sample may give a better actual picture of cystic artery branching in the Calot's triangle.

We noticed in 164 (82%) cases, the cystic artery was of normal length (1-3cm). A short cystic artery (<1cm) was seen in 14 (7%) cases while a long cystic artery (>3cm) in 16 (8%) cases. De Silva reported a mean length of cystic artery to be 2.3cm seen in his study[9]. In 192 (96%) cases, the cystic artery was originating from the right hepatic artery (Figure 2) while in 2 (1%) cases we found a rare variation i.e. the cystic artery originating from the superior mesenteric artery. In the remaining 6 (3%) cases, the cystic artery was arising from the liver bed. This is in accordance with the findings described by other workers[19,20,21]. These unusual positions and numbers make the

cystic artery susceptible to injury during laparoscopic cholecystectomy. So when the cystic artery is not found in the usual common position, then a variant anatomy should be kept in mind to avoid troublesome bleeding during the procedure.

In 6 (3%) cases, the right hepatic artery was taking a sharp turn in front of the cystic duct and the cystic artery was arising as a short twig from the right hepatic artery. This anomaly i.e. Moynihan's Hump is reported in 1% of cases by Ayyaz and colleagues[4]. This variation endangers the blood supply of the right lobe of liver as the right hepatic artery may be mistaken for a large cystic artery and ligated or it may be damaged.

Small branches of the cystic artery, which Hugh and colleagues suggested to be named as Calot's arteries[18], supply the cystic duct and may cause troublesome bleeding during laparoscopic dissection in the Calot's triangle. In our study, we found these Calot's arteries in 4 (2%) of the cases.

Aberrant gall bladder blood supply from the liver bed was found in 6 patients (3%). Ding has reported the incidence of cystic artery originating from liver parenchyma to be 2.5%[22].

Four patients (2%) out of 200 suffered from intra-operative hemorrhage which required conversion to open technique and bleeding control by pressure and ligature. Khan in his study noticed a conversion rate of 6.4%[23]. The morbidity encountered in our study is comparable to local and international data and is in the acceptable range. There was no mortality in this series. More emphasis is however needed to properly train young surgeons in the field of laparoscopic surgery[24].

CONCLUSIONS

In the dissection of the Calot's triangle for routine laparoscopic cholecystectomy, the concept of the so called normal / abnormal or anomalous anatomy is difficult to state. Certainly, the anatomy of Calot's triangle is a "VARIANT ANATOMY" and after doing this original study and an extensive review of pertinent literature, this is how we state it.

Just like their genes, faces and finger prints, Calot's triangles of humans differ from each other. It is almost impossible to find two congruent Calot's triangles. The knowledge of a variant anatomy in the Calot's triangle is the key for dissection. Surgical trainees should be taught this principle for doing a safe cholecystectomy.

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