Original Article

Ductal Variations in the Calot's Triangle Seen on Laparoscopic Cholecystectomy

1. M. Taimur 2. Azmat Hasan 3. Rehan Masood 4. Sami Ullah 5. M Imran

1. Reg. Unit-1 2. Asstt. Prof. Unit-1 3. Assoc. Prof. Unit-III 4. Asstt. Prof. Unit-II 5. Reg.. Unit-III, Dept. of Surgery, Fauji Foundation Hospital, Rawalpindi

ABSTRACT

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

Study Design: Descriptive study.

Place and Duration of Study: This study was conducted in the Surgical Unit 1, Fauji Foundation Hospital, Rawalpindi from December 13, 2008 to February 22, 2011,

Patients and Methods: 200 patients with a diagnosis of biliary colic, cholelithiasis, acute cholecystitis, empyema gall bladder and mucocele gall bladder were included in this study. 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 duct 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 duct was of normal size in 88%, short in 7%, and long in 5% of the cases. The cystic duct terminated laterally into the common hepatic duct in 94% of the cases, anteriorly into the common hepatic duct in 5% and posteriorly into the common hepatic duct in 1% of the cases.

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

Key Words: Cholelithiasis, Cholecystitis, 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 bile duct injuries during cholecystectomy is a failure to identify the structures in the Calot's triangle. Anomalous variations of the 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 duct, thus reducing complications like iatrogenic injuries. 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

It is a descriptive study in which the pattern and frequency of vascular and ductal variations in the surgical anatomy of Calot's triangle is 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 03 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 functions 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 Calot's triangle was displayed by holding the infundibulum of the gall bladder with grasping forceps. The loose areolar tissue in the Calot's triangle lateral to the cystic lymph node of Lund was dissected with great care. With the help of a Maryland's forceps, small strands of tissue were dissected to skeletonize the cystic duct and cystic artery. The use of diathermy current was minimal during dissection of the Calot's triangle. For minor bleeding in that area, only pressure and packing was successful. The cystic duct was clipped only when the operating surgeon was certain about its entry into the gall bladder. The cystic artery was either clipped or coagulated with diathermy depending upon each surgeon's preference. To measure the length of the cystic duct, 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 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 taken from all patients prior to inclusion in the study. Data collection was done on a pre-designated patient performa. Anatomy of the Calot's triangle was mentioned under the headings of normal and varied anatomy including anomalies of the cystic duct, cystic artery and other anomalies like the duct of Lushka, aberrant Right hepatic duct and Mirrizzi's syndrome. The cystic duct length was measured using the tip of a maryland's forceps and designated as short, medium and long. The number of cystic ducts and their joining point with the common hepatic duct (T Junction) were noted. Other operative findings noted 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 performa 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 duct length, 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 in our study to assess the probability of error / chance findings.

RESULTS

The age range was from 19 years to 88 years. The median age was 48 years. 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%) patients. In our study, the weight of the patients ranged from 38 kilograms (kg.) to 100 Kg. The median weight was 65 Kg. The hemoglobin (Hb.) of patients ranged from 9.40 gm/dL to 15.90 gm/dL. The median Hb. was 12.40 gm/dL. The range of patients' white blood cell count (WBC) was from 4.90 x 10^9/L to 17.30 x 10^9/L. The median WBC was 7.90 x 10^9/L. The Alkaline phosphatase (AP) levels ranged from 36 IU/L to 199 IU/L. The median AP was 118 IU/L. The most common clinical diagnosis was biliary colic seen in 176 patients (88%). Acute cholecystitis was seen in 14 patients (7%) while 4 patients (2%) had an empyema gall bladder and 6 patients (3%) had a mucocele of the gall bladder. A nasogastric tube was used in 164 patients (82%).

Conventionally, the dissection in the region of Calot's triangle was assigned as easy and difficult. In 18 patients (9%), 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 patients (91%).

In 66 patients (33%), dissection was done by spatula with diathermy while in 98 patients (49%), hook with diathermy was used. Only in 36 patients (18%), scissors were used for dissection.

In our study, a single cystic duct was found in all 200 cases (100%). We divided the cystic duct length into short (<1cm), normal (1-3cm) and long (>3cm) groups using the tip of a maryland's forceps. The cystic duct was found to be of normal length in 176 patients (88%) (Figure 1). A short cystic duct was found in 14 patients (7%) and a long cystic duct was present in 10 patients (5%). The cystic duct terminated into the common hepatic duct to form the common bile duct (CBD) in all 200 patients (100%). A common termination was laterally into the common hepatic duct in 188 patients (94%), in 10 patients (5%), the cystic duct terminated anteriorly into the common hepatic duct while in 2

patients (1%), the cystic duct was joining the common hepatic duct in a posterior position (Figure 2).

Figure 1: Variation of Cystic Duct Length.

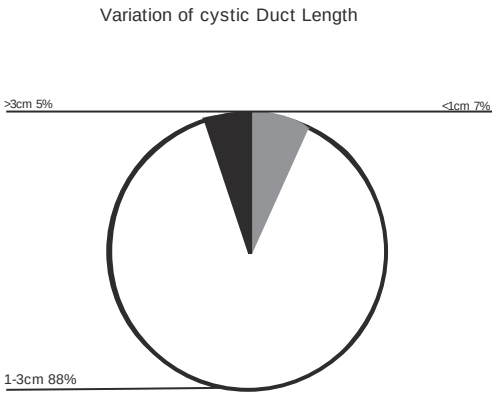
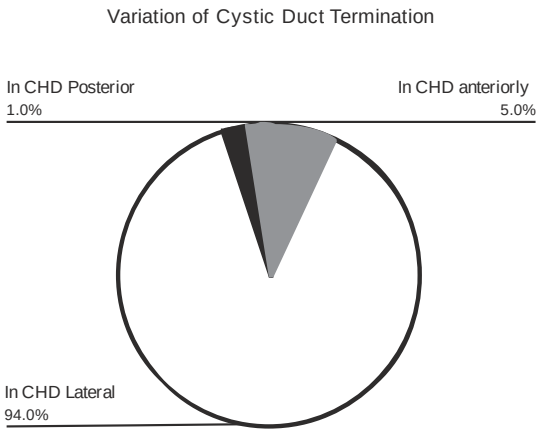


Figure 2: Variation of Cystic Duct Termination.



Complications

4 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 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.

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. The mean age was 48 years. The age distribution in this study population is the same as that of western population[1]. In our study, the mean weight of patients was 65 kg. The range was from 38 to 100 kg. Our study 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 our study period and were included in the study as part of our inclusion 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%. Acute cholecystitis was seen in 7%, mucocele in 3% and empyema in 2% cases. In his study, Salman Yousuf 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]. In our study, we noted that the gall bladder contained a single calculus in 38 (19%) patients and multiple calculi in 162 (81%) patients on ultrasonography. Khadim 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 KK 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. This warrants extra care to avoid

mishaps even for experienced surgeons, especially when a variant anatomy is present.

The most common variation was a cystic artery anterior to the cystic duct in 12 (6%) cases. Ayaz 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. The different frequencies of cystic duct position found in our study, corresponds to local and international data.

The literature contains case reports of congenital absence of the cystic duct. Probably the variation is too rare. We were unable to find such a variation.

During our procedure, we divided the cystic duct length into short cystic duct (<1cm), normal cystic duct (1-3cm) and long cystic duct (>3cm). By conventional method, the length of the proximal end of a maryland's forceps is taken as 1cm. In our study, 176 (88%) cases had a normal cystic duct, 10 (5%) cases had a long cystic duct and 14 (7%) cases had short cystic duct. The length of the cystic duct in the Calot's triangle is important because the "classical" biliary injury usually involves misidentification of the common bile duct as the cystic duct. Strasberg and colleagues described the "hidden cystic duct syndrome" i.e. the cystic duct may be hidden in inflammatory tissue behind the common bile duct and a false infundibulum may be seen, connecting the common bile duct and gallbladder. It is here that the common bile duct is mistaken as the cystic duct[17, 18].

The study performed by Francouer further highlights the importance of the length of the cystic duct. A response to a questionnaire from 114 Laparoscopic Surgeons is reported in his study. It cites inflammation and short / anomalous cystic ducts as the most responsible factors contributing to injury[19]. This misperception can occur if the cystic duct is absent or of very short length. In our study, we found that the cystic duct was short in 7% of patients and in these cases, superimposed inflammation gave the impression of a false infundibulum and a hidden cystic duct syndrome. The CBD is at risk of injury in such variations of length[18].

In our 200 (100%) cases, we noticed a single cystic duct. In 188 (94%) cases, the cystic duct was terminating laterally into the common hepatic duct. The common variation was the termination of the cystic duct into the common hepatic duct anteriorly in 10 (5%) cases. In 2 (1%) cases, we found the cystic duct terminating posteriorly into the common hepatic duct. In a study by Fatima, she noticed an original pattern described in textbooks i.e. union of the cystic duct on the lateral side of the common hepatic duct in only 32% cases[20]. Such may be the variation in the anatomy of the T junction.

In this study, we performed gall bladder dissection with the help of spatula, hook or scissors. In 66 (33%) cases, dissection was done by a spatula with diathermy. In 98 (49%) cases, hook with diathermy was used while in 36 (18%) cases, scissors were used for dissection.

4 patients (2%) out of 200 suffered from intra-operative complications. None of these were related to major extra-hepatic hepatic duct or surrounding structures. One patient had hemorrhage from a supra-duodenal vein injury, which required conversion to open technique and bleeding control by pressure and ligature. The second patient had a difficult dissection of the gall bladder from the liver bed due to hepatomegaly and an overhanging left lobe of liver, so the procedure was converted to open cholecystectomy. The other 2 patients had bleeding from the cystic artery which required conversion to open surgery. Khan in his study noticed a conversion rate of 6.4%[21]. 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[22].

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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Address for Corresponding Author:
M. Taimur,
Department of Surgery,
Fauji Foundation Hospital, Rawalpindi
0333-5127691