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The course of the cystic artery during laparoscopic cholecystectomy

K. Torres[1, 2], A. Chrościcki[2], A. Golonka[1], A. Torres[1, 3], G. Staśkiewicz[1, 4], R. Palczak[5], J.M. Ceja-Sanchez[6], M. Ceccaroni[7], A. Drop[4]

[1]*Human Anatomy Department, Medical University of Lublin, Poland*
[2]*Department of General and Oncological Surgery, District Specialistic Hospital, Lublin, Poland*
[3]*3th Department of Gynaecology, Medical University of Lublin, Poland*
[4]*1st Department of Radiology, Medical University of Lublin, Poland*
[5]*Public Health Department, UITS Rzeszów, Poland*
[6]*Regional Hospital of High Specialty, Hospital Reforma Oaxaca Mexico, Mexico*
[7]*Gynecologic Oncology Division, European Gynaecology Endoscopy School, Sacred Heart Hospital, Negrar (Verona), Italy*

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Proper recognition of the particular structures that form the triangle of Calot is essential for the proper and safe performance of laparoscopic cholecystectomy. Proper recognition, ligation, and cut of the cystic duct and cystic artery with branches (dorsal and ventral) remain an integral condition for the removal of the gallbladder. Calot's triangle, as an orientation structure, determines the most common location of the cystic artery. The triangle of Calot is one of the most variable regions of the abdomen in terms of anatomy. The aim of this study was to evaluate how important for surgery is the detailed anatomical recognition of the main branches of the cystic artery in Calot's triangle during laparoscopic cholecystectomy.

Relations of the main branches of the cystic artery were evaluated in 88 patients that underwent laparoscopic cholecystectomy at the Department of General Surgery of the District Specialistic Hospital of Lublin. The anatomical relations of cystic duct and artery were classified into typical and variant types. Significantly more frequently variants of cystic artery were observed in women. However, the time of the procedure was not significantly related with the type of cystic artery. (Folia Morphol 2009; 68, 3: 140–143)

Key words: cholecystectomy, laparoscopy, cystic artery

INTRODUCTION

Currently laparoscopic cholecystectomy (LC) is a gold standard treatment for cholelithiasis [20, 21] and many authors emphasize that LC has many advantages when compared with open cholecystectomy (OC). The described method is a safer procedure [9] with less chance of destroying natural layers of the anterolateral abdominal wall, rare frequency of intra- and post-operative complications, less traumatizing, less pain after procedure, better cosmetic effect, and earlier recovery back to physical activity [4]. It also allows a shorter hospitalization period [18] and decreased costs of hospitalization [11]. It is commonly known that the longer hospitalization the higher risk of postoperative complications such as hospital-acquired infections, thrombophlebitis, or longer patient recovery time. However, the risk of intraoperative injury during LC is significantly higher [7]. The

Address for correspondence: G. Staśkiewicz, 1st Department of Radiology, Medical University of Lublin, Jaczewskiego 8, 20–090 Lublin, Poland, tel: +48 609 522 559, e-mail: grzegorz.staskiewicz@umlub.pl

most frequent complications are: haemorrhage or bile leakage [19], lost gallstones [15], and iatrogenic bile duct injuries [10]. Haemorrhage and bile leakage usually occur due to variants of structures of Calot's triangle and they constitute the most common cause for the conversion to OC. An infiltrated wall of the gallbladder is susceptible to accidental injury during dissection. Lost gallstones often lead to stones in the port site or the abdominal abscesses. Iatrogenic bile duct injuries are the most serious and important causes of morbidity after cholecystectomy, and they are most commonly caused by poor identification of the anatomical structures in the operation field. That is why every surgeon should be familiar with the anatomical conditions in the Calot's triangle.

The Calot's triangle is an anatomical space bounded superiorly by the inferior surface of the liver, inferiorly by the cystic duct and medially by the right hepatic duct. Since the second half of 20th century, the most common variant of Calot's triangle, which is bounded medially by the common hepatic duct, was adopted, and currently the name 'hepatobiliary triangle' is suggested. In most cases, the cystic artery can be found in this area. Careful blunt dissection of the hepatobiliary triangle region is vital in order to reveal all of the gallbladder's arterial supply sources. Proper identification of all arteries in this area allows the avoidance of accidental injury or ligation of vessels which do not supply the gallbladder but are important for the liver vascularisation. There are many descriptions concerning the variations of the origins and courses of the gallbladder's arteries available in the literature [1, 2, 5, 6, 8, 16]. A single cystic artery, which originates from right hepatic artery and runs within Calot's triangle, is a typical situation [2, 21]. However, the literature and our studies prove that variations of the origin and course of the cystic artery are very common. In our evaluation, there is a gap in the descriptions of the topography of the cystic artery. The aim of this study was to evaluate the course and diameter of the main branches of the cystic artery and other parameters of the patients, such as age, body weight, and height, and how they influence the time of the laparoscopic cholecystectomy.

MATERIAL AND METHODS

We analyzed 88 cases of patients that underwent laparoscopic cholecystectomy at the Department of General Surgery of the District Specialistic Hospital of Lublin between April and December 2007, and were operated by the same team of surgeons. Our group included 18 men and 70 women aged from 22 to 84 years old. The mean age of the females and males was 54.5 and 61.5 years, respectively. Although body mass index (BMI) for both genders was comparable (28.29 in males and 27.99 in females), the average weight was different in women and men (75.0 kg and 87.5 kg, respectively). It was followed by the difference in the average height for each gender — females 164.0 cm and males 175.0 cm. Average procedure time was 47.5 minutes (males), 45.0 minutes (females). Seventy planned cases and 18 emergency cases were distinguished in the evaluated group. In 3 cases, the team of surgeons decided about conversion due to serious difficulties in evaluation and the lack of any possibility of identification of the structures in the hilum of the liver. Information about the type of gallbladder arterial supply was collected. The ratio of the diameter of the two main branches of the cystic artery (superficial and deep) was evaluated whenever possible.

Correlations between these parameters, basic patient data (age, gender, BMI), and operation parameters were evaluated. The obtained results were statistically analyzed with χ^2 and Mann-Whitney tests.

RESULTS

We divided the gallbladder arterial supply into 2 groups: standard and variant. The first group included cases with the artery anteromedial to the cystic duct, near the sentinel cystic lymph node [19], as presented in Figure 1. The second group (variants) consisted of all cases with an atypical course of the cystic artery and its branches (32 patients). From this group no superficial branch of the cystic artery, or dominance of a deep branch, was identified in 12 patients (37.5% of variant cases); in 8 patients, dominance of the superficial branch was found (25%); 4 patients had cystic artery located posterior to the cystic duct and 4 patients showed low division of the cystic artery (12.5%); and other conditions were seen in 4 patients. The variant group consisted almost exclusively of females (male:female ratio = 1:31), who occurred more frequently in variant group than in the standard group ($p = 0.004$). Both of the distinguished types (standard and variant) occurred irrespective of age, height, weight, and BMI. The type of arterial supply did not significantly influence the time of the procedure (Fig. 2). There

Figure 1. The most common course of the cystic artery, referred to as "standard". Schematic depiction based on the collection of the Department of Human Anatomy, Medical University of Lublin.

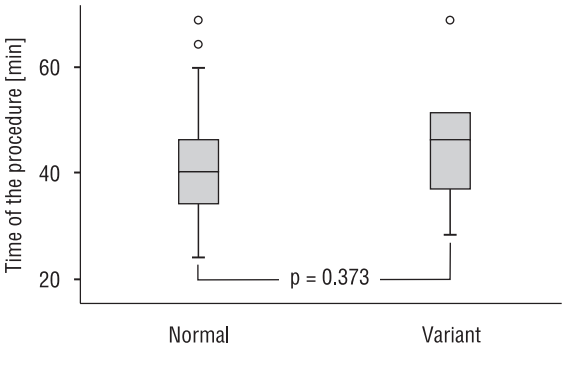

Figure 2. Time of laparoscopic cholecystectomy in patients with normal and variant course of the cystic artery. Boxplot graph presents mean values, upper and lower quartiles, and minimum and maximum values. Circles indicate outliers.

was also no correlation between the ratio of the diameter between the two main branches of the cystic artery and the basic patient data (gender, age, height, weight, BMI). There were 18 emergency cases of LC among the surveyed patients. The surgeons used the same procedural techniques as in planned interventions — clips, electrocoagulation, or harmonic knife. The emergency procedures lasted 30––85 minutes (median 60 minutes), which was significantly longer ($p < 0.001$) than in the planned procedures (average duration 40 minutes). A weak positive correlation between BMI and procedure time was observed ($r = 0.320$; $p = 0.034$).

DISCUSSION

Laparoscopic cholecystectomy (like other videoscopic procedures) is a recognized method ensuring better postoperative quality of life in comparison to procedures with open surgical access [12]. It allows a shortening of the postoperative hospitalization. The number of complications after laparoscopic procedures is comparable to or less than after open procedures [3, 13, 17]. This means that LC is a safe procedure and can be used as a diagnostic instrument to recognize unclear causes of abdominal symptoms, abdominal injuries, and gynaecological problems. Each time it can be changed into a therapeutic procedure (laparoscopy or laparotomy) [4, 11]. As a diagnostic instrument it allows the avoidance of unnecessary laparotomy in cases with incorrect preoperative diagnosis [11]. Diagnostic laparoscopy, as a less invasive procedure, can provide a solution between non-invasive methods and laparotomy [4]. Researchers report a high diagnostic value of laparoscopy in diagnosing the causes of chronic and acute stomachache, peritonitis, and other abdominal illnesses [4]. Because of the safety of laparoscopic techniques, an increasing percentage of emergency interventions are performed in that way; except for acute cholelithiasis, this method enables the cure of many other acute abdominal illnesses — appendicitis, perforation of the gastrointestinal tract, etc. [11, 14].

In our research we focused on the evaluation of the frequency of anatomical variations regarding the cystic artery within Calot's triangle because this changeability may lead to one of the most dangerous intraoperative complications: bleeding in the hepatobiliary triangle. We identified 32 cases (37.6%) with an atypical course of the cystic artery different, which is a higher rate compared to other researchers [1] (26.5%), [19] (23.4%).

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