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Assessment of lateral to medial dissection of Calot's triangle in laparoscopic cholecystectomy: A case-control study

Laparoskopik kolesistektomide Calot üçgeninin lateralden mediale disseksiyonunun değerlendirilmesi: Vaka-kontrol çalışması

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Abstract

Aim: We aimed was to compare intraoperative results of the dissection of the Calot's triangle through classical method and the dissection starting from the posterior side of the cystic duct toward the cystic artery along lateral to the medial surface in LC.

Methods: In Group 1 (n=60), peritoneum was dissected anteriorly along medial to the lateral surface of the Hartmann's pouch. In Group 2 (n=60), the peritoneal dissection started from the posterior side of the cystic duct toward the cystic artery along lateral to the medial surface of the Hartmann's pouch. Data including demographic characteristics of the patients, cystic duct dissection time, cystic artery dissection time, and intraoperative bleeding amount were recorded.

Results: The median cystic duct and cystic artery dissection times were 308.00 (IQR=68-927) sec and 403.50 (IQR=98-1045) sec, respectively. In Group 1, these values were 347.90±186.33 and 469.73±225.02 sec for cystic duct and cystic artery dissection, respectively. In Group 2, the median cystic duct and cystic artery dissection times were 285.50 (IQR=68-927) sec and 389.50±143.28 sec, respectively. There was no statistically significant difference in the Calot's triangle dissection time (p=0.122 and p=0.075, respectively) and intraoperative blood loss amount between the groups (p=0.852).

Conclusion: Our study results suggest that this technique can be safely performed in an acceptable time in LC patients. It also appears to be a safe alternative option for residents, left-handed surgeons, and patients with biliary and vascular abnormalities.

Keywords: Laparoscopic cholecystectomy, Lateral dissection, Medial dissection, Calot's triangle

Öz

Amaç: Laparoskopik kolesistektomide Calot üçgeninin diseksiyonunun intraoperatif sonuçlarını; klasik yöntemle ve sistik kanalın arkasından sistik artere doğru, lateralden mediale yapılan disseksiyonla karşılaştırmayı amaçladık.

Yöntemler: Grup 1'de (n = 60) periton; önde Hartmann poşunun anterior yüzeyi boyunca kese lateral yüzeyine dek disseke edildi. Grup 2'de (n = 60) peritoneal diseksiyon, sistik kanalın arka tarafından sistik artere doğru, lateralden mediale doğru yapıldı. Hastaların demografik özellikleri, sistik kanal disseksiyon süresi, sistik arter disseksiyon zamanı ve intraoperatif kanama miktarı da dahil olmak üzere veriler kaydedildi.

Bulgular: Medyan sistik kanal ve sistik arter diseksiyon süreleri sırasıyla 308,00 (IQR = 68-927) sn ve 403,50 (IQR = 98-1045) sn idi. Grup 1'de sistik kanal ve sistik arter diseksiyonu için bu değerler sırasıyla 347,90±186,33 ve 469,73±225,02 sn idi. Grup 2'de median sistik kanal ve sistik arter diseksiyon süreleri sırasıyla 285,50 (IQR = 68-927) sn ve 389,50±143,28 saniye idi. Calot üçgeni disseksiyon zamanında (p sırasıyla 0,122, 0,075) ve gruplar arasındaki intraoperatif kan kaybı miktarı arasında istatistiksel olarak anlamlı fark yoktu (p=0,852).

Sonuç: Bu tekniğin laparoskopik kolesistektomi yapılan hastalarda kabul edilebilir bir süre içinde güvenli bir şekilde uygulanabileceğini düşünmekteyiz. Aynı zamanda laparoskopik kolesistektomiye yeni başlayanlar, sol elini kullanan cerrahlar ile safra ve vasküler anomalileri olan hastalar için güvenli bir alternatif seçenek olarak göründüğünü düşünmekteyiz.

Anahtar kelimeler: Laparoskopik kolessistektomi, Lateral disseksiyon, Medial disseksiyon, Calot üçgeni

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Introduction

Laparoscopic cholecystectomy (LC) is the gold standard in the treatment of gallbladder diseases with smaller incisions, less postoperative pain, and shorter hospital stay compared to open cholecystectomy [1]. However, this technique has some risks of potentially severe complications, such as biliary duct injury (BDI) and intra- and postoperative bleeding [2-4]. These complications may originate from anatomical variations, surgical skills and experiences, previous hepatobiliary infections, pathologies of the gallbladder, surgical techniques, and technological capabilities. In particular, in the education of surgical residents during the learning curve, the intraoperative complications such as bleeding may extend the operation time.

At the end of the 19th century, Jean-François Calot was first described a very important anatomical landmark of a special value in hepatobiliary surgery in his academic thesis [5]. Although modern description of the Calot's triangle is slightly different from the original definition, this critical anatomical space still remains important for hepatobiliary surgeons.

Cystic artery, common hepatic duct, and cystic duct are contemporary borders of the Calot's triangle [6]. It is critical to perform an attentive dissection in this anatomical triangular area, before the ligation and division of the cystic duct and artery during cholecystectomy and common bile duct surgery. These are the mainstays of LC. Despite some authors have described many dissection techniques for safer LC [7-9], there is still no consensus about the exploration of the critical anatomical structures, such as cystic duct and cystic artery in this laparoscopic procedures and, therefore, more precise approaches are required to minimize complications.

Classically, the surgeon starts the dissection of peritoneum in LC from the anterior side of cystic artery toward the cystic duct along medial to the lateral surface of the Hartmann's pouch. However, this technique has some challenges due to vascular variations.

In this study, we aimed to compare intraoperative results of the dissection of the Calot's triangle through classical method and the dissection starting from the posterior side of cystic duct toward the cystic artery along lateral to the medial surface in LC.

Materials and methods

This clinical, comparative study was designed as case-control study, and it was approved by the Ethics Committee of Şevket Yılmaz Training and Research Hospital. The study was conducted in the general surgery department of Şevket Yılmaz Training and Research Hospital, Suleyman Demirel University and Ankara Guven Hospital. A written informed consent was obtained from each patient. The study was conducted in accordance with the principles of the Declaration of Helsinki.

A total of 120 patients from three centers who were scheduled for LC due to symptomatic cholelithiasis between January 2015 and July 2016 were included in the study (Table 1). Patients who had acute or chronic cholecystitis, porcelain gallbladder, or empyema of the gallbladder were excluded from the study. In addition, patients with comorbidities such as liver diseases (e.g. cirrhosis), intra- and extrahepatic biliary tract abnormalities, or an additional disease which may affect the biliary tract surgery, intra-abdominal adhesions affecting the corpus of the gallbladder due to a previous upper abdominal surgery and coagulopathies were also excluded. Also, those with a provisional diagnosis of gallbladder cancer or with a stone with >2.5 cm diameter were excluded. All patients were examined with preoperative ultrasonography (USG), and the absence of pericholecystic fluid and dilated extrahepatic biliary tract was radiologically confirmed.

Data including demographic characteristics of the patients such as age, sex, and body mass index (BMI), and intraoperative data cystic duct dissection time, cystic artery dissection time, and intraoperative bleeding amount were recorded.

Surgical procedure

Standard LC was performed. In the operating room, the optimal Calot's triangle dissection technique for the patient was selected based on the discretion of the surgeon. Patient's divided into two groups. In Group 1, after inserting laparoscopic tools via the ports, the gallbladder was lifted and the cystic duct was identified by lifting the infundibulum of the gallbladder from the liver bed and dissecting the peritoneum anteriorly along medial to the lateral surface of the Hartmann's pouch (regular right-sided dissection of the Calot's triangle). The most optimal cystic duct exposure was obtained by retracting it anteriorly and superiorly. Different from the classical approach, in Group 2, the peritoneal dissection started from the posterior side of the cystic duct toward the cystic artery along lateral to the medial surface of the Hartmann's pouch (left-sided dissection of the Calot's triangle). The gallbladder was enucleated from its fossa after isolation, ligation, and dividing the cystic duct and artery and, then, the specimen was removed from the abdomen via the umbilical port. Due to the risk of abdominal wall bleeding, the ports were retrieved under the guidance of a camera. The fascia was closed where necessary to prevent incisional hernia.

The patients were operated by experienced surgeons who had experience with more than 200 LC procedures. In addition, all surgeons performed at least five left-sided Calot's triangle dissection before.

During surgery, cystic duct and cystic artery dissection times were measured using a digital chronometer. Surgeons performed standard antegrade dissection of the gallbladder from the fossa vesica biliaris subsequent to the cystic duct and artery ligation; therefore, total time of the procedure was unable to be recorded.

Intraoperative blood loss was classified into five groups through visual evaluation: no bleeding in case of less than 1 cc blood loss, minimally bleeding in case of 1-5 cc blood loss, mild blood loss in case of 6-15 cc blood loss, moderate bleeding in case of 16-25 cc blood loss, and severe bleeding in case of more than 25 cc blood loss during the dissection.

Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 21.0 (IBM Corp, Armonk, NY, USA). As the sample number of each group was >50, normality was analyzed using the Kolmogorov-Smirnov test. Descriptive data were expressed in mean ± standard deviation for normally distributed data and in median, min-max

values and percentage for non-parametric data. Parametric values were compared using the Student t-test, while non-parametric values were evaluated using the Mann-Whitney U test. The homogeneity of variances for the Student t-test was analyzed by the Levene's test. The chi-square test with the Yates continuity correction was used to compare categorical variables. An alpha (α) value of 0.05 and a p value of <0.05 were considered statistically significant.

Results

Of a total of 120 patients, 32 (26.7%) were males and 88 (73.3%) were females. The overall mean age was 51.36±16.19 (IQR=18-87) years. The mean age of Group 1 and Group 2 was 54.36±16.29 years and 48.36±15.66 years. The overall mean BMI was 25.98±3.06 kg/m2. The mean BMI was 26.44±2.33 kg/m2 in Group 1 and 25.66 (IQR=20.32-39.12) kg/m2 in Group 2. There was a statistically significant difference in the age and BMI values between the groups (p=0.042; p=0.024, respectively) (Table 1).

On the other hand, we found no statistically significant difference in the Calot's triangle dissection times between the groups (p=0.122 and p=0.075, respectively). The median cystic duct and cystic artery dissection times were 308.00 (IQR=68-927) sec and 403.50 (IQR=98-1045) sec, respectively. In Group 1, these values were 347.90±186.33 and 469.73±225.02 sec for cystic duct and cystic artery dissection, respectively. In Group 2, the median cystic duct and cystic artery dissection times were 285.50 (IQR=68-927) sec and 389.50±143.28 sec, respectively (Table 1).

None of the patients experienced severe (>25 cc) blood loss during the Calot's triangle dissection. The intraoperative blood loss amounts are summarized in Table 2. There was no statistically significant difference in the intraoperative blood loss amount between the groups (p=0.852).

In addition, none of the patients developed early major complications such as massive bleeding requiring re-laparotomy or biliary fistulas. Only in one patient (0.8%), superficial surgical site infections developed and were treated with oral amoxicillin-clavulanate antibiotherapy.

Discussion

In the literature, several techniques have been described to reduce the complications such as intraoperative BDI and bleeding during dissection of the Calot's triangle, which is the critical step of LC. In difficult open and LC cases, subtotal excision of the gallbladder has been used as a secure option, particularly in the event of fibrosis or severe inflammation. Using this method, the wall of the gallbladder is partially left through the liver bed, right side of the hepatic hilum or common hepatic duct [10-12]. Additionally, intraoperative cholangiography has been used as one of the important methods to prevent the structural injuries [13-15]. In a report of Kato et al. [16], LC from fundus downward was introduced as a new preventive method. In this procedure, the peritoneum was initially divided from the inferior of gallbladder and extended to the neck. After enucleation of the gallbladder, the cystic structures were isolated, ligated, and divided.

In 1995, Strasberg et al. [2] introduced that surgeons should not clip and cut the cystic artery and duct before the Calot's triangle with the cystic artery duct dissected and identified completely and they identified "critical view of safety" (CVS). According to this technique, the infundibulum of the gallbladder is completely separated from the liver bed by dissections and all surrounding fatty and fibrous tissues in the Calot's triangle are removed to provide maximum visualization.

Table 1: Demographic characteristics and Calot's dissection times

		Group 1	Group 2	Total	p
Gender (n; %)	male	20 (33.3%)	12 (20.0%)	32 (26.7%)	[1] 0.074
	female	40 (66.7%)	48 (80.0%)	88 (73.3%)	
Age (year)		54.36±16.29 (25; 87)	48.36±15.66 (18; 83)	51.36±16.19 (18; 87)	[2] 0.042
BMI (kg/m²)		26.44±2.33 (21; 31,95)	25.66 (20.32; 39.12)	25.98±3.06 (20.32; 39.12)	[3] 0.024
Cystic duct dissection time (second)		347.90±186.33 (72; 853)	285.50 (68; 927)	308.00 (68; 927)	[2] 0.122
Cystic artery dissection time (second)		469.73±225.02 (98; 1045)	389.50±143.28 (115; 760)	403.50 (98; 1045)	[2] 0.075

[1] Chi-square (Fisher exact) test, [2] Student –T Test, [3] Mann-Whitney Test

Table 2: Intraoperative blood loss amount

		Group 1	Group 2	Total	p [1]	
Peroperative bleeding (n; %)	none	37 (61.7)	35 (58.3%)	72 (60.0%)	No hemorrhage	0.852
	minimally	16 (26.7)	19 (31.7%)	35 (29.2%)	Hemorrhage	
	mild	6 (10.0)	5 (8.3%)	11 (9.2)		
	moderate	1 (1.7%)	1 (1.7%)	2 (1.7%)		
	high	0 (0.0%)	0 (0.0%)	0 (0.0%)		

[1] Chi-square Test with Yates continuity correction

In addition, Vettoretto et al. [17] compared the critical view of safety technique with classical infundibular technique for hilar dissection. Despite the resemblance of biliary and hemorrhagic complications in both techniques, operation time was shorter and the method was simpler with the critical view of safety technique. In another study, Sekimoto et al. [8] described a new approach to visualize this triangular anatomical space more detailed and to prevent injury to the biliary and vascular structures. In this procedure, instead of the gallbladder fundus, the liver's lateral segment and quadrate lobe were initially retracted with a forceps which was placed from the lateral port for better exposure of the Calot's triangle during LC. However, in case of sagging gallbladder, this method can lead to poor field of vision [18].

Since early days of laparoscopy, the infundibular or infundibular-cystic method has been used for the dissection of gallbladder by by the surgeons. According to this technical approach, isolation of cystic duct is initially performed through the Calot's triangle dissection from the back and front side [19]. However, the hidden cystic duct, probably due to inflammation, may cause a false infundibulum view, thereby, accidentally leading to misdiagnose the common hepatic duct as the cystic duct [19].

In a study, Kunasani and Kohli [20] suggested that, in the Calot's area dissection, enlarged cystic lymph nodes which are common manifestations in patients with cholecystitis, could be used as a landmark. The risk of BDI could be reduced by the lateral approach to this tissue during dissection. However, in these patients, lymph node dissection may cause bleeding. In our study, we also attempted to prevent the blurry and distorted view of the dissection area due to bleeding caused by lymph node dissection at the beginning of surgery.

To prevent the common bile duct injury, another procedure was reported by Sari et al. [21]. In their method, first, the bile was aspirated from the gallbladder by puncturing with the Veress needle and, then, a small amount of diluted methylen blue was injected to the gallbladder to visualize the bile tree, including the cystic and common bile ducts, and safer LC was able to be performed. However, we consider that this method is time-consuming and may result in several complications, such as poor view of the dissection area and infections.

In another study, Wijsmuller et al. [22] demonstrated that isolating and dividing the cystic artery before the cystic duct increased the Calot's triangle area in LC. During surgery, this maneuver offered better visualization of the cystic duct and reduced the risk of BDI. Avgerinos et al. [23] also performed LC in about 1,000 patients using this technique and achieved quite satisfactory results. However, in more than 25 patients, the procedure was converted to open surgery due to bleeding, anatomical difficulties, firm adhesions, and severe inflammation. However, in difficult cases, the initial artery dissection and cutting may cause right hepatic artery injury and increase the morbidity.

Furthermore, in 2009, Almutairi et al. [24] described another new method to obtain more effective anatomical exposure. In this method called triangle of safety technique, the dissection initially starts from the gallbladder corpus and cystic artery is identified. Then, the dissection extends to the junction of cystic duct with infundibulum. Dissection of the duct is performed over the gallbladder corpus near this junction, and Calot's triangle is by-passed. This approach is considered to be more useful in the presence of vascular and ductal variations and to prevent probable injuries [24]. In general, the right-handed surgeons start to the dissection of the Calot's triangle from the point of cystic artery and medial side of the gallbladder.

In 2011, Hannan et al. [25] described a new method to avoid injury and complications in pediatric patients who underwent LC by sparing the cystic artery. In this technique, the dissection was performed using the hook cautery from distal to lymph with no-touch-technique to the cystic artery, and the Calot's triangle was exposed.

For the exposure of the Calot's triangle clearly, the energized (ultrasonic scalpel, electric coagulation and monopolar electrosurgery) and cold (blunt and sharp) dissections are commonly used in LC (1). As a different method, Ohashi et al. [26] used a special surgical brush to perform safer and rapid exposure of the Calot's triangle. In addition, Cai et al. [1] presented the blunt dissection technique and its results in their single-center study. The authors provided the exposure of the Calot's triangle by flush and aspiration, and they concluded that this method could avoid biliary structures-related complications in LC cases.

Although there is no common consensus on dissection technique of the Calot's triangle in LC, medial to lateral dissection is frequently used and surgical residents are trained in this field in Turkey. Therefore, the majority of surgeons consider that lateral to medial dissection is time-consuming and probably leads to more complications, including iatrogenic ductal and vascular injuries. However, in certain cases, an alternative approach may be required. In our study, we found no statistically significant difference in the intraoperative bleeding and dissection times between the groups.

To the best of our knowledge, there is no study in the literature in which the intraoperative results of medial to lateral and lateral to medial dissections were compared. For experienced surgeons, less than 5 LC procedures performed by using the left-sided Calot's triangle dissection technique would be sufficient to complete their learning curve about this relatively undesired approach. We believe that this clinical and anatomical pilot study would be encouraging for surgeons to decide the most optimal approach in LC. In addition, we consider that this technique is useful and facilitator, particularly for residents by exploring and understanding the anatomy.

The major limitation of this study is the selection of the patients. To ensure the homogeneity of the study, very strict exclusion criteria were applied. However, it was difficult to estimate the efficacy of left-sided dissection technique in complicated patients who were scheduled for LC. Nevertheless, this is a necessity to rule out other factors which may influence the dissection time, such as adhesions due to acute or chronic cholecystitis and/or previous upper abdominal surgery. In this regard, strict exclusion policy could not be considered as a complete study limitation. In the light of the promising results of this pilot study, we plan a further, large-scale study including a higher number of consecutive patients.

Another limitation of the study is the statistical difference in the age and BMI values of the patient groups. However, we believe that age and BMI would not influence the study results, considering the advanced surgical experience of the authors in LC.

In conclusion, extrahepatic biliary tree shows many anatomical variations, and it is an absolute necessity to recognize and dissect the Calot's triangle during surgery to avoid iatrogenic injuries. Therefore, surgeons should be familiar with normal Calot's triangle anatomy, from both left and right side, and be ready to the potential anatomical variations of this special area. Our study results suggest that this technique can be safely performed in an acceptable time in LC patients. It also appears to be a safe alternative option for residents, left-handed surgeons, and patients with biliary and vascular abnormalities.

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