ORIGINAL ARTICLE

Fundus-first technique and partial cholecystectomy for difficult laparoscopic cholecystectomies

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ABSTRACT

BACKGROUND: This study aims to evaluate the impact of conversion from retrograde dissection to fundus-first technique (FF) or laparoscopic partial cholecystectomy (LPC) on complication rates, operation time, and duration of hospitalization.

METHODS: The medical records of 210 consecutive patients who underwent laparoscopic cholecystectomy between January 2010 and December 2014 were retrospectively evaluated. All laparoscopic cholecystectomies were initiated with retrograde dissection (RD). In cases of difficulty in dissection of critical view of safety , the operation strategy was first converted to FF and then to LPC when FF was considered insufficient for safe cholecystectomy.

RESULTS: Of the 210 cases, LC was initiated and completed with RD in 197 cases. FF was implemented in 13 cases due to difficulties in dissection. In the FF group, laparoscopic total cholecystectomy was successfully accomplished in seven patients, and LPC was performed in the remaining six cases. Three postoperative complications occurred in the RD group and two in the LPC group. No major intraoperative complications or perioperative mortality occurred in any patients.

CONCLUSION: In elective, noncomplicated cases, the safe posterior window (critical view of safety) principle should be implemented. However, in complicated cases where anatomic uncertainties are dominant, the performance of FF technique or LPC may decrease conversion rates to open surgery and contribute to accomplishing the laparoscopic intervention safely.

Keywords: Anterograde dissection; difficult cholecystectomy; fundus-first; laparoscopy; partial cholecystectomy; retrograde dissection.

INTRODUCTION

Laparoscopic cholecystectomy (LC) was first introduced by Eric Muhe through a direct-view laparoscope without any camera monitor imaging system in 1985.[1] In the mid-1990s, Kato et al.[2] reported that the gallbladder could be successfully separated from the cystic bed via dissection of the Calot's triangle. Since then, the retrograde approach has become widely used by surgeons throughout the world, and LC became the standard treatment for gallstone disease and acute cholecystitis.

In the setting of difficult dissection of Calot's triangle during LC, the risk of severe complications and the rate of conversion to open surgery increases. Although conversion to open surgery is not considered as a failure, it is clear that it eliminates the advantages of laparoscopy and lengthens the time of recovery and does not always provide a better view of the anatomy.[3] In the era of minimally invasive surgeries, junior surgeons, in particular, do not have enough experience with the open approach. This may lead to more serious bile duct injuries, such as transsection or resection of the common bile duct (CBD).[4]

The fundus-first (FF) technique (dome down, antegrade dissection) and laparoscopic partial cholecystectomy (LPC) decreases the rate of major complications and conversion rate

in cases with difficult dissection of the cystic duct and cystic artery.[5,6] This study aims to evaluate the effects of conversion from RD to FF or LPC on complication and conversion rates to open surgery in cases of difficult laparoscopic cholecystectomies.

MATERIALS AND METHODS

The medical records of 240 consecutive patients who underwent LC for cholelithiasis and cholecystopathy between January 2010 and December 2014 in a tertiary reference center were retrospectively evaluated. All laparoscopic cholecystectomies were initiated with a retrograde dissection (RD). In cases of difficulty in dissection or inability in clearly identifying the cystic pedicle components, the operation was continued using the FF approach. Patients who underwent LC in addition to other abdominal operations and/or underwent primary open surgery due to additional medical conditions were excluded from the study. Urgent conversions (hemorrhage or suspicious of malignancy) to open surgery were also excluded. The patients who underwent LC with RD or FF technique were defined as the RD or FF groups, respectively. Demographic data, indications for surgery, intraoperative findings, and the rate of complications were analyzed in these two patient groups.

All procedures performed in the study involving human participants were in accordance with the ethical standards of the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Written and informed consent was obtained from each patient before surgery. Ethics committee approval was not required because the study had a retrospective design.

Surgical Technique

A 30-degree telescope and a high-definition camera monitor were used as standard in all cases, and the operations were performed with four ports. Antibiotics (ampicillin/sulbactam 1000 mg) were prophylactically administered at the induction of anesthesia. After hanging the gallbladder fundus in the cephalic direction with the grasper, the dissection was started from the Calot's triangle. In accordance with the "critical view of safety" method,[7] the underlying fatty tissue and fibrous tissue were dissected by first opening the serosa on the posterior face of Calot's triangle and then on the anterior face. Near the infundibulum, the cystic duct and cystic artery were separated in such a way that it allowed the appearance of only these two structures. The cystic artery and biliary duct were then clipped at the proximal and distal ends and were divided. The gallbladder was separated from the liver bed with a RD using a hook, spatula, or scissors connected to an electrocautery device. After ensuring hemostasis of the liver bed, the gallbladder was removed from the abdomen through the port, where a 10-mm clip gun was used.

In cases where the Calot's triangle could not be identified

clearly enough with the RD method, the FF technique was used as an early step of the operation. In the anterograde approach, the dissection continued from the fundus up to the infundibulum. The gallbladder was dissected from the liver bed using an electrocautery device. For retracting the liver, a part of the peritoneum was left on the liver bed for holding and hanging the liver. In cases where the cystic artery and biliary duct were safely identified, these structures were divided after clipping. However, if access to the Calot's triangle could not be safely achieved due to fibrosis or inflammation, LPC was performed by excising a part of the gallbladder and its content from a safe margin. All stones and debris were carefully removed, and suction/irrigation was repeated until all stones and debris were removed. The infundibular stump was closed with approximation of the surrounding tissues, or it was left open in case there was no suitable tissue for approximation. In cases where the posterior wall of the gallbladder was difficult to separate from the liver bed and the bladder pedicle components were not accessible, the posterior wall of the bladder was partially left *in situ* and a partial cholecystectomy was performed. The mucosa of the remaining posterior wall was cauterized. A drain was placed in the subhepatic region in all patients who underwent cholecystectomy by the FF technique or LPC.

Statistical Analysis

Statistical analysis was performed using SPSS version 16.0 (SPSS, Chicago, IL, USA). Continuous variables were calculated as mean±SD, and compared using the Mann–Whitney U test. $P<0.05$ was considered statistically significant

RESULTS

Of the 240 patients who underwent cholecystectomy, 30 patients were excluded who underwent LC simultaneously with another abdominal operation during the same session or had primary open surgery due to additional medical conditions (n=27), were converted to open surgery due to hemorrhage from the liver bed (n=2), or were intraoperatively suspected of having gallbladder malignancy (n=1). Therefore, 210 patients were included in this study.

All 210 dissections were initiated with RD. A total of 197 operations (93.8%) were completed with RD and 13 (6.2%) with the FF technique. Of the 13 patients who underwent the FF technique, LPC was performed in six.

The mean age of the two groups was similar in the RD and FF groups; however, the male ratio was higher in the FF group. The mean duration of operation was significantly shorter in the RD group than in FF group (46.12±5.98 vs. 87.00±34.25, p<0.001). The mean duration of hospitalization was also significantly lower in the RD group than in the FF group (1.28±0.56 vs. 2.76±2.48, p<0.001) (Table 1).

In the FF group, the main reason for converting from RD to

Table 1. Patient and operative characteristics for retrograde dissection and fundus-first groups

	Retrograde dissection group	Fundus-first technique group	p
Age, years (range)	44.29±13.36 (18–72)	42.38±6.27 (36–58)	0.36
Sex (female/male)	150/47	7/6	<0.05
Duration of surgery, min (range)	46.12±5.97 (30–65)	87.00±34.25 (55–145)	<0.001
Duration of hospitalization, days (range)	1.28±0.56 (1–3)	2.76±2.48 (2–11)	<0.001

FF was the inability for safe surgical dissection at the Calot's triangle due to dense fibrotic tissue in 11 patients who had either chronic (n=8) or acute (n=3) cholecystitis. In the remaining two patients in the FF group, FF was preferred because of intraoperative suspicion of anatomic variation at the Calot's triangle. In the FF group, laparoscopic total cholecystectomy was successfully achieved in seven patients, whereas LPC was performed in the remaining six patients. Of these six patients, safe dissection at the Calot's triangle could not be achieved because of unclear anatomy due to chronic cholecystitis in four patients and suspicion of anatomic variations in two. In the six patients who underwent LPC, the infundibular stump of the gallbladder was oversewn using a 3/0 PDS in four. In the remaining two patients with LPC, the gallbladder stump could not be sewn because the surrounding tissues were fragile and no bile leakage was observed intraoperatively. In one case, the liver was very friable and vulnerable to bleeding; therefore, the posterior wall of the gallbladder was partially left *in situ* and the mucosa was cauterized. In the RD group, intraoperative gallbladder perforation during surgical manipulation occurred in 10 (4.8%) patients.

In the whole group, postoperative complications occurred in five (2.4%) patients. The complication rates were significantly higher in the FF group than in the RD group [15.4% (2/13) vs. 1.5% (3/197), p<0.001].

Postoperative complications were observed in three (1.4%) patients in the RD group. The first patient, a woman aged 31 years, developed extrahepatic bile duct obstruction postoperatively. No calculi or obstructions were detected in the choledochus on magnetic resonance cholangiopancreatography (MRCP), which was performed twice. The patient underwent diagnostic endoscopic retrograde cholangiopancreatography (ERCP), and a stone was removed from the distal choledochus. The patient was discharged after ERCP without any problems. The second patient, a man aged 55 years with diabetes, underwent LC 6 days after an acute cholecystitis attack. The patient was discharged on the 1st postoperative day after drain removal. He was readmitted to the emergency room with abdominal pain and fever 7 days after LC. Abdominal ultrasonography revealed an infected hematoma at the subhepatic region. Percutaneous abscess drainage and antibiotic therapy were applied and the patient was discharged 1 week later without any symptoms. The third patient was

an obese woman aged 35 years who developed port-site infection postoperatively. Incisional hernia at the port site occurred in this patient and primary repair of the hernia was performed 3 months after the operation.

Postoperative complications occurred in two patients in the FF group. The first patient, aged 44 years, developed biliary fistula after the operation. This patient had undergone LPC and the infundibular stump had not been oversewn due to the fragility of the surrounding tissues. The fistula persisted with a flow of 300 cc/day for 7 days. MRCP showed leakage from the gallbladder stump. He underwent endoscopic papillotomy and stent application, which resulted in complete recovery of the fistula, and the patient was discharged following drain removal 11 days after surgery. The second patient, a woman aged 42 years, presented with jaundice 2 years after the operation. MRCP revealed extrahepatic bile duct obstruction due to a retained stone at the distal choledochus. Endoscopic papillotomy was performed and the stone was successfully removed. No major intraoperative complications or perioperative mortality occurred in all patients.

DISCUSSION

Laparoscopic cholecystectomy is the gold standard treatment for symptomatic cholelithiasis[8–11] and protecting vascular and biliary structures is essential during LC. LC can be difficult, even for experienced surgeons, when severe fibrosis and sclerosis at the Calot's triangle prohibit safe surgical dissection. In such cases, most surgeons consider conversion from laparoscopic to open surgery. It is generally accepted that conversion to open surgery during cholecystectomy should not be considered as failure and it can be performed for the safety of the operation when needed. However, conversion to open surgery loses the advantages of laparoscopic surgery such as the magnification offered by camera, better exploration than subcostal incision, and faster and more comfortable postoperative recovery. In cases of difficulty in dissection and inability in determining the biliary duct and/or cystic artery, the option of FF and LPC should be considered before conversion.

The conversion rates to open surgery during LC range between 1% and 24%.[12–15] The conversion rate can be as high as 44% during LC in patients with acute gangrenous cholecystitis.[16] The use of FF and LPC techniques during difficult cases can avoid conversion to open surgery. In the study of Mah-

mud et al.,[17] the conversion rate to open surgery decreased from 5.2% to 1.2% with the use of FF technique. Gupta et al.[18] reported that the use of FF technique decreased the conversion rate from 18.8% to 2.1% in patients with chronic cholecystitis. In a recent review, it was reported that partial cholecystectomy and the FF technique resulted in decreased rate of complications[19] On the other hand, the FF technique can be hazardous in cases with thickened and shortened cystic plate due to inflamed gall bladder, and vasculobiliary injuries can occur because of the proximity of the right portal pedicle and bile duct in such patients.[20]

The FF technique might pose some technical difficulties during LC. Retracting the liver can be difficult during cholecystectomy when using the FF technique. Therefore, we preferred to leave a part of peritoneum on the liver bed for retraction to overcome this problem. The other limitation of the FF technique is the blood staining of the operative field in case of bleeding. The flow direction of the bleeding is to the opposite site of dissection direction in RD, whereas blood flows directly to the dissection field in the FF technique. Attentive hemostasis is crucial to avoid blood staining of the dissection field. In our study, the use of FF technique instead of RD was decided during the early stages of the operations, when RD was considered to be insufficient for safe dissection in difficult cases. The FF technique was used in 6.2% of our patients, and 2.8% of the patients underwent LPC.

Partial cholecystectomy might be considered as another surgical option for cholecystectomy during laparoscopy before deciding to proceed with open cholecystectomy. In a systematic review and meta-analysis, it was reported that partial cholecystectomy resulted in lower rates of common bile duct injury, but more frequent postoperative minor complications in difficult cholecystectomies.[6] Kulen et al.[21] analyzed the data of 80 patients with cholelithiasis who underwent LPC (n=40) and conversion cholecystectomy (n=40). The authors reported that no patients in the LPC group suffered from late complications; however, the rate of late complications was 32.5% in the conversion cholecystectomy group. Subhepatic collection, biliary fistula, and residual bile duct stones constituted the most frequent complications after LPC.[6,21] Palliative or minimally invasive techniques such as percutaneous drainage and ERCP are the most efficient treatments for such complications following LPC.[22] The incidence of postoperative ERCP after LPC was reported as 4.1%, and the most common indications for ERCP after LPC were retained stones (59%) and bile leakage (31.5%).[6] In our study, postoperative ERCP was performed in two of the six patients who underwent LPC. The indications for ERCP were postoperative biliary leakage and retained bile duct stone in these patients. Both patients did well after appropriate endoscopic intervention with no further morbidity. The complication rate in the patients who underwent LPC was high (33%) in our study, which was probably due to the relatively small number of such patients. It is well-known that the rate of wound infection,

bile leaks, CBD injury, and cardiopulmonary complications is lower in LPC than in open surgery.[22] Also, the median duration of hospitalization in open surgery is 3–10 days;[23–26] our median duration of hospitalization was 3.25 days (2–11 days).

The use of RD or FF technique might affect the duration of surgery. In our study, the duration of operation was longer in the FF group than in the RD group. Neri et al.,[5] reported that the mean duration of surgery was 70 min and 90 min with the use of FF and RD technique, respectively. However, in their series, the FF technique was not used as an alternative method before converting to open surgery instead the dissections initially began with the "fundus-first" method, which was different from our study. Contrary to our findings, the authors found that the operation duration was longer in the RD group than in the FF group. We used the FF technique in difficult cases when RD was considered unsafe for further dissection during surgery; therefore, the operative time was found to be longer in the FF group in our patients.

This study has some limitations. This was a retrospective study with small sample size, and follow-up evaluation was lacking in most of the cases without complication.

The general approach in difficult cholecystectomy is performing LPC or conversion to open approach. In our study, we performed the FF technique before proceeding with LPC. We accomplished successful cholecystectomy in more than 50% (7/13) of the operations using the FF approach and avoided the potential complications of LPC in these patients. In the remaining patients (6/13), LPC was performed with an acceptable rate of minor complications.

Conclusion

The protection of the main vascular and biliary tract structures is essential to perform a safe LC. Risk factors can be predictive for difficult cholecystectomy and surgeons with inadequate experience should be aware of potential complications. In the event of difficult cholecystectomies, safer options such as the FF technique and LPC should be determined by the experience of surgeon in complex biliary surgery before converting to open surgery. It should be kept in mind that difficult cases in LC may be aggravating even in case of open surgery. Nevertheless, it should be considered that conversion to open surgery is not a complication. In cases where the exploration cannot be performed safely, or in cases such as hemorrhage where open surgery is considered safer, one should not hesitate to convert to open cholecystectomy. The desire to complete the operation must not prevent finishing the procedure safely.

Conflict of interest: None declared.

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ORİJİNAL ÇALIŞMA - *ÖZET*

Zor kolesistektomiler için teknik çözümler: Fundus-first tekniği ve parsiyel kolesistektomi

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AMAÇ: Bu çalışmanın amacı, retrograd diseksiyondan (RD) fundus-first (FF) tekniğine ya da laporoskopik parsiyel kolesistektomiye (LPK) geçişin komplikasyonlar, ameliyat süresi ve hastanede kalış süresi üzerine etkisini değerlendirmektir.

GEREÇ VE YÖNTEM: Ocak 2010–Aralık 2014 tarihleri arasında laparoskopik kolesistektomi (LK) yapılan 210 hastanın tıbbi kayıtları geriye dönük olarak incelendi. Tüm LK'lere RD yöntemiyle başlanıldı. Güvenlik penceresinin diseksiyonunda zorluk yaşanması durumunda operasyon ilk olarak FF tekniğine geçildi. Fundus-first tekniğinin de güvenli bir kolesistektomi için yetersiz kaldığı durumlarda ise LPK tercih edildi.

BULGULAR: Laparoskopik kolesistektomi ile başlanan 210 olgunun 197'si RD ile sonlandırıldı. On üç olguda diseksiyon sırasındaki zorluklar nedeniyle FF tekniği uygulandı. Fundus-first grubunda yedi olguda laparoskopik total kolesistektomi başarıyla gerçekleştirildi, geri kalan altı hastada LPK uygulandı. Ameliyat sonrası RD grubunda üç komplikasyon, LPK grubunda iki komplikasyon saptandı. Tüm olgular değerlendirildiğinde majör intraoperatif komplikasyon ve peroperatif mortalite görülmedi.

TARTIŞMA: Elektif ve komplikasyonsuz olgularda güvenli posteriyor pencere (güvenlik penceresi) prensibi uygulanmalıdır. Ancak anatomik belirsizliklerin ön planda olduğu komplike olgularda RD tekniğinde ısrarcı olmamak ve FF ya da LPK tekniklerinden birini tercih etmek açık cerrahiye dönme oranlarını azaltır ve güvenli bir laporoskopik müdahale yapılmasını sağlar.

Anahtar sözcükler: Antegrad diseksiyon; fundus-first; laparoskopi; parsiyel kolesistektomi; retrograde diseksiyon; zor kolesistektomi.