Original Investigation

Ulus Cerrahi Derg 2016; 32: 185-190

DOI: 10.5152/UCD.2015.3086

Laparoscopic partial cholecystectomy: A safe and effective alternative surgical technique in "difficult cholecystectomies"

Fatih Kulen, Deniz Tihan, Uğur Duman, Emrah Bayam, Gökhan Zaim

ABSTRACT

Objective: Laparoscopic cholecystectomy has become the ''gold standard'' for benign gallbladder diseases due to its advantages. In the presence of inflammation or fibrosis, the risk of bleeding and bile duct injury is increased during dissection. Laparoscopic partial cholecystectomy (LPC) is a feasible and safe method to prevent bile duct injuries and decrease the conversion (to open cholecystectomy) rates in difficult cholecystectomies where anatomical structures could not be demonstrated clearly.

Material and Methods: The feasibility, efficiency, and safety of LPC were investigated. The data of 80 patients with cholelithiasis who underwent LPC (n=40) and conversion cholecystectomy (CC) (n=40) were retrospectively examined. Demographic characteristics, ASA scores, operating time, drain usage, requirement for intensive care, postoperative length of hospital stay, surgical site infection, antibiotic requirement and complication rates were compared.

Results: The median ASA value was 1 in the CC group and 2 in the LPC group. Mean operation time was 123 minutes in the CC group, and 87.50 minutes in the LPC group. Surgical drains were used in 16 CC patients and 4 LPC patients. There was no significant difference between groups in postoperative length of intensive care unit stay (p=0.241). When surgical site infections were compared, the difference was at the limit of statistical significance (p=0.055). Early complication rates were not different (p=0.608) but none of the patients in the LPC group suffered from late complications.

Conclusion: LPC is an efficient and safe way to decrease the conversion rate. LPC seems to be an alternative procedure to CC with advantages of shorter operating time, lower rates of surgical site infection, shorter postoperative hospitalization and fewer complications in high-risk patients.

Keywords: Cholelithiasis, laparoscopic partial cholecystectomy, difficult cholecystectomy, conversion cholecystectomy, safe cholecystectomy, bile duct injury

INTRODUCTION

Laparoscopic cholecystectomy (LC) has become the gold standard for the surgical treatment of benign gallbladder diseases owing to its shorter hospitalization, more rapid recovery, and much fewer wound complications when compared to open cholecystectomy (1-4). However, a direct vision is essential for safe dissection of Calot's triangle - outlined by the cystic duct, right liver lobe, and the common hepatic duct-, which indicates the importance of a clear anatomical demonstration of the cystic duct and cystic artery to perform a safe cholecystectomy (5). While early on its routine application, LC was considered to be contraindicated in situations such as severe adhesions in Calot's triangle, acute cholecystitis, and cirrhosis, it is currently being applied successfully even in challenging cases due to introduction of novel techniques and increased experience (6).

Severe inflammation and fibrosis of the gallbladder may increase the risk of bleeding and biliary tract injury during Calot's triangle dissection (7). Open subtotal cholecystectomy has been used safely in patients at high-risk of bile duct injury due to disruption of natural anatomy due to severe fibrosis and inflammation (8). With improvements in laparoscopic techniques, laparoscopic partial cholecystectomy (LPC) has become an effective and safe method of decreasing the rates of conversion to open surgery (9, 10).

The quality of life improvement after LC is markedly better than open cholecystectomy (11). Laparoscopic completion of the procedure is recommended especially for the elderly since it is associated with lower incidence of pulmonary infection, reduced rates of postoperative complications and better quality of life (12, 13).

Our aim was to investigate the feasibility, effectiveness and safety of LPC in difficult cases of cholecystectomy.

MATERIAL AND METHODS

Clinical and operative data of 40 patients who underwent LPC and 40 patients in whom the operation initiated with laparoscopic technique has been converted to open surgery (conversion cholecystecto-

Clinic of General Surgery, Şevket Yılmaz Training and Research Hospital, Bursa, Turkey

Address for Correspondence
Deniz Tihan
e-mail: dtihan@yahoo.com

Received: 21.01.2015
Accepted: 16.02.2015
Available Online Date: 06.04.2016

Available online at
www.ulusalcerrahidergisi.org

my-CC) for symptomatic cholelithiasis without an associating malignancy were retrospectively investigated. The study included patients who were operated between January 2008 and January 2011. For standardization, all patients were operated by the same surgeon. In order to evaluate differences between procedures, 40 LPC and 40 CC cases were selected by a computerized randomization program out of the database including all patients who underwent laparoscopic partial cholecystectomy and conversion cholecystectomy.

The laparoscopic intervention was performed in the same manner in both groups using two 10-mm and two 5-mm trocars. All patients met the criteria of difficult cholecystectomy that was defined as the presence of phlegmonous gallbladder due to adherence of the colon and greater omentum or severe thickening of the gallbladder wall due to inflammation.

Laparoscopic partial cholecystectomy was defined as procedures where the posterior wall of the gallbladder was left in the hepatic bed. The triangle of Calot was exposed, and the cystic duct was ligated in all patients. Dissection was initiated at the fundus and advanced with a traditional retrograde dissection. Cauterization with an argon beam device was performed to the posterior gallbladder wall mucosa to prevent subhepatic fluid collection, and this part was left in place. All gallstones were extracted with a laparoscopic endobag. The intraperitoneal cavity was irrigated with sterile isotonic solution and the intraabdominal fluid collection was aspirated at the end of the procedure.

Conversion to open surgery was performed via a right subcostal incision in all CC patients. Demographic variables, ASA (American Society of Anesthesiology) scores, operation times, rate of drainage tube usage, length of intensive care unit and hospital stay, rates of surgical site infection, antibiotic requirement rate and complication incidence were compared between the two groups. Any complication occurring within the first month of surgery was defined as an "early complication".

Statistical Analysis

Statistical analysis were performed by Statistical Package for the Social Sciences version 20.0, (SPSS Inc; Chicago, IL, USA) software. The Shapiro-Wilk test was used to verify the normality of distribution. The Mann-Whitney U test and Student's T-test were used for intergroup comparisons. Chi-square test and Fisher's Exact test were used for comparison of categorical data. Results were evaluated within 95% confidence interval and $p<0.05$ was considered to be statistically significant.

RESULTS

The mean age was not significantly different between the two groups (p=0.541) (Table 1).

There was a significant difference between the two groups in terms of gender distribution (p=0.013). Female gender was more frequent in the CC group while male gender was more common in the LPC group (Table 2).

ASA scores were significantly different between the two groups (p=0.008). The median ASA score was 1 in the CC group and 2 in the LPC group. LPC patients were at higher operative risk (Table 3).

The mean operation duration was significantly different between two groups (p=0.001). The mean time of operation was 123 minutes in the CC group and 87.50 minutes in the LPC group (Table 4).

The rate of surgical drain usage was significantly different between two groups (p=0.005). Surgical drains were used in 16 CC patients and 4 LPC patients, and one subhepatic passive drain was inserted in all (Table 5).

There was no significant difference between the groups in terms of length of postoperative intensive care unit stay (p=0.241). Three patients in the CC group required a postoperative intensive care stay for one day. None of the patients in the LPC group required postoperative intensive care stay.

When surgical site infections were compared between groups, the difference was at the limit of statistical significance (p=0.055). None of the LPC patients and five CC patients developed surgical site infection. Rates of postoperative antibiotic use were not significantly different between the two groups (p=0.201) (Table 6).

Table 1. Age distribution between groups (p=0.541)

Group		n	Mean	SD
CC	Age	40	56.20	14.819
LPC		40	58.35	16.473

CC: conversion cholecystectomy; LPC: laparoscopic partial cholecystectomy; SD: standard deviation

Table 2. Gender distribution between groups (p=0.013)

Group		Gender		Total
		Male	Female	
CC	n	12	28	40
	%	30.0	70.0	100.0
LPC	n	24	16	40
	%	60.0	40.0	100.0
Total	n	36	44	80
	%	45.0	55.0	100.0

CC: conversion cholecystectomy; LPC: laparoscopic partial cholecystectomy

Table 3. Comparison of ASA scores between groups (p=0.008)

Group		ASA
CC	Median	1.00
	Minimum	1
	Maximum	3
LPC	Median	2.00
	Minimum	1
	Maximum	4

CC: conversion cholecystectomy; LPC: laparoscopic partial cholecystectomy; ASA: American Society of Anesthesiology

The mean postoperative length of hospital stay was significantly different between the two groups (p=0.001). The mean time of hospitalization was three days in the CC group and one day in the LPC group (Table 7).

Early complication rates were not significantly different between the two groups (p=0.608). Early complications were observed in three patients in the CC group and one patient in the LPC group. Two patients in the CC group underwent local wound exploration due to wound infection and pain. The remaining patient in the CC group was complicated by a postoperative paralytic bowel obstruction that resolved with conservative treatment. An early complication of postoperative anemia was observed in one LPC patient. Any identifiable cause of anemia was not present and the patient's condition improved with conservative treatment.

Late complication rates were significantly different between the two groups (p=0.001). None of the patients in the LPC group suffered from late complications whereas 13 patients in the CC group developed complications, all of which were incisional hernias (Table 8).

DISCUSSION

The laparoscopic technique has replaced open surgery and become the gold standard in cholecystectomy since its first introduction for gallbladder operations in the mid-1980s by Erich Mühe in Germany and Philippe Mouret in France (14). More than 770.000 laparoscopic cholecystectomies are being performed annually in the United States (15). Advantages of LC include rapid improvement in physical activity and quick return to normal life, short hospital stay, increased operative safety with magnified view, low morbidity rates, low cost, less tissue trauma, better cosmesis and less postoperative pain (16).

Rates of conversion to the open technique and iatrogenic injury are significantly higher in difficult cholecystectomies. Risk factors for difficult cholecystectomy include male gender, advanced age, acute presentation, thick-walled gallbladder with chronic inflammation, dilated and short cystic duct, gallbladder fistulas, previous history of upper abdominal surgery, obesity, cirrhosis, anatomic variation, cholangiocarcinoma and surgical inexperience (17). Application of subtotal cholecystectomy and retrograde dissection technique and usage of perioperative cholangiogram have decreased the rates of conversion to open technique (17, 18).

Open subtotal cholecystectomy has been used safely in patients who are at high risk of injury to the structures within the triangle of Calot due to severe fibrosis and inflammation (8).

Table 4. Comparison of operation times between groups (p=0.001)

Group		Operation times (min)
CC	Median	125
	Minimum	100
	Maximum	140
LPC	Median	87.50
	Minimum	80
	Maximum	105

CC: conversion cholecystectomy; LPC: laparoscopic partial cholecystectomy

Table 5. Comparison of drainage tube use between groups (p=0.005)

Group		Drainage tube		Total
		-	+	
CC	n	24	16	40
	%	60.0	40.0	100.0
LPC	n	36	4	40
	%	90.0	10.0	100.0
Total	n	60	20	80
	%	75.0	25.0	100.0

CC: conversion cholecystectomy; LPC: laparoscopic partial cholecystectomy

Table 6. Comparison of surgical site infection between groups (p=0.055)

Group		Surgical site infection		Total
		-	+	
CC	n	35	5	40
	%	87.5	12.5	100.0
LPC	n	40	0	40
	%	100.0	0.0	100.0
Total	n	75	5	80
	%	93.8	6.3	100.0

CC: conversion cholecystectomy; LPC: laparoscopic partial cholecystectomy

Table 7. Postoperative length of hospital stay (p=0.001)

Group		Postoperative length of hospital stay (days)
CC	Median	3
	Minimum	2
	Maximum	20
LPC	Median	1
	Minimum	1
	Maximum	4

CC: conversion cholecystectomy; LPC: laparoscopic partial cholecystectomy

Table 8. Comparison of late complications between groups (p=0.001)

Group		Late complications		Total
		-	+	
CC	n	27	13	40
	%	67.5	32.5	100.0
LPC	n	40	0	40
	%	100.0	0.0	100.0

CC: conversion cholecystectomy; LPC: laparoscopic partial cholecystectomy

By the advances in laparoscopic technique, it was noted that LPC decreased the rates of biliary tract injuries and of severe hepatic bed hemorrhages, and provided a marked decrease in the rates of conversion to open surgery in patients with benign cholecystitis (1, 6, 9, 10).

Advanced age was evaluated as a risk factor for difficult cholecystectomy (19, 20). Studies suggested that LC was safe, did not increase complication rates, shortened the time of hospitalization, and was associated with a marked improvement in the quality of life for the elderly. Surgeons were recommended to complete an operation in the laparoscopic setting as much as possible in patients with advanced age (12, 21-25). In our study, the mean age did not significantly differ between the two groups. The mean age was 56.20 in the CC group and 58.35 in the LPC group. Both CC and LPC patients were in the difficult cholecystectomy group in terms of their ages.

Male gender was also evaluated as a risk factor for difficult cholecystectomy (26). Male sex was reported among the risk factors for conversion to open surgery in some previous studies (27-30). In our study, male gender was significantly more frequent in the LPC group. Combining facts that male gender is a risk factor for difficult cholecystectomy and that conversion to open surgery is more prevalent in the male population, LPC technique is likely to decrease the rate of conversion to open surgery and seems to be a safe option for men. Al-Mulhim et al. (31) reported that male gender did not cause an adverse impact on LC outcomes. In our study, LPC technique was successfully performed in the treatment of difficult cholecystectomy in both male and female patients.

In high-risk patients, LC seems to be a better option than open cholecystectomy concerning overall mortality (31, 32). Frazee et al. (33) suggested that LC was associated with improvement in pulmonary function when compared to the open technique. Mimica et al. (34) reported that the open technique was associated with a higher risk of anesthesia-related complications in the postoperative period as compared to LC. Koivusalo et al. (35) reported that pneumoperitoneum was not associated with an additional risk in ASA III and ASA IV elderly patients during LC. Luo et al. (36) concluded that LC is beneficial for restoration of stress hormones, nitrogen balance, and energy metabolism but that it may also cause acidemia and pulmonary hypoperfusion due to pneumoperitoneum. In our study, ASA scores were significantly different between the groups, the LPC group consisted of higher risk patients. Anesthesia-related complications were not observed in the LPC group whereas such complications occurred in 3 patients in the CC group who required an intensive care unit stay.

Patients that meet the definition of difficult cholecystectomy were older and in the high-risk group (5-8). Therefore, it is important to shorten the duration of operation to reduce anesthesia-related complications. In previous studies, mean operation times were ranging from 53.60 to 95 minutes (1, 5-7). In our study, the mean operation time was 87.50 minutes. Laparoscopic partial cholecystectomy was compared with LC in studies performed by Ersöz et al. (6) and Ji et al. (7). However, we suggest that LPC should not be considered as an alternative to LC, and that it should be rather regarded as an alternative to the open technique. We believe that LPC would not be required in cases where total LC is possible in the standard fashion except for occasional cases with a risk of bleeding in which the gallbladder is embedded into the hepatic bed. In our study, LPC was considered as an alternative to the CC technique. Thus, conversion to open procedure was not required in the LPC group. Moreover, the mean operation duration was significantly different between the two groups. The average time of surgery was shorter in the LPC group, and this provided additional benefit for at-risk patients due to difficult cholecystectomy.

Previous studies demonstrated that use of surgical drains after cholecystectomy had no benefit for the patient (37-39). Tzovaras et al. (37) found no difference in mortality, morbidity and hospital stay between patients in whom drains were and were not used. However, they concluded that postoperative pain was significantly lower in patients in whom drains were not used. In a prospective randomized trial (39), Lewis et al. (39) concluded that usage of drainage tubes was not necessary in elective cholecystectomy. Moreover, in a prospective randomized trial including 479 patients Monson et al. (38) suggested that usage of drainage tubes should be abandoned since the incidence of wound infections, pulmonary infections, subhepatic fluid collection and length of hospitalization were higher in the drainage group. In a review of six patients, Gurusamy et al. (40) concluded that wound infection rates and hospital length of stay were higher in patients with drainage tubes. In our study, drainage tubes were used in 16 CC patients and 4 LPC patients. Usage of drainage tubes was significantly different between the two groups. LPC technique decreased the need for surgical drain usage and prevented patients from harmful effects of their unnecessary use.

Wound infection was also found to be lower in the LPC group ($p=0.55$). According to 2003 National Nosocomial Infections Surveillance System report that included 54,504 cases of cholecystectomy, LC was associated with a lower risk of surgical site infection when compared with open cholecystectomy (15). In our study, postoperative antibiotic usage was not significantly different between the two groups ($p=0.201$). In a review of 11 clinical trials, Sanabria et al. (41) found no significant difference regarding surgical site infection and antibiotic use. In our study, surgical site infection was not encountered in the LPC group while it occurred in 5 CC patients. The difference between groups was at the limit of statistical significance ($p=0.055$). This finding was considered likely to be due to the decrease in surgical site infection because of reduced requirement for converting to the open technique during LC.

Several reports suggested that postoperative hospital stay was significantly shorter in LC series when compared with CC series (2, 4, 22, 42-44). Ivatury et al. (45) concluded that postoperative stay after LC was associated with ASA score. In our study, although ASA values were higher in the LPC group, their postoperative stay was significantly lower than the CC group. This condition makes LPC technique more advantageous by providing a shorter postoperative stay in high-risk patients.

Complications are more common after open cholecystectomy than laparoscopic procedures, particularly at the site of incision (4, 22, 46, 47). Brune et al. (20) observed that the rate of incision site complications was higher after CC when compared to LC, and they showed that this was related to the size of the

incision. In addition, Lim et al. (42) reported the rate of incision site complications to be significantly higher in the CC group. In our study, late complications were not observed in the LPC group. Incision site complications were significantly higher in the CC group, which may be considered as another issue that makes LPC more advantageous.

Although postoperative bile leak was detected in the studies by Henneman et al. (48) and Kaplan et al. (49), we did not observe any bile leak in our study. We were able to ligate the cystic duct in each and every patient; however, ligation is not indispensable. Persistent bile leak may occur, but biliary drainage will decrease and cease with time with postoperative endoscopic sphincterotomy that reduces the intraluminal biliary tract pressure (48).

Study Limitations

The major limitation of this study was its retrospective nature. Randomized controlled trials in larger series are needed to achieve accurate results.

CONCLUSION

With advances in laparoscopic technique, LPC has become an effective and safe method for decreasing the rates of conversion to open surgery in patients with benign gallbladder disease and difficulties during their operations. In this preliminary study, we suggest that LPC is a good and safe alternative to CC due to its shorter operation duration, a lower rate of surgical site infection, shorter length of postoperative hospital stay, and lower incidence of postoperative complications.

Ethics Committee Approval: Ethics Committee approval was not required as the study was retrospective.

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - F.K., D.T.; Design - D.T., A.D.; Supervision - D.T., A.D., M.P.; Resources - F.K., D.T., U.D.; Materials - U.D., G.Z.; Data Collection and/or Processing - D.T., U.D., G.Z.; Analysis and/or Interpretation - F.K., D.T., U.D.; Literature Search - E.B.; Writing Manuscript - F.K., D.T., U.D.; Critical Review - E.B., A.D., M.P.; Other - E.B., G.Z.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

REFERENCES

1. Tian Y, Wu SD, Su Y, Kong J, Yu H, Fan Y La. Laparoscopic subtotal cholecystectomy as an alternative procedure designed to prevent bile duct injury: Experience of a hospital in Northern China. Surg Today 2009; 39: 510–513. [CrossRef]
2. Jatzko GR, Lisborg PH, Perti AM, Stettner HM. Multivariate comparison of complications after laparoscopic cholecystectomy and open cholecystectomy. Ann Surg 1995; 221: 381–386. [CrossRef]
3. Velpen V, Shimi SM, Cuschieri A. Outcome after cholecystectomy for symptomatic gallstone disease and effect of surgical access: laparoscopic vs open approach. Gut 1993; 34: 1448–1451. [CrossRef]
4. Cleary R, Venables CW, Watson J, Goodfellow J, Wright PD. Comparison of short term outcomes of open and laparoscopic cholecystectomy. Qual Health Care 1995; 4: 13–17. [CrossRef]
5. Philips JAE, Lawes DA, Cook AJ, Arulampalam TH, Zaborsky A, Menzies D, et al. The use of laparoscopic subtotal cholecystectomy for complicated cholelithiasis. Surg Endosc 2008; 22: 1697–1700. [CrossRef]
6. Ersöz F, Arıkan S, Bektaş H, Özcan Ö, Sarı S. Zor laparoskopik kolesistektomi ameliyatlarında laparoskopik subtotal kolesistektominin yeri. Ulus Cerrahi Derg 2009; 25: 105–108.
7. Ji W, Li LT, Li JS. Role of laparoscopic subtotal cholecystectomy in treatment of complicated cholecystitis. Hepatobiliary Pancreat Dis Int 2006; 5: 584–589.
8. Katsohis C, Prousalidis J, Tzardinoglu E, Michalopoulos A, Fahandidis E, Apostolidis S, et al. Subtotal cholecystectomy. HPB Surgery 1996; 9: 133–136. [CrossRef]
9. Beldi G, Glattli A. Laparoscopic subtotal cholecystectomy for severe cholecystitis. Surg Endosc 2003; 17: 1437–1439. [CrossRef]
10. Horiuchi A, Watanabe Y, Doi T, Sato K, Yukumi S, Yoshida M, et al. Delayed laparoscopic subtotal cholecystectomy in acute cholecystitis with severe fibrotic adhesions. Surg Endosc 2008; 22: 2720–2723. [CrossRef]
11. Li C, Si-feng T, Yuan X, Fu F, Shu-you P. Patients' quality of life after laparoscopic or open cholecystectomy. J Zhejiang Univ Sci B 2005; 6: 678-681.
12. Kuwabara K, Matsuda S, Ishikawa KB, Horiguchi H, Fujimori K. Comparative quality of laparoscopic and open cholecystectomy in the elderly using propensity score matching analysis. Gastroenterol Res Pract 2010; 2010: 490147. [CrossRef]
13. Neri V, Ambrosi A, Lauro GD, Fersini A, Valentino TP. Difficult cholecystectomies: Validity of laparoscopic approach. JSLS 2003; 7: 329–333.
14. Reynolds W Jr. The first laparoscopic cholecystectomy. JSLS 2001; 5: 89-94.
15. Richards C, Edwards J, Culver D, Emori G, Tolson J, Gaynes R. Does using a laparoscopic approach to cholecystectomy decrease the risk of surgical site infection? Ann Surg 2003; 237: 358–362. [CrossRef]
16. Amaral PC, Azaro Filho EM, Galvão-Neto MP, Fortes MF, Souza EL, Alcântra RS, et al. Acute cholecystitis: video-laparoscopic versus traditional treatment. JSLS 2001; 5: 159-165.
17. Hussain A. Difficult laparoscopic cholecystectomy: Current evidence and strategies of management. Surg Laparosc Endosc Percutan Tech 2011; 21: 211–217. [CrossRef]
18. Kırk RM. Genel Cerrahi Ameliyatları. In: Laparoskopik safra cerrahisi. 5. Baskı. Adana: 2008. 304–316.
19. Sakpal SV, Bindra SS, Chamberlain RS. Laparoscopic cholecystectomy conversion rates two decades later. JSLS 2010; 4: 476–483. [CrossRef]
20. Brune IB, Schönleben K, Orman S. Complications after laparoscopic and conventional cholecystectomy: A comparative study. HPB Surgery 1994; 8: 19–25. [CrossRef]
21. Yetkin G, Uludag M, Oba S, Citgez B, Paksoy I. Laparoscopic cholecystectomy in elderly patients. JSLS 2009; 13: 587-591. [CrossRef]
22. Chau CH, Tang CN, Sui WT, Ha JPY, Li MKW. Laparoscopic cholecystectomy versus open cholecystectomy in elderly patients with acute cholecystitis. Hong Kong Med J 2002; 8: 394–399.
23. Mayol J, Martinez-Sarmiento J, Tamayo FJ, Fernández-Represa JA. Complications of laparoscopic cholecystectomy in the ageing patient. Age Ageing 1997; 26: 77-81. [CrossRef]
24. Weber DM. Laparoscopic surgery. An excellent approach in elderly patients. Arch Surg 2003; 138: 1083–1088. [CrossRef]
25. Bingener J, Richards ML, Schwesinger WH, Strodel WE, Sirinek KR. Laparoscopic cholecystectomy for elderly patients. Gold Standard for golden years? Arch Surg 2003; 138: 531–536. [CrossRef]
26. Gholipour C, Fakhree MBA, Shalchi RA, Abbasi M. Prediction of conversion of laparoscopic cholecystectomy to open surgery with artificial neural networks. BMC Surgery 2009; 9: 1–6. [CrossRef]

27. Genc V, Sulaimanov M, Cipe G, Basceken SI, Erverdi N, Gürel M, et al. What necessitates the conversion to open cholecystectomy? A retrospective analysis of 5164 consecutive laparoscopic operations. CLINICS 2011; 66: 417–420. [CrossRef]
28. Shapiro AJ, Costello C, Harkabus M, North Jr JH. Predicting conversion of laparoscopic cholecystectomy for acute cholecystitis. JSLS 1999; 3: 127-130.
29. Yol S, Kartal A, Vatansev C, Aksoy F, Toy H. Sex as a factor in conversion from laparoscopic cholecystectomy to open surgery. JSLS 2006; 10: 359–363.
30. Brandon JC, Velez MA, Teplick SK, Mueller PR, Rattner DW, Broadwater JR, et al. Laparoscopic cholecystectomy: Evolution, early results and impact on nonsurgical gallstone therapies. AJR 1991; 157: 235–239. [CrossRef]
31. Al-Mulhim AA. Male gender is not a risk factor for the outcome of laparoscopic cholecystectomy: A single surgeon experience. Saudi J Gastroenterol 2008; 14: 73-79. [CrossRef]
32. Wittgen CM, Andrus JP, Andrus CH, Kaminski DL. Cholecystectomy. Which procedure is best for the high-risk patient? Surg Endosc 1993; 7: 395–399. [CrossRef]
33. Frazee RC, Roberts JW, Okeson GC, Symmonds RE, Snyder SK, Hendricks JC, et al. Open versus laparoscopic cholecystectomy: A comparison of postoperative pulmonary function. Ann Surg 1991; 213: 651–653. [CrossRef]
34. Mimica Z, Biocic M, Bacic A, Banovic I, Tocilj J, Radonic V, et al. Laparoscopic and laparotomic cholecystectomy: A randomized trial comparing postoperative respiratory function. Respiration 2000; 67: 153–158. [CrossRef]
35. Koivusalo AM, Pere P, Valjus M, Scheinin T. Laparoscopic cholecystectomy with carbon dioxide pneumoperitoneum is safe even for high-risk patients. Surg Endosc 2008; 22: 61–67. [CrossRef]
36. Luo K, Li JS, Li LT, Wang KH, Shun JM. Operative stress response and energy metabolism after laparoscopic cholecystectomy compared to open surgery. World J Gastroenterol 2003; 9: 847–850. [CrossRef]
37. Tzovaras G, Liakou P, Fafoulakis F, Baloyiannis I, Zacharoulis D, Hatzitheofilou C. Is there a role for drain use in elective laparoscopic cholecystectomy? A controlled randomized trial. Am J Surg 2009; 197: 759-763. [CrossRef]
38. Monson JR, Guillou PJ, Keane FB, Tanner WA, Brennan TG. Cholecystectomy is safer without drainage: the results of a prospective randomized clinical trial. Surgery 1991; 109: 740–746.
39. Lewis RT, Goodall RG, Marien B, Park M, Lloyd-Smith W, Wiegand FM. Simple elective cholecystectomy: to drain or not. Am J Surg 1990; 159: 241–245. [CrossRef]
40. Gurusamy KS, Samraj K, Mullerat P, Davidson BR. Routine abdominal drainage for uncomplicated laparoscopic cholecystectomy (Review). The Cochrane Collaboration. Published by John Wiley & Sons, Ltd. 2009.
41. Sanabria A, Dominguez LC, Valdivieso E, Gomez G. Antibiotic prophylaxis for patients undergoing elective laparoscopic cholecystectomy (Review). The Cochrane Collaboration. Published by John Wiley & Sons, Ltd. 2010.
42. Lim KR, İbrahim S, Tan NC, Lim SH, Tay KH. Risk factors for conversion to open surgery in patients with acute cholecystitis undergoing interval laparoscopic cholecystectomy. Ann Acad Med Singapore 2007; 36: 631–635.
43. Lujan JA, Parilla P, Robles R, Marin P, Torralba JA, Ayllon JG. Laparoscopic cholecystectomy vs open cholecystectomy in the treatment of acute cholecystitis. Arch Surg 1998; 133: 173–175. [CrossRef]
44. Keus F, Gooszen HG, Van Laarhoven CJHM. Open, small incision, or laparoscopic cholecystectomy for patients with symptomatic cholecystolithiasis. An overview of cochrane hepato-biliary group reviews. The Cochrane Collaboration. Published by John Wiley & Sons, Ltd. 2010. [CrossRef]
45. Ivatury SJ, Louden CL, Schwesinger WH. Contributing factors to postoperative length of stay in laparoscopic cholecystectomy. JSLS 2011; 15: 174–178. [CrossRef]
46. Attwood SEA, Mealy K, Hill ADK, Stephens RB. A prospective comparison of laparoscopic versus open cholecystectomy. Ann R Coll Surg Engl 1992; 74: 397–400.
47. Keus F, De Jong J, Gooszen HG, Laarhoven CJHM. Laparoscopic versus open cholecystectomy for patients with symptomatic cholecystolithiasis (Review). The Cochrane Collaboration. Published by John Wiley & Sons, Ltd. 2009.
48. Henneman D, da Costa DW, Vrouenraets BC, van Wagensveld BA, Lagarde SM. Laparoscopic partial cholecystectomy for the difficult gallbladder: a systematic review. Surg Endosc 2013; 27: 351-358. [CrossRef]
49. Kaplan D, Inaba K, Chouliaras K, Low GM, Benjamin E, Grabo D, et al. Subtotal cholecystectomy and open total cholecystectomy: alternatives in complicated cholecystitis. Am Surg 2014; 80: 953-955.