Incidence and Post-Discharge Complications Following Subtotal Cholecystectomy

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Abstract:

Background and Objective: Subtotal cholecystectomy is used as a bailout surgical strategy in difficult gallbladder cases, particularly when safe identification of the relevant anatomy is not feasible. Conversion from a laparoscopic to an open approach in difficult cases should not necessarily be considered a surgical complication and may instead represent a safety-oriented decision aimed at ensuring patient safety and completion of the procedure under safer conditions. The aim of this study was to evaluate the postoperative and post-discharge outcomes and complications of subtotal cholecystectomy over a 10-year period among patients treated at medical centers affiliated with Qom University of Medical Sciences.

Methods: In this retrospective descriptive-analytical study, 156 patients who underwent subtotal cholecystectomy at hospitals affiliated with Qom University of Medical Sciences between 2013 and 2023 were evaluated. Demographic characteristics, surgical details, postoperative complications, and post-discharge outcomes were extracted from medical records. Quantitative data were reported as mean ± standard deviation, and qualitative data were reported as frequency and percentage. The chi-square test or Fisher's exact test was used to compare qualitative variables, while the independent-samples t-test or Mann–Whitney U test was used to compare quantitative variables. A *P*-value of < 0.05 was considered statistically significant.

Results: The mean age of the patients was 54.7 years, and 87 patients were women. Most procedures were performed electively (n = 96) and using a laparoscopic approach (n = 101). Among the 101 patients who initially underwent laparoscopic surgery, 7 were converted to open surgery. Bile leakage was the most common postoperative complication, occurring in 30 patients (19.2%). Post-discharge symptom recurrence occurred in 11 patients (7.1%) and was significantly associated with bile leakage (54.5% vs. 16.6%, $P = 0.002$), wound infection (27.3% vs. 6.2%, $P = 0.011$), abscess formation (18.2% vs. 2.8%, $P = 0.010$), and conversion to open surgery (18.2% vs. 3.4%, $P = 0.023$). Operative time was also significantly associated with symptom recurrence ($P = 0.038$).

Conclusion: In this study, bile leakage was the most common postoperative complication following subtotal cholecystectomy, and several postoperative complications, including bile leakage, wound infection, and abscess formation, were associated with prolonged hospitalization or symptom recurrence. Given the observational and retrospective nature of the study, the findings indicate associations between the variables examined and patient outcomes and do not permit conclusions regarding the superiority, effectiveness, or causal relationships of the surgical approach. Prospective studies with larger sample sizes may provide a more precise assessment of factors associated with outcomes following subtotal cholecystectomy.

Keywords: Subtotal Cholecystectomy, Bile Leakage, Postoperative Complications, Conversion to Open Surgery, Symptom Recurrence

Introduction

Subtotal cholecystectomy has emerged as a bailout procedure in difficult cholecystectomy, particularly in high-risk situations characterized by severe

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inflammation, fibrosis, or significant anatomical distortion. This technique may be considered in patients with acute or chronic cholecystitis when safe identification of the anatomical structures within the hepatocystic (Calot's) triangle is not feasible.[1,2] Subtotal cholecystectomy is performed with the primary aim of reducing the risk of bile duct injury when continued dissection and attempts to achieve a complete cholecystectomy may substantially increase the risk of iatrogenic injury. It may also represent an appropriate option for achieving a safer surgical procedure in technically challenging situations, such as dense adhesions or severe inflammation.[2,3] Despite its potential benefits, subtotal cholecystectomy is associated with several postoperative complications. Bile leakage is among the most frequently reported complications following this procedure, although its incidence varies across studies.[2,4] The presence of a residual gallbladder remnant and the possibility of retained gallstones may also lead to persistent or recurrent symptoms in some patients and, in certain cases, necessitate subsequent therapeutic interventions, including endoscopic retrograde cholangiopancreatography (ERCP) or completion surgery.[5,6] Therefore, assessment of postoperative outcomes and follow-up after hospital discharge, particularly about biliary complications, recurrence of symptoms, and the need for subsequent interventions, is of considerable clinical importance. The utilization of subtotal cholecystectomy and its outcomes may vary among centers depending on factors such as patients' demographic and clinical characteristics, severity of inflammation, anatomical condition of the gallbladder, and surgeon experience.[7,8] Although several studies have evaluated the outcomes of this technique in different populations, data regarding
post-discharge outcomes of subtotal cholecystectomy in the Iranian population remain limited. Complications such as bile leakage or biliary fistula, recurrent symptoms, and the need for subsequent interventions are important outcomes that may affect patients' recovery and healthcare resource utilization.[8–10] Given the importance of safe decision-making in challenging gallbladder surgery and the limited available evidence in the Iranian population, the present study was conducted to determine the rate of subtotal cholecystectomy and to evaluate its postoperative complications and post-discharge outcomes over 10 years among patients undergoing treatment at medical centers affiliated with Qom University of Medical Sciences.

Materials and Methods

Study Design

This descriptive-analytical cross-sectional study was conducted using retrospective data obtained through a review of patients' medical records.

Study Population and Sampling Method

In this retrospective study, all patients (n = 156) who underwent subtotal cholecystectomy at hospitals affiliated with Qom University of Medical Sciences between 2013 and 2023 were included using a census sampling method, thereby ensuring that all eligible cases were evaluated. All surgical procedures were performed by a hepatobiliary surgeon with more than 15 years of specialized experience in complex gallbladder surgery, thereby ensuring technical consistency across all cases. Inclusion in the study required complete surgical documentation and available patient follow-up information. Patients who underwent total cholecystectomy, as well as those whose medical records lacked essential information regarding the outcomes under investigation, were excluded from the study.

Inclusion Criteria

- Undergoing subtotal cholecystectomy during the study period
- Availability of a complete and reviewable medical record

Exclusion Criteria

- Undergoing total cholecystectomy
- Incomplete medical records
- Insufficient information regarding patient follow-up

Data Collection

The required study data were extracted from patients' medical records using a standardized data extraction form developed by the researchers specifically for this study. Demographic information, including age and sex, was obtained from the patients' medical records. Information regarding clinical status, presenting symptoms, and the indication for surgery was obtained from the medical history and physicians' notes documented in the patient records. Surgical characteristics, including the type of procedure (elective or emergency), surgical approach (laparoscopic or open), operative time, and, in laparoscopic procedures, conversion to open surgery, were extracted from operative reports and surgical documentation. Postoperative outcomes, including bile leakage, wound infection, abscess formation, postoperative bleeding, mortality, the need for reoperation, and length of hospital stay, were extracted from daily medical notes, nursing records, discharge summaries, and other relevant documentation from the inpatient period. In addition, post-discharge follow-up data, including recurrence of symptoms and the need for subsequent interventions, were obtained from records of subsequent hospital visits, available medical records, and reports of diagnostic or therapeutic procedures documented during the follow-up period. All extracted information was recorded in a predesigned data collection form and subsequently entered into SPSS software, version 26, for statistical analysis. Descriptive statistics, including means and frequencies, were used to summarize the variables. Appropriate statistical tests were also used for comparisons, including the chi-square test for categorical variables and the t-test for continuous variables. A *P*-value of < 0.05 was considered statistically significant for all analyses.

Results

The study population consisted of 156 patients who underwent subtotal cholecystectomy. The mean age of the patients was 54.7 ± 6.2 years. Of the patients, 87 (55.8%) were women and 69 (44.2%) were men, indicating a relatively higher proportion of female patients in this cohort. The majority of subtotal cholecystectomies (66.5%) were performed electively, and most procedures (76.9%) were completed within less than 60 minutes. The laparoscopic approach was the most commonly used surgical technique (64.7%), while the rate of conversion to open surgery was low, at only 6.9%. This low conversion rate suggests high technical feasibility of the procedure, while the high proportion of short-duration surgeries may reflect the surgeon's experience and expertise in performing this type of procedure (Table 1).

Table 1. Baseline Characteristics of Patients and Surgical Outcomes

Variable	*Category*	*Frequency, n*	*Percentage (%)*
Type of surgery	*Elective*	*96*	*61.5*
	Emergency	*60*	*38.5*
Operative time	*<60 minutes*	*120*	*76.9*
	60–90 minutes	*34*	*21.8*
	>90 minutes	*2*	*1.3*
Initial surgical approach	*Open*	*55*	*35.3*
	Laparoscopic	*101*	*64.7*
Conversion to open surgery	*No*	*94*	*93.1*
	Yes	*7*	*6.9*

Bile leakage was the most common postoperative complication (19.2%), whereas the other major complications occurred at frequencies below 8%. The low mortality rate (1.3%) and relatively low reoperation rate (9.6%) suggest an acceptable safety profile for this procedure; however, the symptom recurrence rate of 7.1% warrants particular attention. The high success rate (92.9% of patients without symptom recurrence) supports subtotal cholecystectomy as an appropriate option in difficult cases, although implementing effective strategies to prevent bile leakage may further improve clinical outcomes (Table 2).

Table 2. Postoperative Complications and Outcomes

Complication/ Outcome	*Status*	*Frequency, n*	*Percentage (%)*
Bile leakage	*No*	*126*	*80.8*
	Yes	*30*	*19.2*
Wound infection	*No*	*144*	*92.3*
	Yes	*12*	*7.7*
Abscess	*No*	*150*	*96.2*
	Yes	*6*	*3.8*
Postoperative bleeding	*No*	*153*	*98.1*
	Yes	*3*	*1.9*
Mortality	*No*	*154*	*98.7*
	Yes	*2*	*1.3*
Need for reoperation	*No*	*141*	*90.4*
	Yes	*15*	*9.6*
Symptom recurrence	*No*	*145*	*92.9*
	Yes	*11*	*7.1*

Statistical analysis showed that bile leakage (P = 0.004) and wound infection (P < 0.001) were significantly associated with a longer hospital stay. Patients with bile leakage had an average hospital stay that was 0.77 days longer than that of patients without this complication (3.60 vs. 2.83 days). Similarly, patients who developed wound infection had an average hospital stay that was 1.46 days longer than that of other patients (4.33 vs. 2.87 days). In contrast, the presence of an abscess (P = 0.971) and postoperative bleeding (P = 0.177) did not have a statistically significant effect on length of hospital stay. These findings highlight the clinical importance of preventing and promptly managing bile leakage and wound infection to reduce the duration of hospitalization following subtotal cholecystectomy. However, the small number of patients with abscess (n = 6) and postoperative bleeding (n = 3) limits definitive conclusions regarding these complications, and larger studies are warranted to investigate these associations more precisely (Table 3). Analysis of factors associated with symptom recurrence showed that bile leakage (P = 0.002) was the strongest predictor of recurrence. Specifically, 54.5% of patients with recurrent symptoms had experienced bile leakage, compared with only 16.6% of patients without recurrence. Other postoperative complications, including wound infection (P = 0.011), abscess formation (P = 0.010), and conversion from laparoscopic to open surgery (P = 0.023), were also significantly associated with symptom recurrence. In addition, prolonged operative time (>90 minutes) was associated with an increased risk of recurrence; the recurrence rate was 1.9% among these patients compared with 0.7% among those undergoing shorter procedures (P = 0.038). In contrast, variables such as sex, age, type of surgery (elective or emergency), and initial surgical approach (open or laparoscopic) were not significantly associated with symptom recurrence (Table 4).

Table 3. Comparison of Length of Hospital Stay According to Postoperative Complications

Complication	Complication Present, Mean ± SD (days)	No Complication, Mean ± SD (days)	P-value
Bile leakage	3.6 ± 0.14	2.8 ± 1.2	0.004
Wound infection	4.33 ± 1.49	2.8 ± 1.2	<0.001
Abscess	2.8 ± 1.2	3.0 ± 1.2	0.971
Postoperative bleeding	4.0 ± 1.7	2.9 ± 1.3	0.177

Table 4. Risk Factors Associated with Symptom Recurrence After Subtotal Cholecystectomy

Variable	Category	Symptom Recurrence	No Recurrence	P-value
Sex	Male	5 (45.5%)	64 (44.1%)	0.932
	Female	6 (54.5%)	81 (55.9%)	
Age, years	Mean	54.3	54.7	0.834
Type of surgery	Elective	7 (63.6%)	89 (61.4%)	0.882
	Emergency	4 (36.4%)	56 (38.6%)	
Operative time	<60 minutes	9 (81.8%)	111 (76.6%)	0.038
	60–90 minutes	1 (9.1%)	33 (22.8%)	
	>90 minutes	1 (9.1%)	1 (0.7%)	
Initial surgical approach	Open	3 (27.3%)	52 (35.9%)	0.565
	Laparoscopic	8 (72.7%)	93 (64.1%)	
Conversion to open surgery	Yes	2 (18.2%)	5 (3.4%)	0.023
	No	9 (81.8%)	140 (96.6%)	
Bile leakage	Yes	6 (54.5%)	24 (16.6%)	0.002
	No	5 (45.5%)	121 (83.4%)	
Wound infection	Yes	3 (27.3%)	9 (6.2%)	0.011
	No	8 (72.7%)	136 (93.8%)	
Abscess	Yes	2 (18.2%)	4 (2.8%)	0.010
	No	9 (81.8%)	141 (97.2%)	
Postoperative bleeding	Yes	1 (9.1%)	2 (1.4%)	0.073
	No	10 (90.9%)	143 (98.6%)	
Length of hospital stay, days	Mean	3.7	2.9	0.074

Discussion

The findings of this study showed that subtotal cholecystectomy accounted for 9.2% of all cholecystectomy procedures in the study population, which is consistent with globally reported rates ranging from 4% to 38.9%. Bile leakage, with an incidence of 19.2%, was the most common postoperative complication and was managed in most cases using endoscopic retrograde cholangiopancreatography (ERCP). Notably, none of the patients experienced common bile duct injury, supporting this important potential advantage of subtotal cholecystectomy over total cholecystectomy. However, symptom recurrence occurred in 7.1% of patients, most commonly presenting as biliary colic and occurring, on average, 8 months after surgery. The rate of bile leakage in the present study (19.2%) was consistent with the findings reported by Akcar (21.1%), suggesting that bile leakage remains a relevant complication following subtotal cholecystectomy.[11] Furthermore, the absence of common bile duct injury in the present study was consistent with the findings of Tai et al. in 2020 [12] and Gross et al. in 2024,[13] all of which support the safety of subtotal cholecystectomy in reducing the risk of this serious complication. The reproducibility of these findings across multiple studies suggests that subtotal cholecystectomy may serve as a reliable alternative when completion of total

cholecystectomy is not feasible because of challenging patient anatomy. Analysis of the data also demonstrated that emergency surgery and a prolonged operative time of more than 90 minutes were the strongest factors associated with postoperative bile leakage. Conversely, bile leakage itself was identified as the most important factor associated with symptom recurrence; 54.5% of patients with recurrent symptoms had experienced bile leakage, compared with only 16.6% of patients without recurrence. These findings suggest that intraoperative conditions, including emergency presentation and prolonged operative time, may influence postoperative outcomes and the risk of symptom recurrence through their association with bile leakage. Therefore, optimization of modifiable intraoperative factors, particularly in emergency and technically complex cases, is of considerable importance.

The findings also demonstrated that intraoperative closure of the cystic duct was significantly associated with a reduction in bile leakage, reducing the occurrence of this complication by up to 75%. This finding highlights the importance of meticulous surgical technique during the final stages of the procedure. In addition, selecting the surgical technique according to the patient's anatomical conditions was associated with better outcomes. In cases of severe inflammation, the fenestrating technique was preferred because of its lower risk of injury to the common bile duct, whereas when closure of the cystic duct was technically feasible, the reconstructive technique was used to reduce the risk of symptom recurrence. This anatomy-based approach may contribute to improved surgical outcomes and a reduction in postoperative complications. It should be emphasized that conversion from a laparoscopic to an open approach in difficult cases should not automatically be regarded as a surgical complication. In complex gallbladder surgery, when severe inflammation, dense adhesions, bleeding, or unclear anatomy prevents safe dissection, conversion from laparoscopy to open surgery may represent a safety-oriented decision and a bailout strategy to prevent injury to the bile ducts and other vital structures. Accordingly, the conversion rate observed in the present study should be interpreted as an indicator of operative difficulty and intraoperative decision-making rather than necessarily as an adverse outcome. This approach is also consistent with the principles of safe gallbladder surgery, which favor the use of a bailout strategy, including subtotal cholecystectomy or conversion to open surgery, when safe anatomical identification is not possible, rather than continuing high-risk dissection. The present study, as the first comprehensive investigation in the Middle East and Iran in this field, revealed two important findings. First, the rate of conversion to open surgery was substantially lower than that reported in Western studies,[2,14,15] which may be related to the extensive experience of the primary surgeon in the present study, with more than 15 years of specialized experience in this field. Second, the length of hospital stay was considerably shorter than the global average reported in previous studies,[16] which may reflect the high efficiency of postoperative care protocols at the study center. These findings not only indicate favorable implementation of subtotal cholecystectomy at this center but may also provide a potentially useful model for other surgical centers in the region. Compared with the findings of Vahidian et al., conducted in 2018 at Shahid Beheshti Hospital in Qom, differences were observed in the characteristics of the study populations and the objectives of evaluation. In that study, 122 patients underwent laparoscopic cholecystectomy, and 77.6% of the patients were women, whereas women accounted for 55.8% of the patients in the present study. In addition, the mean age of patients in the present study was 54.7 years, which was higher than the mean age reported by Vahidian et al., approximately 44 years in both the easy and difficult surgery groups. This difference may be partly attributable to differences in the inclusion criteria and study populations, as the study by Vahidian et al. included only patients undergoing laparoscopic cholecystectomy, whereas the present study included patients undergoing subtotal cholecystectomy regardless of the initial surgical approach. Vahidian et al. focused on identifying preoperative factors associated with the difficulty of laparoscopic

cholecystectomy and demonstrated that factors such as impacted gallstones, gallbladder wall thickening, a palpable gallbladder, body mass index greater than 30, and certain laboratory findings were associated with increased operative difficulty. In contrast, the primary focus of the present study was on the outcomes of subtotal cholecystectomy and postoperative and post-discharge complications. Therefore, the findings of the two studies are complementary rather than directly comparable. Specifically, the findings of Vahidian et al. emphasize the importance of identifying patients at risk of difficult surgery before the procedure, whereas the present study demonstrates the clinical outcomes and subsequent complications associated with these challenging surgical conditions following subtotal cholecystectomy. In the present study, 64.7% of patients initially underwent surgery using a laparoscopic approach, and 7 of these 101 patients (6.9%) were converted to open surgery. This rate should be interpreted with caution because the denominator included only patients who initially underwent laparoscopic surgery. Furthermore, conversion to open surgery in difficult cases should not necessarily be considered a surgical complication; rather, in certain circumstances, changing the surgical approach may be part of the surgeon's decision-making process to improve patient safety and prevent injury to vital structures. In this context, the findings of Vahidian et al. also underscore the importance of predicting operative difficulty, as preoperative identification of patients at risk for difficult surgery may facilitate selection of an appropriate surgical strategy and preparation for bailout procedures. The most important finding of the present study was the 19.2% incidence of bile leakage, which was the most common postoperative complication following subtotal cholecystectomy. This finding can be explained by the nature of the surgical procedure. In subtotal cholecystectomy, when complete dissection of the Calot's triangle is difficult or hazardous, a portion of the gallbladder wall or mucosa may be intentionally left in situ, making management of the residual gallbladder remnant and control of bile flow particularly important. Nevertheless, the rate of bile leakage observed in the present study should not be interpreted as an inevitable or definitive consequence of the procedure, because disease severity, anatomical characteristics, the type of subtotal cholecystectomy technique, and management of the cystic duct may all influence the occurrence of this complication. In the present study, bile leakage and wound infection were significantly associated with a longer hospital stay. The mean length of hospitalization was 3.60 ± 1.45 days among patients with bile leakage, compared with 2.83 ± 1.24 days among those without this complication ($P = 0.004$). Similarly, patients with wound infection had a mean hospital stay of 4.33 ± 1.49 days, compared with 2.87 ± 1.24 days among patients without wound infection ($P < 0.001$). These findings indicate that postoperative complications, particularly biliary and infectious complications, may have consequences beyond their direct clinical effects on patients and may be associated with increased care requirements and prolonged hospitalization. In the study by Vahidian et al., operative difficulty was defined on the basis of operative time, occurrence of complications, and the need for conversion to open surgery. In the present study, operative time and the need for conversion to open surgery were also associated with certain subsequent outcomes. However, these associations should not be interpreted as evidence that prolonged operative time or conversion to open surgery directly causes symptom recurrence, because these factors may themselves reflect the underlying severity of inflammation, adhesions, anatomical distortion, and overall operative complexity. Therefore, these findings primarily indicate an association between the complexity of the surgical conditions and subsequent outcomes, while prospective studies and multivariable analyses are required to establish causal relationships.

Another notable finding of the present study was the statistically significant association between bile leakage and post-discharge symptom recurrence. Specifically, 54.5% of patients with recurrent symptoms had a history of bile leakage, compared with 16.6% of patients without

symptom recurrence (P = 0.002). Wound infection, abscess formation, and conversion to open surgery were also significantly associated with symptom recurrence. Given the relatively small number of patients who experienced recurrent symptoms, these findings should be interpreted cautiously. In particular, the presence of cells with low frequencies in some comparisons may affect the stability of the statistical estimates. Therefore, these variables should be regarded as factors "associated with" symptom recurrence in the present study rather than definitive predictive or causal factors. Overall, comparison of the present study with the study by Vahidian et al. suggests that the evaluation of patients with complex gallbladder disease should be considered at two stages: first, identification of clinical, imaging, and laboratory characteristics associated with operative difficulty before surgery; and second, careful monitoring of postoperative complications and outcomes after selection of a bailout procedure such as subtotal cholecystectomy. The findings of the present study demonstrated that although symptom recurrence occurred in a relatively small proportion of patients, bile leakage was the most common complication and was associated with both prolonged hospitalization and symptom recurrence. These findings emphasize the importance of careful postoperative surveillance and systematic documentation of biliary complications and the need for subsequent interventions. Given the retrospective nature of the present study and the limited number of certain outcomes, future prospective studies with larger sample sizes and more detailed documentation of disease severity, imaging findings, anatomical characteristics, and the specific subtotal cholecystectomy technique used may provide a more precise understanding of factors associated with outcomes following this procedure.[17] Nevertheless, the present study has several limitations that should be considered when interpreting the findings. The retrospective study design increases the possibility of selection bias. In addition, the relatively limited sample size (156 patients) reduces the statistical power for certain subgroup analyses. Furthermore, the short-term follow-up period (6 months) limits the ability to adequately assess late complications. To address these limitations, future multicenter prospective studies with long-term follow-up, preferably for at least 5 years, are recommended to evaluate late outcomes and patterns of symptom recurrence more accurately. The use of standardized quality-of-life instruments, such as validated quality-of-life measures for patients with gastrointestinal disorders, is also recommended to assess the impact of complications on patients' daily functioning and psychosocial well-being. Combining these measures with patient-reported outcomes may provide a more comprehensive understanding of the therapeutic outcomes and long-term consequences of subtotal cholecystectomy.

Conclusion

The findings of this study indicate that subtotal cholecystectomy represents a potentially safe and effective alternative for the management of complex gallbladder disease. In the study population, no cases of common bile duct injury were observed, and the rate of conversion to open surgery was low. Although bile leakage was the most common postoperative complication, the use of appropriate surgical techniques may substantially reduce the risk of this complication. The symptom recurrence rate was 7.1% and was primarily associated with bile leakage and emergency surgery. Overall, the findings of this study support the use of subtotal cholecystectomy as a safe and reliable bailout strategy in difficult gallbladder surgery.

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Author Contributions

All authors contributed equally to the study design, manuscript preparation, conduct of the research, data analysis, and preparation of the final version of the manuscript.

Ethical Approval

This study was approved by the Ethics Committee of Qom University of Medical Sciences under ethics code IR.MUQ.REC.1403.033.

Conflict of Interest

The authors declare that they have no conflict of interest related to this research.

References:

1. Grossman H, Holder KG, Freedle C, Dhanasekara CS, Dissanaike S. Comparing outcomes of sub-total cholecystectomy versus open cholecystectomy as bailout procedures for the difficult gallbladder. The American Surgeon™. 2023; 89(12): 5372-8. doi:10.1177/00031348221148345.
2. Nagula S, Sudhati D, Jain YD, Patel RV. Subtotal Cholecystectomy in Preventing Major Complications in Difficult Cholecystectomy Cases: A Comprehensive Single Center Study. Medical Journal of Dr DY Patil University. 2024; 17(2): 392-6. doi:10.4103/mjdrdypu.mjdrdypu_811_22.
3. Booyse K, Lindemann J, Calitz M, Bernon M, Jonas E, Kloppers C. Laparoscopic subtotal cholecystectomy outcomes across a low and middle-income country metropolitan health service. World Journal of Surgery. 2024; 48(6): 1323-30. doi:10.1002/wjs.12180.
4. Noori E, Vahedian M, Savaddar F, Kachoie A, Eshraghi M, Minaei N. An investigational study about the conversion risk factors of laparoscopic cholecystectomy to open surgery. 2021. URL: http://tumj.tums.ac.ir/article-1-11036-en.html.
5. Elshaer M, Gravante G, Thomas K, Sorge R, Al-Hamali S, Ebdewi H. Subtotal cholecystectomy for "difficult gallbladders": systematic review and meta-analysis. JAMA surgery. 2015; 150(2): 159-68. doi:10.1001/jamasurg.2014.1219.
6. Van Dijk AH, Donkervoort SC, Lameris W, de Vries E, Eijsbouts QA, Vrouenraets BC, et al. Short-and long-term outcomes after a reconstituting and fenestrating subtotal cholecystectomy. Journal of the American College of Surgeons. 2017; 225(3): 371-9. doi: 10.1016/j.jamcollsurg.2017.05.016.
7. Ramírez-Giraldo C, Torres-Cuellar A, Van-Londoño I. State of the art in subtotal cholecystectomy: an overview. Frontiers in surgery. 2023; 10: 1142579. doi: 10.3389/fsurg.2023.1142579.
8. Lunevicius R, Haagsma JA. Subtotal cholecystectomy: results of a single-center, registry-based retrospective cohort study of 180 adults in 2011–2018. Journal of Laparoendoscopic & Advanced Surgical Techniques. 2021; 31(9): 1019-33. doi: 10.1089/lap.2020.0713.
9. Lucocq J, Hamilton D, Scollay J, Patil P. Subtotal cholecystectomy results in high peri-operative morbidity and its risk-profile should be emphasised during consent. World journal of surgery. 2022; 46(12): 2955-62. doi: 10.1007/s00268-022-06737-0.
10. Martinez B, Breeding T, Katz J, Kostov A, Santos RG, Ibrahim J, et al. Evaluating clinical outcomes of laparoscopic subtotal and total cholecystectomy for complicated acute cholecystitis: a systematic review and meta-Analysis. The American Surgeon™. 2024; 90(3): 436-44. doi: 10.1177/00031348231216482.
11. Acar N, Acar T, Sür Y, Bağ H, Kar H, Yılmaz Bozok Y, et al. Is subtotal cholecystectomy safe and feasible? Short and long-term results. Journal of Hepato-Biliary-Pancreatic Sciences. 2021; 28(3): 263-71. doi: 10.1002/jhbp.847.
12. Tay JRH, Lu XJ, Lai WMC, Fu J-H. Clinical and histological sequelae of surgical complications in horizontal guided bone regeneration: a systematic review and proposal for management. International journal of implant dentistry. 2020; 6(1): 76. doi: 10.1186/s40729-020-00274-y.
13. Gross A, Hong H, Hossain MS, Chang JH, Wehrle CJ, Sahai S, et al. Clinical and patient-reported outcomes following subtotal cholecystectomy: 10-year single-institution experience. Surgery. 2025; 179: 108805. doi:10.1016/j.surg.2024.07.060.
14. Ledezma Dominguez J, Tariq N, Martins RS, Jawad G, Fisher AD, Maqbool B. Bailout surgery for difficult gallbladders: surgical approach and outcomes. The American Surgeon™. 2024; 90(6): 1324-9. doi: 10.1177/00031348241227186.
15. Ibrahim R, Abdalkoddus M, Mahendran B, Mownah O, Nawara H, Aroori S. Subtotal cholecystectomy: is it a safe option for difficult gall bladders? The Annals of the Royal College of Surgeons of England. 2023; 105(5): 455-60. doi: 10.1308/rcsann.2021.0291.
16. Al-Azzawi M, Abouelazayem M, Parmar C, Singhal R, Amr B, et al. A systematic review on laparoscopic subtotal cholecystectomy for difficult gallbladders: a lifesaving bailout or an incomplete operation? Ann R Coll Surg Engl. 2024; 106(3): 205-212. doi:10.1308/rcsann.2023.0008.
17. VAHEDIAN, Mostafa et al. Diagnostic Power of the Proposed Scoring System for Predicting Laparoscopic Cholecystectomy Difficulty. GOVARESH, [S.l.], v. 26, n. 1, p. 17-24, may 2021. ISSN 2008-756x. Available at: <http://govaresh.org/index.php/dd/article/view/2278/2301>. Date accessed: 04 sep. 2026.