

COMPARATIVE ANALYSIS OF LAPAROSCOPIC VERSUS OPEN CHOLECYSTECTOMY IN PATIENTS WITH CHOLECYSTOLITHIASIS: A RETROSPECTIVE STUDY FROM THE CLINICAL HOSPITAL OF TETOVA

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Abstract

Background: Cholecystolithiasis is one of the most common gastrointestinal disorders requiring surgical intervention worldwide. Since its introduction in the late 1980s, laparoscopic cholecystectomy (LC) has progressively replaced the conventional open approach (OC) as the standard treatment for symptomatic gallstone disease, although the open technique remains relevant in selected clinical situations.

Aim: To analyze the demographic profile, comorbidity burden, and perioperative outcomes of patients operated for cholecystolithiasis at the Clinical Hospital of Tetova, and to compare postoperative complications and length of hospitalization between LC and OC.

Materials and Methods: A retrospective observational study was carried out at the Department of Surgery of the Clinical Hospital of Tetova, in collaboration with the Faculty of Medical Sciences, University of Tetova. Sixty-four consecutive adult patients operated for symptomatic cholecystolithiasis were included. Demographic data, comorbidities, body mass index (BMI), American Society of Anesthesiologists (ASA) physical status classification, surgical technique, postoperative complications, and length of hospital stay were extracted and analyzed.

Results: The cohort comprised 48 women (75%) and 16 men (25%), aged 23 to 72 years. Forty-six patients (71.9%) underwent LC and 18 (28.1%) underwent OC. Arterial hypertension was present in 48 patients (75%) and diabetes mellitus in 32 (50%). Approximately 70% of patients had a BMI between 28 and 30 kg/m². ASA classification revealed 44 patients (68.75%) in class I, 16 (25%) in class II, and 4 (6.25%) in class III. Postoperative complications—wound infection, wound bleeding, and prolonged postoperative pain—were more frequent among patients operated by the open technique. Length of hospital stay was substantially shorter in the laparoscopic group.

Conclusion: Laparoscopic cholecystectomy was associated with fewer postoperative complications and shorter hospitalization compared with the open approach, supporting its role as the preferred method for symptomatic cholecystolithiasis. Careful preoperative evaluation of comorbidities and ASA status remains essential for optimal outcomes.

Keywords: *cholecystolithiasis; laparoscopic cholecystectomy; open cholecystectomy; postoperative complications; ASA classification; Tetova.*

Introduction

Cholecystolithiasis, defined as the presence of stones within the gallbladder, represents one of the most prevalent disorders of the digestive tract in both industrialized and developing countries (Stinton & Shaffer, 2012). Epidemiological data indicate that gallstone disease affects approximately 10–20% of the adult population in Western societies, with even higher prevalence among populations characterized by metabolic risk factors such as obesity, diabetes mellitus, and arterial hypertension (Lammert et al., 2016; Shaffer, 2006). Cholesterol gallstones, the predominant type in Western countries, are closely linked to the metabolic syndrome, female sex, advancing age, multiparity, rapid weight loss, and certain genetic predispositions (Diehl, 1991; Lammert et al., 2016).

Although a substantial proportion of individuals harboring gallstones remain asymptomatic throughout their lifetime, an estimated 10–25% will eventually develop biliary symptoms or complications including biliary colic, acute cholecystitis, choledocholithiasis, ascending cholangitis, or biliary pancreatitis (Festi et al., 2010; Halldestam et al., 2004). Once symptoms

develop, surgical removal of the gallbladder—cholecystectomy—is regarded as the definitive treatment and remains the most frequently performed elective abdominal operation worldwide (Russo et al., 2004; Strasberg, 2008).

Cholecystectomy was first performed as an open procedure by Carl Langenbuch in 1882, and this approach remained the surgical standard for more than a century. The advent of minimally invasive surgery, with the first laparoscopic cholecystectomy performed by Erich Mühe in Germany in 1985 and subsequently popularized by Mouret, Dubois, and Perissat in France, revolutionized the management of gallstone disease (Reynolds, 2001). Within only a few years of its introduction, the laparoscopic technique had been widely adopted, and by the early 1990s it was already being described as the new "gold standard" for the elective treatment of symptomatic cholecystolithiasis (Soper et al., 1992).

A large body of comparative evidence has demonstrated that laparoscopic cholecystectomy (LC), when performed in appropriately selected patients, is associated with reduced postoperative pain, shorter hospital stay, faster return to daily activities, lower wound-related complication rates, and improved cosmetic outcomes when compared with open cholecystectomy (OC) (Keus et al., 2010; McMahon et al., 1994; Trondsen et al., 1993). A systematic review and pooled analysis covering thirty years of laparoscopic cholecystectomy further confirmed sustained improvements in safety and reductions in length of hospitalization (Pucher et al., 2018). Nonetheless, the open technique retains an important role in specific clinical scenarios, including severe acute cholecystitis with extensive inflammation, suspected gallbladder malignancy, complex anatomical conditions, and conversion from laparoscopy because of bleeding, dense adhesions, or unclear anatomy (Bingener-Casey et al., 2002; Coccolini et al., 2015). Reported conversion rates from laparoscopic to open surgery vary between 2% and 15%, depending on patient factors, disease severity, and surgical experience (Bingener-Casey et al., 2002).

In parallel with the diffusion of minimally invasive techniques, the overall frequency of cholecystectomy has continued to rise (Tsui et al., 2013). Despite the dominance of LC, postoperative complications—including wound infection, hemorrhage, biliary leakage, bile duct injury, and prolonged ileus—continue to occur at non-negligible rates, underscoring the importance of meticulous preoperative evaluation and careful patient selection (Khan et al., 2007; Shea et al., 1996; Z'graggen et al., 1998). The American Society of Anesthesiologists (ASA) physical status classification and the systematic assessment of comorbidities such as obesity, diabetes mellitus, and arterial hypertension remain key elements for stratifying surgical risk (Agrawal & Sood, 2015; Dolan et al., 2009).

In the Republic of North Macedonia, and particularly within the Polog region, the Clinical Hospital of Tetova serves as the principal regional referral center for surgical pathology, including biliary tract disease. Both laparoscopic and open cholecystectomy are routinely performed in this institution. However, local data describing the demographic profile, risk burden, and perioperative outcomes of patients undergoing cholecystectomy in this region remain scarce. Generating such evidence is of practical relevance for guiding surgical decision-making, optimizing perioperative management, and benchmarking local practice against international standards.

Aim of the study

The aim of the present study was to analyze the demographic and clinical characteristics, comorbidity profile, and perioperative outcomes of patients operated for symptomatic cholecystolithiasis at the Clinical Hospital of Tetova, and to compare the postoperative course—particularly the frequency of complications and the length of hospitalization—between patients managed by laparoscopic cholecystectomy and those managed by the

conventional open technique. A secondary objective was to characterize the distribution of anesthesiologic risk according to the ASA classification and to assess the prevalence of relevant metabolic comorbidities (arterial hypertension, diabetes mellitus, and increased BMI) in this surgical population.

Materials and methods

3.1 Study design and setting: A retrospective observational study was conducted at the Department of Surgery of the Clinical Hospital of Tetova, Republic of North Macedonia, in collaboration with the Faculty of Medical Sciences of the University of Tetova. The medical records of consecutive adult patients who underwent cholecystectomy for symptomatic cholecystolithiasis at the institution were reviewed. The study was carried out in accordance with the principles of the Declaration of Helsinki, and patient confidentiality was preserved throughout.

3.2 Study population: A total of 64 patients were included. Inclusion criteria were: (i) age ≥ 18 years; (ii) clinical, biochemical, and ultrasonographic confirmation of cholecystolithiasis; (iii) elective or urgent cholecystectomy performed at the institution; and (iv) availability of complete clinical and surgical records. Patients with confirmed or suspected gallbladder malignancy, isolated common bile duct stones treated endoscopically without subsequent cholecystectomy, or incomplete medical records were excluded.

3.3 Variables and data collection: For each patient, the following data were extracted from the institutional records: age, sex, body mass index (BMI), preoperative comorbidities (arterial hypertension and diabetes mellitus), anesthetic risk according to the ASA physical status classification, type of surgical procedure (LC versus OC), intra- and postoperative complications, and length of hospital stay. Postoperative complications recorded included wound infection, hemorrhage from the surgical wound, and persistent or prolonged postoperative pain.

3.4 Surgical procedures: Laparoscopic cholecystectomy was performed using a standard four-port technique under general anesthesia, with carbon dioxide pneumoperitoneum, careful dissection of Calot's triangle to obtain the critical view of safety, and clipping of the cystic artery and cystic duct prior to gallbladder removal, in accordance with internationally accepted standards (Litwin & Cahan, 2008; Yamashita et al., 2013). Open cholecystectomy was performed through a right subcostal (Kocher) incision following standard anatomical dissection. The decision regarding the surgical approach was based on clinical presentation, intraoperative findings, anatomical considerations, available equipment, and surgeon judgment.

3.5 Outcome measures and statistical analysis: The primary outcomes were the frequency of postoperative complications and the length of postoperative hospital stay. Secondary outcomes included the distribution of comorbidities, BMI categories, and ASA classification across the surgical groups. Continuous variables are presented as range (minimum–maximum), while categorical variables are presented as absolute frequencies and percentages. Comparisons between LC and OC groups were performed in a descriptive manner, given the size of the cohort.

Results

4.1 Demographic characteristics: The study included 64 patients operated for symptomatic cholecystolithiasis. Of these, 48 (75%) were female and 16 (25%) were male, yielding a female-to-male ratio of 3:1. The age of patients ranged from 23 to 72 years, with the majority of cases concentrated in the fourth to sixth decade of life. The clear female predominance observed in this cohort is consistent with the well-established epidemiological pattern of gallstone disease, in which women are affected approximately two to three times more frequently than men (Shaffer, 2006; Stinton & Shaffer, 2012).

4.2 Surgical approach: Forty-six patients (71.9%) were operated using the laparoscopic approach, while 18 (28.1%) underwent the conventional open technique. This distribution reflects the institutional preference for minimally invasive management whenever feasible, with the open approach reserved for selected cases characterized by complex local anatomy, severe inflammation, or other technical contraindications.

4.3 Comorbidity profile and BMI: The comorbidity burden of the cohort was substantial. Arterial hypertension was present in 48 patients (75%) and diabetes mellitus in 32 (50%); a considerable proportion of patients had both conditions concurrently. Approximately 70% of patients presented with a BMI in the range of 28–30 kg/m², corresponding to overweight or early obesity, while the remainder had values either within the normal range or above 30 kg/m². This metabolic profile is consistent with the recognized association between gallstone disease and the metabolic syndrome (Lammert et al., 2016; Shaffer, 2006).

4.4 ASA classification: Preoperative anesthetic risk evaluation according to the ASA physical status classification revealed that 44 patients (68.75%) were classified as ASA I, 16 (25%) as ASA II, and 4 (6.25%) as ASA III. None of the patients were classified as ASA IV or higher. The summary of demographic and clinical characteristics is presented in Table 1.

Table 1. Demographic and clinical characteristics of the study population (n = 64).

Variable	n	%
Sex – Female	48	75.0
Sex – Male	16	25.0
Age range (years)	23–72	—
Laparoscopic cholecystectomy	46	71.9
Open cholecystectomy	18	28.1
Arterial hypertension	48	75.0
Diabetes mellitus	32	50.0
BMI 28–30 kg/m ² (approx.)	≈45	≈70
ASA I	44	68.75

Variable	n	%
ASA II	16	25.0
ASA III	4	6.25

4.5 Postoperative complications: The frequency of postoperative complications was clearly higher among patients who underwent the open procedure. Wound infection, hemorrhage from the surgical wound, and persistent postoperative pain were the predominant complications observed in the OC group. In contrast, the LC group exhibited a substantially lower complication burden, in line with the findings of large comparative studies and meta-analyses (Coccolini et al., 2015; Keus et al., 2010; Shea et al., 1996). No major bile duct injury, postoperative mortality, or readmission for complications was observed in this cohort. The distribution of postoperative complications by surgical technique is summarized in Table 2.

Table 2. Postoperative complications by surgical technique.

Complication	Laparoscopic (n = 46)	Open (n = 18)
Wound infection	Low frequency	Higher frequency
Wound hemorrhage	Rare	More frequent
Prolonged postoperative pain	Less frequent	More frequent
Length of hospital stay	Shorter	Longer

4.6 Length of hospital stay: Length of postoperative hospitalization was notably shorter in patients who underwent laparoscopic cholecystectomy compared with those treated by the open approach. This finding is in agreement with the broader international literature, which consistently reports shorter hospital stays after LC, even in patients with significant comorbidities (Ahmad et al., 2008; Keus et al., 2010; Pucher et al., 2018).

Discussion

The present study analyzed 64 patients operated for symptomatic cholecystolithiasis at the Clinical Hospital of Tetova, comparing the perioperative outcomes of laparoscopic and open cholecystectomy. The principal findings can be summarized as follows: a clear female predominance, a high prevalence of metabolic comorbidities (arterial hypertension, diabetes mellitus, and increased BMI), a predominantly low-to-intermediate ASA risk profile, a higher rate of wound-related complications and persistent pain in the open group, and substantially shorter hospitalization in the laparoscopic group. These observations are largely consistent with international evidence and reinforce the role of LC as the preferred surgical approach for symptomatic gallstone disease.

The female-to-male ratio of 3:1 observed in this cohort is in agreement with the well-documented sex predisposition to gallstone disease. Stinton and Shaffer (2012) reported that women are approximately twice as likely as men to develop cholelithiasis, with the difference being largest during the reproductive years and decreasing in older age groups. Estrogens increase biliary cholesterol secretion while progesterone reduces gallbladder motility, and pregnancy further accentuates these effects (Lammert et al., 2016). Our findings support the continued relevance of these risk patterns in the population of the Polog region.

The age distribution, ranging from 23 to 72 years, with most patients in the fourth to sixth decade, is in keeping with the natural history of cholelithiasis, in which the prevalence of gallstones increases steadily with age (Diehl, 1991; Shaffer, 2006). The relatively young lower bound of the age range observed in our cohort highlights that gallstone disease is by no means restricted to elderly patients, and that surgical referral pathways must accommodate younger adults presenting with biliary symptoms.

The high prevalence of metabolic comorbidities deserves particular attention. Arterial hypertension was present in three quarters of the cohort and diabetes mellitus in half, while approximately 70% of patients had a BMI in the overweight to early obese range. These figures are consistent with the well-established association between gallstone disease and components of the metabolic syndrome (Lammert et al., 2016; Shaffer, 2006). Obesity, in particular, increases biliary cholesterol saturation and promotes gallbladder hypomotility, while insulin resistance contributes to lithogenic bile composition (Lammert et al., 2016). The clustering of these risk factors in our patients underscores the importance of comprehensive perioperative evaluation and multidisciplinary management, especially in regions where the prevalence of metabolic disease is rising.

Despite the high prevalence of comorbidities, the majority of patients in our cohort were classified as ASA I or II, with only a small minority (6.25%) classified as ASA III. This relatively favorable risk profile is comparable to that reported in other observational series of elective cholecystectomy (Agrawal & Sood, 2015; Dolan et al., 2009). It is important to note that ASA classification is one of the most consistent predictors of postoperative morbidity and mortality after cholecystectomy, with higher classes associated with longer hospital stay, greater rates of complications, and higher conversion rates from laparoscopic to open surgery (Agrawal & Sood, 2015; Bingener-Casey et al., 2002; Dolan et al., 2009).

Approximately 71.9% of our patients underwent laparoscopic cholecystectomy, a figure broadly aligned with international trends, which show that LC has become the dominant approach in elective biliary surgery (Tsui et al., 2013). The remaining 28.1% were managed by the open technique, generally because of severe local inflammation, complex anatomy, or technical considerations. This proportion is somewhat higher than that reported in some Western series, in which open cholecystectomy is now performed in fewer than 10–15% of cases (Pucher et al., 2018; Tsui et al., 2013), and may reflect both case selection and resource availability in the regional setting. Bingener-Casey et al. (2002) similarly reported conversion and primary open rates that varied considerably according to patient comorbidities, acute presentation, and surgeon experience.

The higher frequency of wound infection, wound hemorrhage, and persistent postoperative pain in our open group corresponds closely to the patterns described in randomized trials and meta-analyses comparing the two approaches. McMahon et al. (1994) and Trondsen et al. (1993) demonstrated significantly lower rates of wound complications and postoperative pain in laparoscopic patients in early randomized comparisons. Subsequent Cochrane reviews and updated meta-analyses have consistently shown that LC is associated with fewer wound-related complications, less postoperative pain, faster mobilization, and earlier discharge from hospital (Keus et al., 2010; Pucher et al., 2018). Coccolini et al. (2015), in their meta-analysis comparing LC and OC in acute cholecystitis, also reported significantly lower morbidity and shorter hospital stay in the laparoscopic arm, even in this more challenging clinical setting.

The substantial reduction in length of hospital stay observed in the laparoscopic group is one of the most clinically and economically meaningful advantages of the minimally invasive approach. Multiple studies and pooled analyses have shown that LC enables earlier resumption of oral intake, lower analgesic requirements, and faster mobilization, leading to discharge within 24–48 hours in selected cases and even to ambulatory or day-case management in carefully chosen patients (Ahmad et al., 2008; Pucher et al., 2018). These benefits translate into

lower healthcare costs and improved patient satisfaction, while preserving—and in many series improving—safety outcomes (Pucher et al., 2018).

Although our cohort did not record major bile duct injuries or postoperative mortality, it should be emphasized that LC is not without specific risks. Bile duct injury, although uncommon, remains a feared complication and has been reported with somewhat higher frequency after LC than after OC in some early series (Khan et al., 2007; Shea et al., 1996; Z'graggen et al., 1998). Adherence to standardized technical principles, in particular the routine achievement of the critical view of safety, is widely recommended to minimize this risk (Litwin & Cahan, 2008; Yamashita et al., 2013). Strasberg (2008) further emphasized the importance of timely surgical intervention in acute calculous cholecystitis, ideally within the first week of symptom onset, to reduce both operative difficulty and the risk of conversion.

It is also important to acknowledge that not all patients experience complete symptom relief after cholecystectomy. Berger et al. (2003) reported that abdominal symptoms persist in a proportion of patients postoperatively, particularly when symptoms preoperatively were less specifically biliary in character. Careful selection of surgical candidates, with proper correlation of clinical, biochemical, and imaging findings, is therefore essential to optimize outcomes.

Our study has several limitations. First, the retrospective design and single-center nature of the analysis restrict the generalizability of the findings. Second, the relatively small sample size ($n = 64$) and the absence of formal inferential statistical testing limit the strength of the comparisons between LC and OC. Third, allocation to surgical approach was not randomized but determined by clinical judgment, which may have introduced selection bias, with more complex cases preferentially allocated to the open technique. Despite these limitations, the present study provides locally relevant data on a representative cohort of patients operated for cholecystolithiasis at a regional tertiary hospital and confirms patterns described in larger international series. Future prospective, multicenter studies with standardized definitions of complications and longer follow-up are warranted to refine outcome estimates and to evaluate long-term symptomatic and functional results.

Conclusion

In this retrospective single-center study of 64 patients operated for symptomatic cholecystolithiasis at the Clinical Hospital of Tetova, in collaboration with the Faculty of Medical Sciences of the University of Tetova, laparoscopic cholecystectomy was the predominant surgical approach (71.9%) and was associated with fewer wound-related complications, less prolonged postoperative pain, and substantially shorter hospitalization compared with the open technique. The cohort was characterized by a marked female predominance, a high prevalence of metabolic comorbidities (arterial hypertension in 75%, diabetes mellitus in 50%, and BMI in the overweight range in approximately 70% of patients), and a predominantly low-to-intermediate anesthesiologic risk profile. These results reinforce the position of laparoscopic cholecystectomy as the preferred treatment for symptomatic cholecystolithiasis and emphasize the importance of comprehensive preoperative evaluation, including ASA classification and detailed assessment of metabolic comorbidities, in order to optimize patient selection, perioperative management, and surgical outcomes in regional clinical practice.

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