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Conversion from laparoscopic to open cholecystectomy in patients with obesity and overweight, rate, causes and contributing factors: a cross-sectional study

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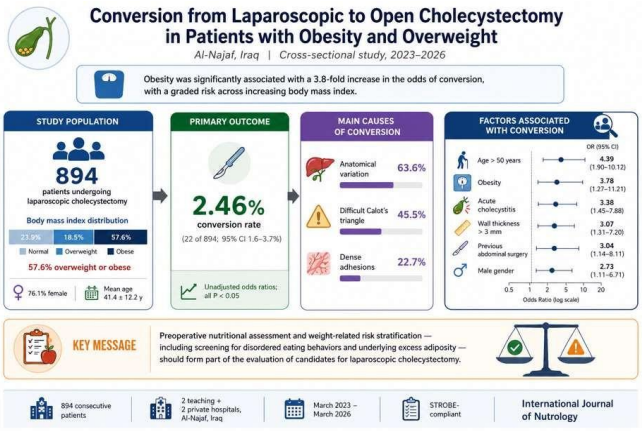
Abstract

Introduction: Laparoscopic cholecystectomy is the gold-standard treatment for symptomatic cholelithiasis. Obesity and overweight - conditions central to nutrology and frequently linked to disordered eating patterns and altered nutritional status - are common among these patients and may complicate the laparoscopic approach, occasionally necessitating conversion to open surgery to preserve patient safety. **Objective:** To estimate the rate of conversion from laparoscopic to open cholecystectomy, to identify the main causes of conversion, and to assess contributing factors - with particular attention to obesity and overweight - among Iraqi patients. **Methods:** This cross-sectional study, reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement, included 894 Iraqi patients of both genders with symptomatic cholecystitis undergoing laparoscopic cholecystectomy at two governmental teaching hospitals and two private hospitals in Al-Najaf, from March 2023 to March 2026. All eligible patients operated on during the study period were enrolled consecutively (total enumeration); this sample exceeded the calculated minimum of 416 patients and estimated the conversion rate with an absolute precision of ±1.0 percentage point at the 95% confidence level. Body mass index was classified per World Health Organization criteria. Unadjusted odds ratios (OR) with 95% confidence intervals (CI) were calculated; $P < 0.05$ was significant. **Results:** Of 894 laparoscopic cholecystectomies, 22 required conversions (rate 2.46%; 95% CI 1.63–3.70%). Overweight (34.3%) and obese (23.3%) patients constituted the majority of the cohort. Causes of conversion were anatomical variation/anomalies (63.6%), difficult Calot's triangle (45.5%), dense adhesions (22.7%), uncontrollable bleeding (9.1%) and bile duct injury (4.5%). Obesity was significantly associated with conversion (OR = 3.78; 95% CI: 1.27–11.21). Additional associated factors were age > 50 years (OR = 4.39; 95% CI: 1.85–10.41), male gender (OR = 2.73; 95% CI: 1.16–6.40), previous abdominal surgery (OR = 3.04; 95% CI: 1.21–7.62), acute cholecystitis (OR = 3.38; 95% CI: 1.29–8.87) and gallbladder wall thickness > 3 mm (OR = 3.07; 95% CI: 1.26– 7.44). **Conclusion:** The conversion rate of 2.46% lies within the lower international range. Obesity and overweight are prevalent and clinically relevant in this surgical population, and obesity was significantly associated with conversion. These findings support the inclusion of nutritional assessment and weight-related risk stratification — including screening for disordered eating behaviors that contribute to excess adiposity — in the preoperative evaluation of candidates for laparoscopic cholecystectomy. Because the analysis was bivariate and the number of conversion events was small, these associations should be regarded as hypothesis-generating and require confirmation in larger studies with multivariable adjustment.

Keywords: Cholecystectomy, Laparoscopic; Conversion to Open Surgery; Obesity; Overweight; Feeding and Eating Disorders; Body Mass Index.

Graphical Abstract



Source: Own authorship.

Introduction

Gallstone disease is one of the most common gastrointestinal disorders worldwide, with a prevalence ranging between 11% and 36%, and it frequently requires hospitalization **[1]**. Cholecystitis is a polyetiologic inflammatory disease of the gallbladder characterized by mechanical or physiological dysfunction, changes in its physico-chemical properties, and dyskinesia. Its incidence increases steadily each year, a trend attributable to changes in individual lifestyle, sedentary behavior, increased consumption of energy-dense fatty foods, and certain endocrine disorders. During their reproductive years, women are about four times more likely than men to develop cholecystitis, and young adults are three to four times more prone to acute cholecystitis than the elderly **[2]**.

The pathophysiology of cholecystitis relates mainly to occlusion of the cystic duct or functional impairment of gallbladder emptying. More than 90% of chronic cholecystitis is associated with gallstones, which most often block the cystic duct and obstruct bile flow, producing inflammation and edema of the gallbladder wall. Conversely, bile stasis due to tumors or strictures can itself promote gallstone formation and cholecystitis **[3]**.

The relevance of this surgical population to nutrology is considerable. Obesity and overweight are well-established risk factors for gallstone disease, and both conditions frequently arise from — or coexist with — disordered eating behaviors and abnormal nutritional patterns. Excess adiposity increases hepatic cholesterol secretion, leading to cholesterol supersaturation of gallbladder bile, and is further associated with impaired gallbladder motility and a chronic low-grade inflammatory state, all of which favor lithogenesis and influence gallbladder function and surgical outcomes **[4]**.

Because a substantial proportion of patients presenting for cholecystectomy carry an elevated body mass index, the nutritional and metabolic characterization of these patients is central to their perioperative management and to understanding the technical difficulty of the laparoscopic approach **[4,5]**.

Surgery is the treatment of choice for symptomatic patients. Open cholecystectomy (OC) was previously the standard, but with advances in laparoscopic technique, growing surgical experience, avoidance of large incisions, shorter hospital stays, and earlier return to normal activity, laparoscopic cholecystectomy (LC) has become the gold-standard approach; OC is now performed largely as a conversion from LC. Several factors contribute to failure to complete LC, including the patient's condition, the surgeon's experience, and technical factors. The main reasons for conversion are difficulty in defining the anatomy, difficult dissection, and the development of complications such as bleeding **[5]**. In elective LC the conversion rate is up to 5%, rising to as high as 30% when complications develop **[6-8]**. Given the wide variation in reported rates and the additional technical challenge posed by obesity, studies continue to assess conversion rates and their determinants in order to identify high-risk patients preoperatively and refine treatment planning **[9-11]**.

Therefore, the objective of the present study was to estimate the rate of conversion from laparoscopic to open cholecystectomy among Iraqi patients operated on for symptomatic cholelithiasis, to identify the main intraoperative causes of conversion, and to assess the patient-related and clinical factors associated with it - with particular attention to overweight and obesity as prevalent, modifiable, nutrition-related conditions of direct relevance to nutrology.

Patients and Methods

Study design and setting

This cross-sectional study was conducted at two main governmental teaching hospitals – Al-Sader Teaching Hospital and Al-Najaf Teaching Hospital - and two private hospitals in Al-Najaf city. Data were collected between March 2023 and March 2026. A total of 894 patients undergoing laparoscopic cholecystectomy who met the inclusion criteria were enrolled. The study was designed, conducted and reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement for cross-sectional studies **[12]**,

and the completed STROBE checklist (available at https://www.strobe-statement.org/) is provided as a supplementary file with this submission.

Inclusion criteria

1. Iraqi adult patients of both genders.
2. Underwent laparoscopic cholecystectomy for symptomatic cholelithiasis.
3. Physical status class I or II according to the American Society of Anesthesiologists classification.
4. Provided signed informed consent.

Exclusion criteria

1. Identified gallbladder or other organ malignancy.
2. Emergency cholecystectomy due to gallbladder perforation, peritonitis or other causes.
3. Cholecystectomy combined with bariatric surgery.
4. Pregnancy.
5. Morbid obesity (body mass index ≥ 40 kg/m²), because these patients are managed along a different perioperative pathway in the participating centers.
6. Severe or uncontrolled heart disease.
7. Active abdominal infection.
8. Missing critical data such as the reason for conversion.

Data collection

Data were recorded electronically using Microsoft Excel 2020 and obtained through full history, thorough clinical examination, and confirmatory imaging and laboratory investigation. Collected variables included socio-demographic characteristics and preoperative, intraoperative and postoperative clinical, laboratory and imaging findings.

Nutritional and anthropometric assessment

Weight and height were measured using standard procedures and the calibrated scales available in each setting, approximated to the nearest 0.5 unit. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m²). Patients were grouped according to the adult BMI classification of the World Health Organization **[13]** as follows: healthy weight (BMI 18.5–24.9 kg/m²), overweight (BMI 25–29.9 kg/m²) and obese (BMI ≥ 30 kg/m²). No patient was underweight (BMI < 18.5 kg/m²). Because only 22 conversions occurred, obesity was not further subdivided into classes I, II and III. Given the nutrology focus of this analysis, the distribution of overweight and obesity across the cohort and its association with conversion were examined as primary variables of interest.

Surgical Procedure

Preoperatively, all patients were prepared according to the standard protocols of the participating hospitals, and all LC procedures followed standard technique. Conversion to open cholecystectomy was undertaken when intraoperative complications developed or when there was difficulty in the approach or anatomical variation; the final decision to convert rested with the operating surgeon and was based on patient safety and clinical status. Postoperatively, patients were transferred to the surgical ward on recovery from anesthesia, monitored for surgical outcomes, and discharged home. Critical study variables included operative time, conversion to OC, timing of the decision to convert, cause of conversion, complications and associated factors.

Ethical considerations

All ethical issues were addressed in accordance with the World Medical Association Declaration of Helsinki — Ethical Principles for Medical Research Involving Human Participants, 2024 **[14]**. The study protocol was approved by the Research Ethics Committee of the College of Medicine, Jabir ibn Hayyan University for Medical and Pharmaceutical Sciences, Al-Najaf, Iraq . All patients were informed preoperatively about the surgical procedure, possible complications and the possibility of conversion, and signed informed consent was obtained from each participant. All patient information was kept confidential and privacy was protected.

Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 28 and the OpenEpi online calculator **[15]**. Variables were presented as frequencies and percentages. The chi-square test was used to compare categorical variables, with Fisher's exact test applied when the chi-square test was inapplicable. The risk of conversion across contributing factors was assessed using the unadjusted odds ratio (OR) and its 95% confidence interval (CI). A multivariable logistic regression model was not fitted because only 22 conversion events were observed; with fewer than 10 events per candidate variable, such a model would yield unstable and potentially biased estimates. All reported odds ratios are therefore bivariate. All tests were two-tailed, with statistical significance set at $p < 0.05$.

Sample size and sampling

A non-probability consecutive (total enumeration) sampling technique was applied: every patient who

fulfilled the eligibility criteria and underwent laparoscopic cholecystectomy at the four participating centers during the 36-month study period was enrolled, so that no eligible patient was excluded on sampling grounds. The minimum required sample size was computed with the

OpenEpi calculator **[15]** using the single-proportion formula $n = Z^2 P (1 - P) / d^2$, assuming an expected conversion rate (P) of 2.5% based on previously published conversion rates **[6]**, a 95% confidence level (Z = 1.96) and an absolute precision (d) of ±1.5%; this yielded a minimum of 416 patients. The 894 patients actually recruited exceeded this requirement and allowed the conversion rate to be estimated with an absolute precision of ±1.0 percentage point (95% CI 1.63–3.70% by the Wilson method). A post hoc power analysis at a two-sided α of 0.05 indicated that the achieved sample provided approximately 90% power to detect the observed difference in conversion between patients older than 50 years and younger patients, and approximately 70% power for the observed difference between obese and normal-weight patients. The study was therefore adequately powered for its primary estimate but only moderately powered for some subgroup comparisons, as acknowledged in the study limitations.

Results

A total of 894 patients with symptomatic cholelithiasis were enrolled. Patient age ranged from 21 to 71 years (mean 41.4 ± 12.2 years), and 58.4% were aged 31–50 years. Females predominated, comprising 76.1% of the cohort (female-to-male ratio ≈ 3.2). Notably, the majority of patients were overweight or obese: 307 patients (34.3%) were overweight and 208 (23.3%) were obese, together accounting for more than half of the cohort (57.6%) and underscoring the nutritional profile of this surgical population. A history of previous abdominal surgery was present in 123 patients (13.8%). Clinically, 89.6% presented with chronic and 10.4% with acute cholecystitis. Preoperative ultrasonography showed a gallbladder wall thickness greater than 3 mm in 145 patients (16.2%) (Table 1).

Intraoperatively, 22 patients required conversion from laparoscopic to open cholecystectomy, giving a conversion rate of 2.46% (95% CI 1.63–3.70%). As shown in Figure 1, the remaining 872 procedures (97.54%) were completed laparoscopically. Among the 22 converted patients, the causes of conversion were anatomical variation/anomalies (ductal or vascular) in 14 (63.6%), difficult Calot's triangle in 10 (45.5%), dense adhesions from previous surgery in 5 (22.7%), uncontrollable bleeding in 2 (9.1%), and bile duct injury in 1 (4.5%); the percentages exceed 100% because more than one cause was recorded in some patients (Table 2).

On cross-tabulation, age older than 50 years was significantly associated with conversion: such patients were about 4.4 times more likely to require conversion (OR = 4.39; 95% CI: 1.85– 10.41). Male patients showed a higher risk of conversion (OR = 2.73; 95% CI: 1.16–6.40) (Table 3).

The association between BMI category and conversion is shown in Table 4. Obesity was significantly associated with approximately 3.8 times higher odds of conversion compared with the normal-weight reference group (OR = 3.78; 95% CI: 1.27–11.21), while overweight showed a non-significant trend toward increased risk (OR = 1.74; 95% CI: 0.54–5.60). This gradient of risk across increasing adiposity highlights the clinical relevance of nutritional status to surgical outcome.

Previous abdominal surgery was a significant predictor: patients with a history of prior surgical intervention had a higher conversion rate of 5.7% (OR = 3.04; 95% CI: 1.21–7.62) (Table 5). Acute cholecystitis was associated with about 3.4 times higher odds of conversion compared with chronic cholecystitis (OR = 3.38; 95% CI: 1.29–8.87), and gallbladder wall thickness greater than 3 mm increased the risk of conversion almost threefold (OR = 3.07; 95% CI: 1.26–7.44) (Table 6). All seven factors examined are summarized graphically in Figure 2, in which each square represents the point estimate of the odds ratio, each horizontal bar the corresponding 95% confidence interval, and the dashed vertical line the null value of OR = 1. The confidence intervals of the six significant factors lie entirely to the right of this line, whereas that of the overweight category crosses it, consistent with the non-significant association reported above.

Table 1. Preoperative characteristics of the studied group (N = 894).

Variable	No.	%
Age (years)		
≤ 30	143	16.0
31–40	305	34.1
41–50	217	24.3
51–60	152	17.0
> 60	77	8.6
Gender		
Male	214	23.9
Female	680	76.1

BMI category		
Obese (≥ 30 kg/m²)	208	23.3
Overweight (25–29.9 kg/m²)	307	34.3
Normal (18.5–24.9 kg/m²)	379	42.4
Previous abdominal surgery		
Yes	123	13.8
No	771	86.2
Type of cholecystitis		
Chronic	801	89.6
Acute	93	10.4
Gallbladder wall thickness*		
> 3 mm	145	16.2
≤ 3 mm	749	83.8

BMI: body mass index. *According to preoperative ultrasonography. Source: Own authorship.

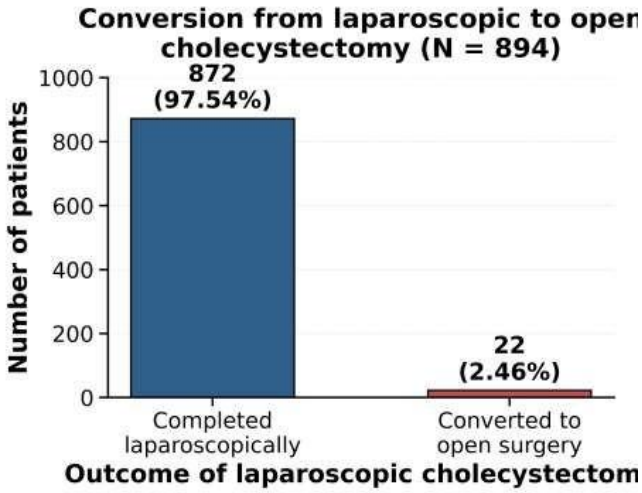


Figure 1. Outcome of laparoscopic cholecystectomy in the studied group (N = 894). The horizontal (x) axis shows the two mutually exclusive outcomes of the procedure and the vertical (y) axis the number of patients. The blue bar represents the 872 procedures (97.54%) completed laparoscopically and the red bar the 22 procedures (2.46%; 95% CI 1.63–3.70%) converted to open cholecystectomy (OC). The label above each bar gives the absolute number of patients and, in parentheses, the corresponding percentage of the whole cohort. Source: Own authorship.

Table 2. Causes of conversion from laparoscopic to open cholecystectomy among the studied group (n = 22).

Cause of conversion*	No.	%
Anatomical variation/anomalies (ductal or vascular)	14	63.6
Difficult Calot's triangle	10	45.5
Dense adhesions (from previous surgery)	5	22.7
Uncontrollable bleeding	2	9.1
Bile duct injury	1	4.5

*Some patients had more than one cause of conversion; percentages are calculated from the 22 converted patients and therefore sum to more than 100%. Source: Own authorship.

Table 3. Association between conversion and patient's age and gender.

Variable	Converted (No., %)	Not converted (No., %)	Total (No., %)	Unadjusted OR (95% CI)	p- value
Age > 50 years	13 (5.7)	216 (94.3)	229 (25.6)	4.39 (1.85–10.41)	0.001
Age ≤ 50 years (ref.)	9 (1.4)	656 (98.6)	665 (74.4)	1.00	—
Male	10 (4.7)	204 (95.3)	214 (23.9)	2.73 (1.16–6.40)	0.023
Female (ref.)	12 (1.8)	668 (98.2)	680 (76.1)	1.00	—

OR: odds ratio; CI: confidence interval; ref.: reference category. Source: Own authorship.

Table 4. Association between conversion and patient's BMI category.

BMI category	Converted (No., %)	Not converted (No., %)	Total (No., %)	Unadjusted OR (95% CI)	p- value
Obese	10 (4.8)	198 (95.2)	208 (23.3)	3.78 (1.27–11.21)	0.014
Overweight	7 (2.3)	300 (97.7)	307 (34.3)	1.74 (0.54–5.60)	0.389
Normal (ref.)	5 (1.3)	374 (98.7)	379 (42.4)	1.00	—

BMI: body mass index; OR: odds ratio; CI: confidence interval; ref.: reference category. Source: Own authorship.

Table 5. Association between conversion and previous abdominal surgery.

Previous abdominal surgery	Converted (No., %)	Not converted (No., %)	Total (No., %)	Unadjusted OR (95% CI)	p-value
Yes	7 (5.7)	116 (94.3)	123 (13.8)	3.04 (1.21–7.62)	0.023*
No (ref.)	15 (1.9)	756 (98.1)	771 (86.2)	1.00	—

*Fisher's exact test used in comparison. OR: odds ratio; CI: confidence interval; ref.: reference category. Source: Own authorship.

Table 6. Association between conversion and type of cholecystitis and gallbladder wall thickness.

Variable	Converted (No., %)	Not converted (No., %)	Total (No., %)	Unadjusted OR (95% CI)	p- value
Acute cholecystitis	6 (6.5)	87 (93.5)	93 (10.4)	3.38 (1.29–8.87)	0.020*
Chronic cholecystitis (ref.)	16 (2.0)	785 (98.0)	801 (89.6)	1.00	—
Wall thickness > 3 mm	8 (5.5)	137 (94.5)	145 (16.2)	3.07 (1.26–7.44)	0.017*
Wall thickness ≤ 3 mm (ref.)	14 (1.9)	735 (98.1)	749 (83.8)	1.00	—

*Fisher's exact test used in comparison. OR: odds ratio; CI: confidence interval; ref.: reference category. Source: Own authorship.

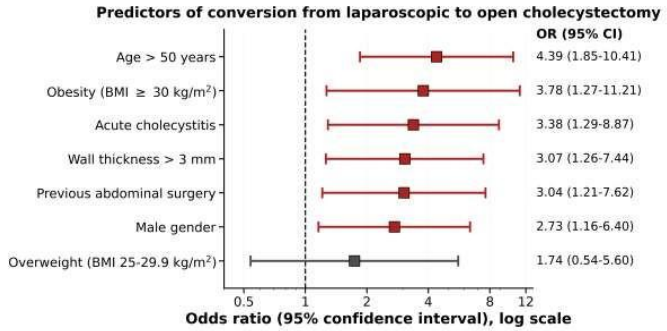


Figure 2. Forest plot of the unadjusted odds ratios (OR) with 95% confidence intervals (CI) for factors associated with conversion from laparoscopic to open cholecystectomy. The vertical (y) axis lists the seven factors examined, arranged in order of decreasing OR; the horizontal (x) axis shows the OR on a logarithmic scale. Each square denotes the point estimate of the OR and each horizontal bar its 95% CI, with vertical end-caps marking the confidence limits. The dashed vertical line at OR = 1 denotes no association: a confidence interval lying entirely to the right of this line indicates a statistically significant increase in the odds of conversion (shown in red), whereas an interval crossing the line indicates a non-significant association (shown in grey). The numerical OR and 95% CI for each factor are printed to the right of the corresponding row. Factors: age > 50 years (OR 4.39), obesity (OR 3.78), acute cholecystitis (OR 3.38), gallbladder wall thickness > 3 mm (OR 3.07), previous abdominal surgery (OR 3.04), male gender (OR 2.73) and overweight (OR 1.74, non-significant). Source: Own authorship.

Discussion

The surgical treatment of gallstone disease has evolved considerably over the past three decades, with LC largely replacing OC. Nonetheless, OC is still performed — now almost exclusively as a conversion — because of patient-related, clinical and technical factors. LC remains preferred for its many advantages, including less postoperative pain, fewer complications, shorter hospital stay and earlier resumption of normal activity **[16,17]**. Conversion to OC, however, remains a significant surgical outcome that challenges surgeons owing to the complexity of the procedure and its associated risks. Because studies from Iraq remain scarce or based on small samples, and because conversion rates vary widely both internationally and nationally, this study set out to estimate the conversion rate, describe its causes, and identify contributing factors, with particular attention to the nutritional profile of the cohort.

Over the 36-month study period, 894 patients were selected from two governmental teaching hospitals and two private hospitals. Most were aged 31–50 years and predominantly female (76.1%), and the majority presented with chronic cholecystitis. These findings are consistent with the epidemiological profile of the disease and agree with previous Iraqi studies from Al-Diwaniyah, Baghdad, Samawa and Erbil **[18-21]** as well as international studies from Saudi Arabia, Turkey and Pakistan **[22-24]**.

A defining feature of this cohort — and one central to its relevance for nutrology — is that overweight and obese patients together comprised the majority (57.6%) of participants. This reflects the well-recognized link between excess adiposity, disordered eating and nutritional patterns, and gallstone disease **[4,13]**. From a nutrological perspective, the high prevalence of overweight and obesity in patients presenting for cholecystectomy reinforces the importance of nutritional assessment, dietary history, and screening for disordered eating behaviors as part of comprehensive perioperative care. Obesity not only predisposes to gallstone formation through altered bile cholesterol saturation but also increases the technical difficulty of laparoscopic surgery through thickened abdominal wall, increased intra-abdominal fat, and impaired visualization of the operative field **[4]**.

The conversion rate in our series was 2.46%, close to the 2.7% reported by Witwit and Jassim at Baghdad Teaching Hospital **[25]**. Abdulhussein et al. reported 3.5% among 1600 patients **[26]**, Rashid et al. 5.2% at Al-Kindy Teaching Hospital **[27]**, and Alsagban et al. an overall rate of 8.6% at Al-Diwaniyah Teaching Hospital **[18]**. Muhammed et al. in Erbil reported 3.86% **[21]**, Faraj et al. in Sulaymaniyah 4.5% **[28]**, and Al-Shammari and Al-Khazaali 6% in Baghdad **[19]**, while a much higher rate of 21.4% was reported in an earlier Baghdad study **[29]**. Internationally, our rate lay within the lower range, comparable with that reported from a large Saudi series **[22]**. In general, 2–15% of LCs are converted to OC, with the rate depending on the surgeon's decision, patient-related factors and technical considerations **[30]**.

Anatomical variation/anomalies (ductal or vascular) were the leading cause of conversion (63.6%), followed by a difficult Calot's triangle (45.5%) and dense adhesions (22.7%); uncontrollable bleeding and bile duct injury were less frequent. These causes are consistent with the literature: Al Rubaey documented similar reasons from Iraq **[31]**, and Shravan et al. reported acute inflammation, aberrant anatomy, a frozen Calot's triangle and bleeding as the main causes **[30]**. Unclear anatomy is a key contributor because precise identification of structures in Calot's triangle becomes difficult with anatomical variation. Techniques such as fundus-first dissection are associated with lower conversion rates **[31]**.

Regarding contributing factors, obesity emerged

as a significant factor, with obese patients about 3.8 times more likely to require conversion (OR = 3.78) and a graded increase in risk across BMI categories. This finding is of particular importance for nutrology, as it links a modifiable, nutrition-related condition directly to an adverse surgical outcome. Obesity increases operative difficulty through greater abdominal wall thickness, abundant intra-abdominal and visceral fat, hepatomegaly and limited working space, all of which impair exposure and dissection **[4]**. The observation that overweight patients showed an intermediate, non-significant increase in risk suggests a dose–response relationship between adiposity and conversion that merits further study. These results are consistent with Al Rubaey, Shravan et al. and others who reported older age, male gender and obesity as risk factors for conversion **[30,31]**.

Age older than 50 years was associated with 4.4 times higher odds of conversion, likely reflecting age-related physiological and anatomical changes. Male gender carried about 2.7 times higher risk despite the higher prevalence of cholecystitis in women, possibly because inflammation and fibrosis tend to be more severe in men **[30]**; it should be noted, however, that Al-Mulhim found male gender not to be a risk factor for adverse outcome in a single-surgeon series, indicating that this association is not uniform across settings **[32]**. Previous abdominal surgery was another significant factor, plausibly through dense adhesions that distort the surgical field, restrict mobility, limit laparoscopic manipulation and increase the risk of ductal or vascular injury. Acute cholecystitis conferred about 3.4 times higher odds of conversion, attributable to inflammation and edema that obscure tissue planes, adhesions between the gallbladder, omentum and adjacent structures, and increased vascularity that raises the risk of bleeding **[5]**. Finally, a gallbladder wall thickness greater than 3 mm was associated with almost threefold higher odds of conversion, in keeping with the preoperative risk factors identified in a systematic review and meta-analysis of this outcome **[10]**.

Study Limitations

Several limitations should be considered when interpreting these findings. First, the study was observational and cross-sectional, so the associations reported cannot establish causality. Second, only 22 conversion events occurred; this precluded multivariable adjustment, so all odds ratios are unadjusted and residual confounding between correlated factors (for example age, male gender and acute inflammation) cannot be excluded, and the confidence intervals are correspondingly wide — the post hoc power for the obesity comparison was approximately 70%. Third, nutritional status was characterized by BMI alone; waist circumference, body composition, dietary history and validated screening instruments for disordered eating were not applied, which limits the depth of the nutrological characterization and represents an important avenue for future research in this population. Fourth, patients with morbid obesity and those requiring emergency surgery were excluded, so the findings apply to patients with obesity classes I and II undergoing elective procedures and should not be extrapolated to more severe obesity. Fifth, procedures were performed by several surgeons of differing experience across four centers, and the decision to convert — although based on patient safety — remains partly subjective and surgeon-dependent; surgeon experience was not analyzed as a separate variable. Finally, the study was confined to a single Iraqi city, which may limit generalizability to other regions and health systems. Multicentre studies with larger samples, prospective nutritional characterization and multivariable modeling are recommended.

Conclusion

Laparoscopic cholecystectomy is the gold-standard treatment for symptomatic cholelithiasis, but conversion to open surgery remains necessary in a minority of patients at higher risk, to preserve patient safety and outcome. The conversion rate in our study was 2.46% (95% CI 1.63– 3.70%), within the lower international range. The main causes were anatomical variation/anomalies, a difficult Calot's triangle and dense adhesions, with uncontrollable bleeding and bile duct injury being less frequent. Overweight and obese patients constituted the majority of this surgical cohort, and obesity was significantly associated with conversion in bivariate analysis, alongside age over 50 years, male gender, previous abdominal surgery, acute cholecystitis and gallbladder wall thickness greater than 3 mm. Within the limits of an unadjusted cross-sectional analysis, these findings support the inclusion of preoperative nutritional assessment and weight-related risk stratification — including attention to disordered eating behaviors underlying excess adiposity — in the evaluation of candidates for laparoscopic cholecystectomy. They should be regarded as hypothesis-generating, and confirmation in larger multicentre studies with prospective nutritional evaluation and multivariable adjustment is recommended.

CRediT

Author contributions: This manuscript has a single author. Alaa Abood Najim Al Wadees: conceptualization; methodology; validation; formal analysis; investigation; resources; data curation; writing — original draft preparation; writing — review and editing; visualization; supervision; project administration. The author has read and agreed to the published version of the manuscript.

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The author thanks the staff of the participating hospitals for their support during data collection.

Ethical Approval

The study was approved by the Research Ethics Committee of the College of Medicine, Jabir ibn Hayyan University for Medical and Pharmaceutical Sciences, Al-Najaf, Iraq . Written informed consent was obtained from all participants. The author declares that generative artificial intelligence was not used to produce the scientific content, data or conclusions of this manuscript; any AI-assisted editing was limited to language and formatting and was reviewed by the author, and was conducted in accordance with the Declaration of Helsinki, as revised in 2024.

Informed Consent

It was applicable.

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Data Sharing Statement

The de-identified dataset generated and analyzed during the current study is not deposited in a public repository, because neither the approval granted by the institutional research ethics committee nor the informed consent obtained from participants covered the public release of individual patient data. The dataset is available from the corresponding author (a.wadees@jmu.edu.iq) on reasonable request, subject to approval by the institutional research ethics committee and to the completion of a data-use agreement by the requesting party. No web link to an external dataset is applicable to this submission. The STROBE checklist and the high-resolution figure files are provided as supplementary materials.

Conflict of Interest

The author declares no conflict of interest. The ICMJE Disclosure of Interest form (https://icmje.org/disclosure-of-interest/) has been completed and is submitted with this revision.

Similarity Check

It was applied by Ithenticate[@].

Application of Artificial Intelligence (AI)

Not applicable.

Peer Review Process

It was performed.

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