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Original article

Safety of concomitant cholecystectomy at the time of laparoscopic sleeve gastrectomy: analysis of the American College of Surgeons National Surgical Quality Improvement Program database

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Abstract

Background: The indication and safety of concomitant cholecystectomy (CC) during bariatric surgical procedures are topics of controversy. Studies on the outcomes of CC with laparoscopic sleeve gastrectomy (LSG) are scarce.

Objectives: To assess the safety and 30-day surgical outcomes of CC with LSG.

Methods: A retrospective analysis of the American College of Surgeons National Surgical Quality Improvement Program database 2010 to 2013. Univariate and multivariate analyses were used.

Results: Between 2010 and 2013, 21,137 patients underwent LSG; of those 422 (2.0%) underwent CC (LSG+CC), and the majority (20,715 [98%]) underwent LSG alone. Patients in both groups were similar in age, sex distribution, baseline weight, and body mass index. The average surgical time was significantly higher, by 33 minutes, in the LSG +CC cohort. No differences were noted between the groups with regard to overall 30-day mortality and length of hospital stay. CC increased the odds of any adverse event (5.7% versus 4.0%), but the difference did not reach statistical significance (odds ratio 1.49, $P = .07$). Two complications were noted to be significantly higher with LSG+CC, namely bleeding ($P = .04$) and pneumonia ($P = .02$).

Conclusion: CC during LSG appears to be a safe procedure with slightly increased risk of bleeding and pneumonia compared with LSG alone. When factoring the potential risk and cost of further hospitalization for deferred cholecystectomy, these data support CC for established gallbladder disease. (Surg Obes Relat Dis 2017;13:934–942.)

Keywords: Cholecystectomy; Laparoscopic sleeve gastrectomy; Gallstones; American College of Surgeons National Surgical Quality Improvement Program; Bariatric surgery

Obesity is a major risk factor for liver and gallbladder pathologies. The overall prevalence of cholelithiasis in the general population is 10% to 20% [1]. The incidence of cholelithiasis in patients with severe obesity is 3 to 5 times higher compared with that for lean patients [2–7]. The risk of cholelithiasis increases after rapid weight loss, with the incidence ranging between 28% and 71% [2,3,8]. Symptomatic cholelithiasis after bariatric surgery that necessitates cholecystectomy occurs in 3% to 28% of patients [2,7,9–11].

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With the increased risk of cholelithiasis in obese patients, the question of whether to remove the gallbladder at the time of bariatric surgery remains controversial. In the open gastric bypass era, routine cholecystectomy commonly was performed regardless of the presence of gallbladder pathology [12]. This approach was justified given the high likelihood of the development of gallstones with rapid weight loss and because a cholecystectomy can be easily and safely performed through a generous midline incision. With the introduction of laparoscopic surgery, this approach became less popular secondary to the potential difficulties and complications from laparoscopic cholecystectomy that could be challenging in the setting of severe obesity [8,9]. For many surgeons, the benefit of routine cholecystectomy in patients without preexisting biliary disease did not justify the additional risk. Moreover, the risks associated with cholecystectomy after a laparoscopic procedure are not as high as those with cholecystectomy after a previous laparotomy (potential for adhesions) or in a severely obese patient.

Currently, most bariatric surgeons agree that there is no role for routine cholecystectomy, but disagreement persists on the necessity and timing of cholecystectomy in patients with established gallbladder disease [8,13–15]. Delayed or deferred cholecystectomy is advocated by some surgeons because the surgery is easier after massive weight loss. This approach has major disadvantages, including the added cost, morbidity, and hospitalization related to the additional surgery. In addition, some patients may develop complications related to gallstones in the interim, such as pancreatitis, cholecystitis, and cholangitis [7]. This study aimed to examine the safety of performing concomitant cholecystectomy (CC) during laparoscopic sleeve gastrectomy (LSG) by comparing the outcomes of LSG with and without cholecystectomy (LSG+CC and LSG alone, respectively).

Methods

Study design and data source

A retrospective analysis of the American College of Surgeons National Quality Improvement Program (ACS-NSQIP) 2010 to 2013 database was performed. The ACS-NSQIP is a prospective, externally validated outcome registry that collects details about patients undergoing surgical procedures in >250 medical centers. Approval to conduct this study was not needed or sought because data were collected as part of a quality assurance activity in accordance with American University of Beirut's guidelines. The ACS-NSQIP and the hospitals participating in the ACS-NSQIP are the source of the data used herein; they have not verified and are not responsible for the statistical validity of the data analysis or the conclusions derived by the authors.

Patients

Patients who underwent LSG were identified using a specific current procedure terminology code (43775). In addition, to identify patients undergoing concomitant laparoscopic cholecystectomy, 2 additional current procedure terminology codes for laparoscopic cholecystectomy (47,562) and laparoscopic cholecystectomy with cholangiography (47,563) were used. Patients with a missing body mass index (BMI) (n = 24) or with a BMI <35 kg/m^2 (n = 932) were excluded from the analysis. Emergency cases (n = 61) also were excluded because the analysis was targeted toward elective surgeries and because those cases potentially would increase the rate of complications.

Data

Preoperative data included demographic characteristics (age, sex, and race); anthropomorphic data (weight, height, and BMI); presence of medical co-morbidities; and laboratory data. Intraoperative variables included American Society of Anesthesiologists physical status classification, airway trauma, number of red blood cell units given, and total length of the surgery. Sex, race, American Society of Anesthesiologists class, and functional status were imputed to their modes to account for missing values (n = 36, 2086, 29, and 54 respectively). Missing laboratory values were included into a new category called "unknown" and were analyzed accordingly. Analysis was repeated using laboratory values imputed to their means, with the results provided on request. Outcome variables included surgical time; total length of hospital stay; major adverse events such as superficial surgical site infection (SSI), deep SSI, organ/space SSI, wound disruption, pneumonia, unplanned intubation, ventilator >48 hours, deep vein thrombosis, pulmonary embolism, progressive and acute renal failure, urinary tract infection, cardiac arrest requiring cardiopulmonary resuscitation, myocardial infarction, bleeding and/or blood transfusions, sepsis, septic shock; and mortality within 30 days postoperatively. Bleeding transfusion was defined as at least 1 U of packed or whole red blood cells given from the surgical start time up to and including 72 hours postoperatively.

Statistical analyses

Analysis was performed using the Statistical Package for Social Sciences, version 22 (IBM Corp., Armonk, NY). Continuous variables were described with mean ± standard deviation and categorical variables with frequencies (n) and percent (%). For univariate analysis, comparison of categorical variables between the exposure groups was performed using the chi-square or Fischer exact test, as appropriate. Comparison of means of continuous variables was performed using the independent *t* test. Statistically and clinically significant variables from univariate analysis were

Table 1
Baseline characteristics of the 2 study groups

	LSG	LSG+CC	*P* value
Patients (n)	20,715	422	
Age (yr)	44.3 ± 11.5	45.2 ± 11.1	.11
Height (m)	1.67 ± .10	1.65 ± .10	.12
Weight (kg)	127.6 ± 27.4	127.3 ± 24.8	.87
Body surface area	2.4 ± .3	2.4 ± .3	.69
BMI (kg/m^2)	46.1 ± 8.1	46.5 ± 7.6	.31
BMI categories			.06
<45 kg/m^2	11,259 (54.4)	210 (49.8)	
≥45 kg/m^2	9456 (45.6)	212 (50.2)	
Age categories (yr)			.32
<40	7418 (35.8)	144 (34.1)	
40–59	11,154 (53.8)	225 (53.3)	
≥60	2143 (10.3)	53 (12.6)	
Female	16,188 (78.1)	342 (81.0)	
Race			
Caucasian	16,527 (79.8)	348 (82.5)	.4
Black	3988 (19.3)	70 (16.6)	
Other*	200 (1.0)	4 (.9)	
Medical co-morbidity			
Dependent functional status	82 (0.4)	0 (0)	.42
ASA class			
I-II	6665 (32.2)	121 (28.7)	.13
III-IV	14,050 (67.8)	301 (71.3)	
Diabetes			.83
Noninsulin	3274 (15.8)	63 (14.9)	
Insulin	1457 (7)	32 (7.6)	
Dyspnea			.85
Moderate exertion	2653 (12.8)	55 (13)	
At rest	46 (.2)	1 (.2)	
COPD	264 (1.3)	5 (1.2)	.87
Smoking	2060 (9.9)	38 (9)	.52
Cardiac co-morbidities			1
Congestive heart failure	38 (.2)	0 (0)	
Hypertension	10,180 (49.1)	202 (47.9)	
Renal co-morbidities	85 (.4)	3 (.7)	.26
Dialysis	79 (.4)	2 (.5)	.68
Steroid use	336 (1.6)	5 (1.2)	.48
Bleeding disorders	241 (1.2)	2 (.5)	.25
Laboratory values			
WBC (g/dL)			.65
≤11	17,186 (83)	343 (81.3)	
>11	1526 (7.4)	35 (8.3)	
Unknown	2003 (9.7)	44 (10.4)	
Albumin (mg/dL)			<.0001
≤3	67 (.3)	1 (.2)	
>3.0	15,099 (72.9)	343 (81.3)	
Unknown	5549 (26.8)	78 (18.5)	
Bilirubin (mg/dL)			< .0001
<1.3	13,200 (63.7)	309 (73.2)	
≥1.3	310 (1.5)	8 (1.9)	
Unknown	7205 (34.8)	105 (24.9)	
Alkaline phosphatase (U/L)			<.0001
<165	13,642 (65.9)	324 (76.8)	
≥165	77 (.4)	3 (.7)	
Unknown	6996 (33.8)	95 (22.5)	
SGOT (U/L)			<.0001
<75	13,323 (64.3)	321 (76.1)	
≥75	242 (1.2)	5 (1.2)	
Unknown	7150 (34.5)	96 (22.7)	
Creatinine (mg/dL)			.02
<1.5 mg/dL	18,075 (87.3)	388 (91.9)	
≥1.5 mg/dL	522 (2.5)	7 (1.7)	
Unknown	2118 (10.2)	27 (6.4)	
INR			.7
<1.5	9057 (43.7)	179 (42.4)	
≥1.5	114 (.6)	1 (.2)	
Unknown	11544 (55.7)	242 (57.3)	
Year of surgery			.18
2010	1593 (7.7)	22 (5.2)	
2011	3150 (15.2)	58 (13.7)	
2012	5938 (28.7)	123 (29.1)	
2013	10,034 (48.4)	219 (51.9)	

Data are mean ± SD or n (%).

LSG = laparoscopic sleeve gastrectomy; CC = concomitant cholecystectomy; BMI = body mass index; ASA = American Society of Anesthesiologists physical status classification; COPD = chronic obstructive pulmonary disease; WBC = white blood cell count; SGOT = serum glutamic oxaloacetic transaminase; INR = international normalized ratio; SD = standard deviation.

*Other = American Indian, Alaskan native, or Asian.

used to create separate multivariate logistic regression models for each of 3 outcomes (major adverse events, pneumonia, and bleeding). *P* values < .05 were considered significant.

Results

Between January 2010 and December 2013, LSG was performed in 21,137 patients. Of these, 422 (2%) underwent laparoscopic cholecystectomy at the time of surgery (LSG+CC). The comparison of patients who underwent LSG+CC (n = 422) and those who underwent LSG alone (n = 20,715) revealed no difference in baseline characteristics; cardiac, respiratory, and renal co-morbidities; and diabetes (Table 1). The majority of patients in both groups were Caucasian females. Mean age and preoperative BMI were similar in both groups. Mean age was 45.2 ± 11.1 years and 44.3 ± 11.5 and mean BMI was 46.5 ± 7.6 kg/m^2 and 46.1 ± 8.1 kg/m^2, respectively. The number of LSG procedures, both without and with concomitant cholecystectomy, increased steadily from 2010 (1593 and 22 [1.4%]) to 2013 (10,034 and 219 [2.2%], respectively).

The average surgical time was significantly higher with LSG+CC (128.2 ± 53.9 min) versus LSG alone (95.3 ± 47.3 min) by around 33 minutes (*P* < .001). Length of hospital stay was similar in both groups (2.3 versus 2.1 days, *P* = .57). The overall 30-day mortality was similar in both groups: .2% versus .1% of those who underwent LSG alone (*P* = .34).

Univariate analyses of individual postoperative outcomes showed an increased risk of pneumonia with CC (.9% versus .3%, *P* = .04). Bleeding transfusion occurrences were higher with LSG+CC (1.9%) than with LSG

alone (.9%), but the difference was not statistically significant ($P = .07$) (Table 2). No differences in wound complication rates, thromboembolic events, sepsis/septic shock, ventilation, or cardiac or renal complications were observed when cholecystectomy was performed concurrently with LSG. The risk of having at least 1 adverse event (any adverse event; i.e., any wound or infectious, hematologic, respiratory, cardiac, or renal complication listed in Table 2) was slightly higher among LSG+CC patients (5.7%) compared with patients who underwent LSG alone (4.0%) (Fig. 1). The difference, however, did not reach statistical significance ($P = .07$).

On multivariate analysis and after adjusting for potential confounders, CC during LSG was associated with increased odds of bleeding and pneumonia (adjusted odds ratios 2.1 and 3.27, respectively) (Fig. 2A). However, the case number (422) and the overall event rates were low, meaning that the study may not have been powered enough to detect small differences (Table 3). Other factors increasing the risk of adverse events with LSG, irrespective of whether or not a CC was performed, included a preoperative BMI ≥ 45 kg/m^2, dependent functional status, diabetes, increasing dyspnea, bleeding disorders, and cardiac co-morbidities preoperatively and a low albumin level (≤ 3 g/dL) and a high creatinine level (≥ 1.5 mg/dL) (Fig. 2B).

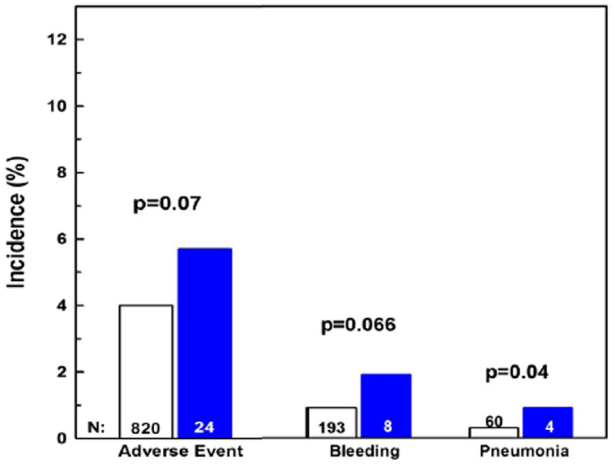

Fig. 1. Distribution of major postsurgical outcomes between LSG alone and LSG+CC. The incidence of major adverse events, pneumonia, and bleeding were higher with LSG+CC. LSG = laparoscopic sleeve gastrectomy; CC = concomitant cholecystectomy.

Table 2
Comparison of hospital and 30-day adverse outcomes between the 2 study groups

	LSG	LSG+CC*	*P* value
Patients (n)	20,715	422	
Continuous variables (mean ± SD)			
Surgical time (min)	95.3 ± 47.3	128.2 ± 53.9	< .001
Length of hospital stay (d)	2.1 ± 6.0	2.3 ± 4.4	.57
Categorical variables, n (%)			
PLOS (>3 d)	1008 (4.9)	29 (6.9)	.06
30-day mortality	19 (.1)	1 (.2)	.34
Wound complications			
Superficial incisional SSI	146 (.7)	4 (.9)	.55
Open wound/infection	77 (.4)	2 (.5)	.67
Organ/space SSI	102 (.5)	2 (.5)	1.00
Deep incisional SSI	12 (.1)	0	1.00
Wound disruption	7 (0)	0	1.00
Infections			
Sepsis/septic shock	94 (.5)	2 (.5)	1.00
Hematologic			
Bleeding/transfusion	193 (.9)	8 (1.9)	.07
DVT/thrombophlebitis	71 (.3)	0 (0)	.41
Pulmonary embolism	37 (.2)	2 (.5)	.18
Respiratory			
Pneumonia	60 (.3)	4 (.9)	.04
Unplanned intubation	54 (.3)	0 (0)	.63
Ventilator >48 hr	40 (.2)	2 (.5)	.20
Cardiac			
Cardiac arrest requiring CPR	10 (0)	0 (0)	1.00
Myocardial infarction	12 (0.1)	0 (0)	1.00
Renal			
Progressive renal insufficiency	39 (.2)	0 (0)	1.00
Acute renal failure	15 (.1)	0 (0)	1.00
Urinary tract infection	116 (.6)	3 (.7)	.52
Any adverse event	820 (4.0)	24 (5.7)	.07
Number of adverse events			.17
1	653 (3.2)	19 (4.5)	
≥2	167 (.8)	5 (1.2)	

LSG = laparoscopic sleeve gastrectomy; CC = concomitant cholecystectomy; PLOS = prolonged length of stay; SSI = surgical site infection; DVT = deep vein thrombosis; CPR = cardiopulmonary resuscitation.

Discussion

Bariatric surgery is the most effective treatment for long-term sustained weight loss and resolution of obesity-related co-morbidity [2]. Roux-en-Y gastric bypass (RYGB) has been the gold standard bariatric procedure, but LSG has gained increasing popularity [16,17]. The number of LSG procedures performed and registered in the ACS-NSQIP database significantly increased from 1615 (7.6%) in 2010 to 10,253 (48.5%) in 2013.

Obese patients have a higher incidence of gallbladder disease than do patients in the general population. The increased rate of cholesterol secretion in obese individuals without a proportional increase in bile salts in addition to a larger gallbladder and a decrease in the cholecystokinin level have been proposed as potential etiologies leading to gallbladder pathologies such as cholelithiasis, cholecystitis, and cholesterolosis [2,3,18,19]. Rapid weight loss that occurs after bariatric surgery also is a risk factor for cholelithiasis [8]. It has been estimated that up to 50% of bariatric patients develop gallstones or sludge within the first 2 years after the surgery, which would necessitate surgical treatment if the patient is symptomatic [7,8,19,20]. Previously, it was believed that cholelithiasis was more common after gastric bypass than after purely restrictive procedures. However, many studies have demonstrated no significant difference in the incidence of symptomatic cholelithiasis between the 2 types of procedures

Table 3
Multivariate analyses of risk factors associated with major postoperative outcomes

Risk Factors	Bleeding		Pneumonia		Adverse Events	
	OR (95% CI)	*P* value	OR (95% CI)	*P* value	OR (95% CI)	*P* value
Cholecystectomy	2.14 (1.04–4.39)	.04	3.38 (1.21–9.47)	.02	1.49 (.98–2.27)	.07
Age categories (yr)		.12		.24		.27
<40	1.00	Ref.	1.00	Ref.	1.00	Ref.
40–59	1.22 (.85–1.76)	.28	.84 (.45–1.58)	.59	1.09 (.92–1.29)	.34
≥60	1.66 (1.02–2.69)	.04	1.48 (.66–3.31)	.34	1.23 (.96–1.58)	.11
Male	1.01 (.73–1.41)	.93	.55 (.27–1.11)	.10	1.05 (.89–1.23)	.58
BMI categories						
<45 kg/m^2	1.00	Ref.	1.00	Ref.	1.00	Ref.
≥45 kg/m^2	.87 (.65–1.16)	.34	.7 (.41–1.19)	.19	1.33 (1.15–1.54)	.00
Race		.08		.69		.00
Caucasian	1.00	Ref.	1.00	Ref.	1.00	Ref.
Black	.62 (.4–.96)	.03	.8 (.4–1.6)	.52	.73 (.6–.89)	.00
Other*	.52 (.07–3.73)	.51	1.71 (.23–12.63)	.60	1.89 (1.09–3.28)	.02
Medical co-morbidity						
Dependent function	3.42 (1.18–9.93)	.02	2.46 (.29–21.26)	.41	2.81 (1.53–5.16)	.00
ASA class						
I-II	1.00	Ref.	1.00	Ref.	1.00	Ref.
III-IV	.91 (.65–1.27)	.57	.89 (.5–1.58)	.69	1.05 (.88–1.24)	.60
Diabetes		.73		.22		.03
No	1.00	Ref.	1.00	Ref.	1.00	Ref.
Noninsulin	.96 (.65–1.4)	.82	.74 (.37–1.46)	.39	1.02 (.84–1.23)	.86
Insulin	1.18 (.74–1.88)	.49	.37 (.11–1.24)	.11	1.37 (1.08–1.73)	.01
COPD	1.18 (.46–3)	.73	2.32 (.66–8.16)	.19	1.15 (.71–1.86)	.58
Dyspnea		.03		.02		.00
No	1.00	Ref.	1.00	Ref.	1.00	Ref.
Moderate exertion	1.11 (.75–1.64)	.61	2.31 (1.3–4.09)	.00	1.46 (1.22–1.75)	.00
At rest	5.29 (1.57–17.83)	.01	NA	1.00	4.02 (1.84–8.81)	.00
Smoking	1.06 (.65–1.72)	.81	1.05 (.47–2.34)	.91	.96 (.75–1.22)	.72
Cardiac co-morbidities	2.13 (1.51–2.99)	.00	2.49 (1.36–4.56)	.00	1.43 (1.22–1.69)	.00
Bleeding disorders	3.28 (1.66–6.49)	.00	2.9 (.81–10.34)	.10	1.86 (1.18–2.92)	.01
Renal co-morbidities	1.07 (.23–4.93)	.94	NA	1.00	1.26 (.56-2.83)	0.57
Laboratory values						
WBC (g/dL)		.73		.02		.96
≤11	1.00	Ref.	1.00	Ref.	1.00	Ref.
>11	.82 (.46–1.45)	.49	2.56 (1.3–5.03)	.01	1.04 (.8–1.34)	.79
Unknown	.87 (.46–1.63)	.66	1.27 (.42–3.81)	.67	.98 (.72–1.35)	.91
Albumin (mg/dL)		.19		.86		.00
≤3 g/dL	1.00	Ref.	1.00	Ref.	1.00	Ref.
>3.0	2.16 (.46–10.1)	.33	NA	1.00	2.84 (1.35–5.99)	.01
Unknown	.73 (.42–1.27)	.26	.75 (.27–2.1)	.59	.79 (.6–1.05)	.10
Bilirubin (mg/dL)		.77		1.00		.14
<1.3	1.00	Ref.	1.00	Ref.	1.00	Ref.
≥1.3	1.32 (.52–3.34)	.56	.99 (.13–7.37)	.99	.71 (.38–1.33)	.29
Unknown	1.28 (.42–3.87)	.66	.95 (.13–7.21)	.96	.57 (.29–1.1)	.09
Alkaline phosphatase (U/L)		.81		.49		.01
<165	1.00	Ref.	1.00	Ref.	1.00	Ref.
≥165	1.62 (.37–7.01)	.52	NA	1.00	2.27 (1.13–4.54)	.02
Unknown	.97 (0.24–3.95)	.97	.27 (.03–2.3)	.23	2.02 (.96–4.24)	.06
SGOT (U/L)		.27		.12		.03
<75	1.00	Ref.	1.00	Ref.	1.00	Ref.
≥75	1.86 (.74–4.71)	.19	2.83 (.67–12.05)	.16	1.83 (1.12–2.97)	.02
Unknown	.6 (.2–1.79)	.35	3.00 (.75–11.96)	.12	.77 (.46–1.31)	.34
Creatinine (mg/dL)		.16		.52		.17
<1.5 mg/dL	1.00	Ref.	1.00	Ref.	1.00	Ref.
≥1.5 mg/dL	1.45 (.73–2.88)	.29	1.92 (.57–6.49)	.29	1.4 (.97–2.01)	.07
Unknown	1.68 (.91–3.12)	.10	.78 (.23–2.68)	.70	.93 (.67–1.3)	.67

Table 3
Continued.

Risk Factors	Bleeding		Pneumonia		Adverse Events	
	OR (95% CI)	*P* value	OR (95% CI)	*P* value	OR (95% CI)	*P* value
INR		.22		.85		.94
<1.5	1.00	Ref.	1.00	Ref.	1.00	Ref.
≥1.5	.74 (.17–3.21)	.69	1.74 (.21–14.28)	.61	.87 (.39–1.94)	.73
Unknown	.77 (.57–1.04)	.09	1.09 (.64–1.86)	.76	.99 (.85–1.15)	.93

OR = odds ratio; CI = confidence interval; Ref = reference category; BMI = body mass index; ASA = American Society of Anesthesiologists Physical Status classification; COPD = chronic obstructive pulmonary disease; WBC = white blood cells; SGOT = serum glutamic oxaloacetic transaminase; INR: international normalized ratio.

*Other = American Indian, Alaskan native, or Asian.

[11,21,22]. Although there is an abundance of literature regarding the incidence of gallbladder disease before and after bariatric surgery, there is little information on the short-term postoperative outcomes when cholecystectomy is performed concurrently with bariatric surgeries, especially LSG.

In this study, only 2% of patients (n = 422) undergoing LSG between January 2010 and December 2013 underwent a concomitant cholecystectomy. Although many surgeons prefer to remove the gallbladder during bariatric surgery only for symptomatic patients with gallbladder pathology proven preoperatively, the reason for performing cholecystectomy was not stated in the ASC-NSQIP database, which highlights the need for careful consideration when these data are applied in clinical practice.

The 2 study groups were very similar in baseline characteristics. CC significantly increased surgical time by around 30 minutes. However, no effect on the total length of hospital stay or 30-day mortality was documented. There was a slightly higher risk of total adverse events in the LSG+CC group (5.7% versus 4.0%) with bleeding and/or transfusion and pneumonia being significantly higher in the LSG+CC group on univariate analysis (see Fig. 1). On multivariate analysis and after adjusting for potential confounders, the association between CC and the risk of total adverse events were of borderline significance (adjusted odds ratio [AOR] 1.49, $P = .07$). However, cholecystectomy still was significantly associated with the risk of bleeding (AOR 2.1, $P = .04$) and pneumonia (AOR 3.27, P .02) (Table 3).

CC at the time of laparoscopic RYGB has been studied extensively, but the results are inconclusive [2,9,10,12–15,18–20,23]. Many reports have shown that the combined procedure can be performed safely; however, it is not a complication-free procedure. Additional ports may be required, and increased surgical time and duration of hospital stay and certain adverse events such as wound infections, gastrointestinal leaks, pneumonia, and renal failure have been reported [13,14] . A large study using the 2005 to 2009 ACS-NSQIP database showed that CC increased the risk of adverse events in laparoscopic but not in open RYGB [15]. That study suggested that CC should be reserved for patients with previously symptomatic disease because access to the biliary system after RYGB

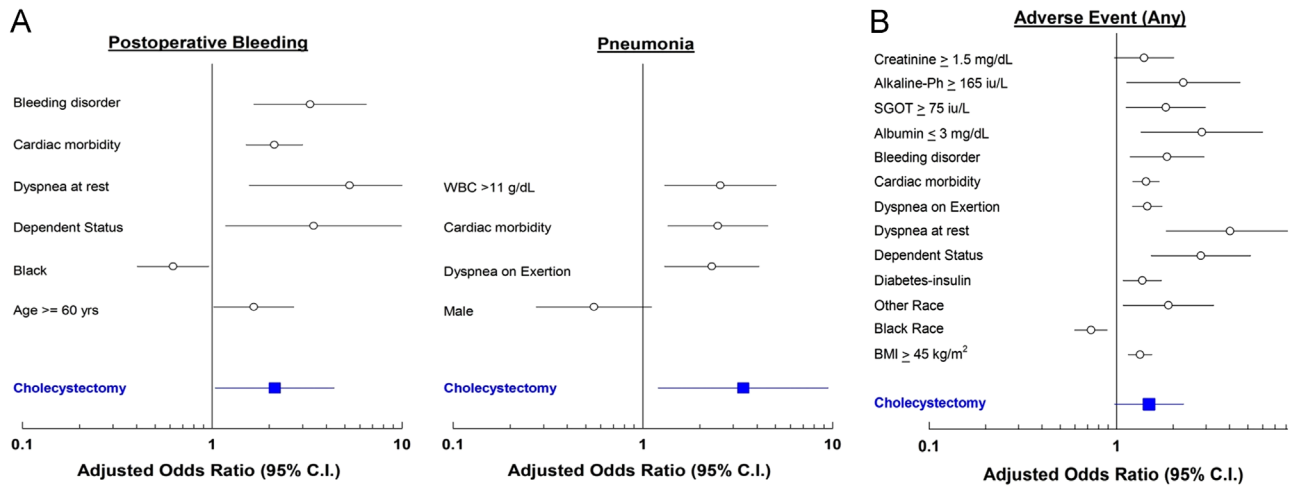

Fig. 2. (A and B) Forest plots of the association between various risk factors and major surgical outcomes. After multivariate adjustment, CC was significantly associated with postoperative bleeding and pneumonia but not with overall major adverse events. CC = concomitant cholecystectomy; WBC = white blood cell count; SGOT = serum glutamic oxaloacetic transaminase; BMI = body mass index.

would not be possible with endoscopic retrograde cholangiopancreatography [15,23].

Despite the increasing popularity of LSG as a primary weight loss procedure, studies on the outcomes of CC at the time of LSG still are limited to 2 case control studies with relatively small sample sizes (16 and 180 patients, respectively) [24,25]. In both studies, CC increased surgical time without an increase in hospital length of stay or major morbidity [24,25]. Unlike the study presented here, the 2 studies had small sample sizes, and many individual postoperative outcomes were not assessed. Because surgeons' expertise and learning curve highly affect the outcomes of small institution studies, the ACS-NSQIP database offers a more reliable source of data that attenuates the selection bias present in single-institution studies, especially when the results are to be applied to clinical practice. Moreover, the ACS-NSQIP database includes a large number of variables such as preoperative demographic characteristics and medical co-morbidity, thus allowing for the assessment of true risk factors involved with major adverse events and mortality.

CC during LSG is not free of complications; however, the data in this study suggest that it is safe to perform LSG+CC with a relatively low added (5.7% versus 4.4%) risk. It must be noted that some patients eventually will develop symptoms related to gallstones and will require cholecystectomy. Some might even develop serious complications such as pancreatitis, cholecystitis, or cholangitis. In their study on the incidence of complicated gallstones after LSG, Sioka et al. demonstrated that 13.0% of LSG patients with positive ultrasound findings preoperatively developed symptomatic cholelithiasis postoperatively [26]. In a study of 34 patients who developed symptomatic cholelithiasis within 2 years after bariatric surgery, 20 patients (58.2%) presented with acute cholecystitis. Two patients (5.9%) developed choledocholithiasis with obstructive jaundice and 11 patients (32.4%) were admitted to the hospital with acute abdomen formation. Laparoscopic cholecystectomy was converted to an open procedure in 6 patients (17.6%) due to severe adhesions or massive bleeding from the gallbladder bed [7]. Therefore, the surgeon must weigh the potential added risk of CC against the potential morbidity of delayed complications from gallstones or deferred cholecystectomy.

A strong body of evidence has suggested that the prophylactic use of ursodeoxycholic acid can significantly prevent gallstone formation after different bariatric procedures [27–29]. However, medication compliance is variable [14,27], and data on the effect of ursodeoxycholic acid on symptomatic gallstones necessitating cholecystectomy are limited [30]. A recent cost-effective analysis reported that the additional cost of prescribing ursodiol does not justify its use after RYGB [30]. Larger controlled studies are needed to establish the effective use of ursodeoxycholic acid in LSG patients [29].

Study limitations

Several limitations exist that are worth mentioning. One limitation is the lack of data regarding the indication for the CC in the ACS-NSQIP database. Because only 2% of patients underwent LSG+CC, it is fair to assume that those patients had gallbladder pathology at baseline because the prevalence of gallbladder pathology in severely obese patients is much higher than 2% [3,18]. Moreover, specific adverse outcomes of LSG such as strictures and leaks and of cholecystectomy such as bile leak and common bile duct injury are not provided in this database. The addition of cholecystectomy is unlikely to increase the risk of LSG-specific adverse outcomes. However, cholecystectomy-specific adverse outcomes, although rare, still can occur and thus affect the results. Another important limitation is the small number of cases (422) and the low overall event rates that might have decreased the power of the study to detect small differences. Because many outcomes approached statistical significance, some might have reached significance if more cases were present.

Other limitations that are relevant to all studies that use the ACS-NSQIP database include the lack of information regarding surgeon volume, an important factor in bariatric surgeries [31], and long-term follow-up data beyond 30 days, which would allow for the assessment of other risks including the incidence of gallbladder disease after LSG, especially because the incidence is highest during periods of rapid weight loss, mainly the first 2 years postoperatively. This information would help when weighing the risks versus the benefits of performing CC at the time of LSG.

Conclusion

CC during LSG is associated with a slightly increased risk of adverse events, namely bleeding and pneumonia. When factoring the potential risks and cost of further hospitalization for deferred cholecystectomy, CC might be a better option for patients with established gallbladder disease.

Disclosures

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