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Does intraoperative endoscopy decrease complications after bariatric surgery? Analysis of American College of Surgeons National Surgical Quality Improvement Program database

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Abstract

Background Intraoperative endoscopy (IOE) has been proposed to decrease serious complications following bariatric surgeries such as leaks, bleeding, and stenosis. Such complications can lead to sepsis and eventually can be fatal. We aim to compare major postoperative complications in patients with and without IOE.

Methods Data from the American College of Surgeons National Surgical Quality Improvement Program database years 2011 till 2016 were used to identify laparoscopic sleeve gastrectomy (LSG) and laparoscopic Roux-en-Y gastric bypass (LRYGB) patients. We compared outcomes of IOE and non-IOE using bivariate and multivariate analysis. Thirty-day outcomes included sepsis, organ space infection, unplanned reoperations, unplanned readmissions, prolonged hospital stay, bleeding, and mortality.

Results Out of 62,805 cases of LSG and 50,047 cases of LRYGB, 17.9%, and 19.7% had IOE, respectively. Endoscopy-assisted LSG was associated with a decrease in sepsis [0.37% vs. 0.21%, adjusted odds ratio (AOR) = 0.55 (0.36, 0.84)], unplanned reoperation [0.58% vs. 0.38%, AOR = 0.61 (0.44, 0.85)], prolonged hospital stay [14.9% vs. 14.0%, AOR = 0.87 (0.82, 0.92)], and composite complications [1.43% vs. 1.17%, AOR = 0.78 (0.65, 0.94)]. Outcomes after LRYGB were similar in both groups, except for decreased prolonged hospital stay with IOE [22.4% vs. 20.6%, AOR = 0.89 (0.84, 0.94)].

Conclusions IOE is generally underutilized in baraitric procedures. IOE is associated with decreased risk of postoperative complications particularly sepsis, unplanned reoperations, prolonged hospital stay, and composite complications after LSG; and hospital stay after LRYGB. Large multicenter prospective studies are needed to explore the benefits of IOE in bariatric surgery, particularly the intermediate or long-term benefits.

Keywords Intraoperative endoscopy · Sleeve gastrectomy · Gastric bypass · Sepsis · Complications

The practice of bariatric surgery has risen dramatically with the worsening epidemic of obesity. Laparoscopic sleeve gastrectomy (LSG) and laparoscopic Roux-en-Y gastric bypass (LRYGB) are the two most commonly performed bariatric procedures [1]. Experience in these two procedures has been extensive and exceeds 10 years in LSG and 25 years in LRYGB [1]. During these years, surgeons have been studying several modifications to the surgical technique in both procedures; one of which is the utility of intraoperative endoscopy (IOE). Several publications have recommended the routine use of IOE to decrease complications such as leak, stenosis, and bleeding following either LSG or LRYGB [2–7]. Haddad et al. [6] reported the utility of IOE in detecting and curing leaks during LRYGB in 96% of patients who had a sustained positive intraoperative leak test. Nimeri et al. [4] concluded that IOE could aid in the prevention of LSG postoperative stenosis through endoscopic intraoperative detection and removal of over-sewing sutures. However, most of the publications on IOE in bariatric surgery were limited to reporting the experience of individual surgeons and bariatric centers which may not represent the population of bariatric surgeons [4–16]. Thus, many of the assumptions regarding the use of IOE might not be firmly

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evidence-based. This was reflected in a statement by The American Society for Metabolic and Bariatric Surgery (ASMBS) in 2015 on the prevention of gastrointestinal leaks after LSG and LRYGB where it has not found any evidence to support the use of IOE for the reduction of leaks [17]. Considering the limitation of previous studies, we aim to compare outcomes of bariatric surgeries with IOE to surgeries without IOE using a large sample of patients that would be representative of the national outcomes.

Methods

Study design

Our study was based on the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) prospective database. ACS-NSQIP includes data on over 130 preoperative, intraoperative, and postoperative variables that are prospectively collected by academic and community hospitals (680 participating sites in 2016 and 315 sites in 2011). To ensure high quality of collected data, ACS-NSQIP has implemented several mechanisms to confirm reliability and consistency of the data [18, 19]. Due to the de-identified nature of the NSQIP database, no institutional review board (IRB) authorization is required.

Inclusion/exclusion criteria

Using Current Procedural Terminology (CPT), LSG patients (CPT code 43775) and LRYGB (CPT codes 43644 and 43645) were identified in ACS-NSQIP database from years 2011 till 2016. Patients with body mass index (BMI) $\geq$ 35 kg/m^2 were included. We excluded emergency cases, patients with disseminated cancer, preoperative sepsis, and concomitant procedures, namely cholecystectomy and removal of gastric band as these might increase the risk of postoperative complications [20, 21].

Exposure

Patients were then categorized based on IOE, which was identified using CPT codes 43234, 43235, 43236, and 43239 described in Table 1. Baseline characteristics, preoperative laboratory values, intraoperative parameters, and postoperative complications in patients who have been endoscoped were compared to patients who have not been endoscoped. The analysis was separately done for LSG and LRYGB.

Outcomes

Thirty-day postoperative outcomes that were studied include sepsis (sepsis and septic shock), organ space infection, bleeding, unplanned reoperation, unplanned readmission, mortality, and prolonged length of stay (PLOS). PLOS was defined as length of hospital stay greater than or equal to 3 days (90th percentile). A composite outcome was also studied and included complications such as sepsis, organ space infection, bleeding, unplanned reoperation, and mortality.

Statistical analysis

Continuous variables were presented by means and standard deviations, while categorical variables were presented as frequencies and percentages. Student t test was used for the comparison of continuous variables, and Pearson χ^2 test or Fisher's exact test was used for categorical variables. Binary multiple logistic regression of outcomes, using forward stepwise method, was used to adjust for age, gender, BMI, ASA $\geq$ 3, diabetes, hypertension, and operative time. Statistical significance was set at the 5% level. Statistical analysis was performed using SAS, version 9.2 (SAS Institute, Cary, NC, USA).

Table 1 Description of intraoperative endoscopy CPT codes

CPT code	Description
43234[a]	Upper gastrointestinal endoscopy, simple primary examination (e.g., with small diameter flexible endoscope) (separate procedure)
43235	Esophagogastroduodenoscopy, flexible, transoral; diagnostic, including collection of specimen (s) by brushing or washing, when performed (separate procedure)
43236	Esophagogastroduodenoscopy, flexible, transoral; with directed submucosal injection (s), any substance
43239	Esophagogastroduodenoscopy, flexible, transoral; with biopsy, single or multiple

CPT current procedural terminology

[a] CPT code deleted at year 2013

Results

Out of 62,805 cases of LSG and 50,047 cases of LRYGB, 11,254 cases (17.9%) and 9,854 cases (19.7%) had IOE, respectively. Mean age in endoscoped LSG patients was slightly lower compared to non-endoscoped (43.7 vs. 44.9 years, $p<0.003$). Mean age in endoscoped LRYGB was similar to non-endoscoped (44.7 vs. 44.6 years, $p=0.16$). Mean BMI in IOE patients was equivalent to non-IOE (rounded to 46 kg/m^2 in LSG and 47 kg/m^2 in LRYGB). The prevalence of American Society of Anesthesiologists (ASA) classification more than III was slightly higher in IOE group (LSG: 72.9% vs. 70.1%, $p<0.001$; LRYGB: 78.9% vs. 73.8%, $p<0.001$). Operative time of LSG increased on average by 9.4 min when IOE was performed (93.6 min vs. 84.2 min, $p<0.001$). In LRYGB, operative time was slightly greater by 2 min with IOE (130.3 min vs. 132.3 min, $p=0.002$). All other preoperative comorbidities and laboratory values in LSG and LRYGB were clinically comparable between IOE and non-IOE group (Table 2).

Postoperative outcomes of LSG are presented in Table 3. Endoscoped LSG patients had lower sepsis rate (0.21% vs. 0.37%, $p=0.009$), prolonged hospital stay (14.0% vs. 14.9%, $p=0.014$), unplanned reoperation (0.38% vs. 0.58%, $p=0.006$), and composite complications (1.17% vs. 1.43%, $p=0.02$). Multivariate logistic regression was performed to adjust for confounding factors such as age, BMI, gender, ASA, diabetes, hypertension, and operative time. IOE in LSG independently decreased sepsis [adjusted odds ratio (AOR) = 0.55 (0.36, 0.84)], unplanned reoperations [AOR = 0.61 (0.44, 0.85)], prolonged length of stay [AOR = 0.87 (0.82, 0.92)] and composite complications [AOR = 0.78 (0.65, 0.94)]. Other LSG complications such as organ space infection, bleeding, and mortality showed no significant difference between the two groups at the crude and adjusted analysis.

All postoperative complications of LRYGB, except for prolonged length of stay, were comparable between IOE and non-IOE groups of patients (Table 4). Prolonged length of hospital stay in LRYGB was lower in endoscoped patients (20.6% vs. 22.4%, $p<0.001$), and similarly lower after multivariate analysis [AOR = 0.89 (0.84, 0.94)].

Table 2 Baseline characteristics and preoperative laboratory values by IOE status for LSG and LRYGB patients

Variables	LSG (*N* = 62,805)			LRYGB (*N* = 50,047)		
	Non-IOE	IOE	*p* value	Non-IOE	IOE	*p* value
Frequency (%)	51,551 (82.1)	11,254 (17.9)		40,193 (80.3)	9854 (19.7)	
Age (years)	44.9 ± 11.9	43.7 ± 11.9	**0.003**	44.6 ± 11.8	44.7 ± 11.5	0.16
BMI (kg/m^2)	45.8 ± 7.8	45.8 ± 7.3	0.57	46.6 ± 7.9	46.8 ± 7.6	0.15
Male	11,068 (21.5)	2446 (21.7)	0.55	7970 (19.8)	2070 (21.0)	**0.009**
White race	35,145 (77.5)	8248 (79.8)	**< 0.001**	28,439 (81.0)	6884 (82.4)	**0.003**
ASA class ≥ 3	36,103 (70.1)	8201 (72.9)	**< 0.001**	29,609 (73.8)	7767 (78.9)	**< 0.001**
Functional status (dependent)	238 (0.46)	40 (0.36)	0.13	177 (0.44)	43 (0.44)	0.98
Smoker	5087 (9.9)	1078 (9.6)	0.35	4042 (10.1)	959 (9.7)	0.34
Diabetes	11,843 (23.0)	2451 (21.8)	**0.006**	13,134 (32.7)	3121 (31.7)	0.06
Hypertension	24,250 (47.0)	5217 (46.4)	0.19	20,975 (52.2)	5176 (52.5)	0.54
COPD	835 (1.6)	185 (1.6)	0.86	833 (2.1)	1997 (2.0)	0.65
CHF	151 (0.29)	29 (0.26)	0.53	118 (0.29)	14 (0.14)	**0.009**
Renal disease	255 (0.49)	42 (0.37)	0.09	92 (0.23)	11 (0.11)	**0.021**
Steroid use	874 (1.7)	253 (2.3)	**< 0.001**	534 (1.3)	134 (1.4)	0.81
Bleeding disorder	520 (1.0)	124 (1.1)	0.37	427 (1.1)	99 (1.0)	0.62
Open wound/wound infection	143 (0.28)	38 (0.34)	0.28	140 (0.35)	49 (0.50)	0.31
Creatinine > 1.2 mg/dL	2647 (5.9)	532 (5.5)	0.11	2194 (6.1)	504 (5.8)	0.23
Hematocrit < 37%	6655 (14.2)	1390 (13.1)	**0.006**	5170 (14.0)	1190 (12.9)	**0.006**
Albumin < 3.5 mg/dL	1661 (4.7)	527 (6.1)	**< 0.001**	1478 (5.1)	390 (6.3)	**0.001**
WBC > 11,000/mm^3	4034 (8.8)	744 (7.5)	**< 0.001**	3341 (9.6)	844 (9.5)	0.73
Operative time (min)	84.2 ± 41.7	93.6 ± 40.6	**< 0.001**	130.4 ± 55.1	132.3 ± 54.5	**0.002**

Mean ± SD for continuous variables. Frequency (%) for categorical variables

IOE intraoperative endoscopy, *BMI* body mass index, *ASA* American Society of Anesthesiologists, *COPD* history of severe chronic obstructive pulmonary disease, *CHF* congestive heart failure

Significant *p* values (< 0.05) are in bold

Table 3 Postoperative complications for IOE vs. non-IOE among LSG patients

Complications	LSG (N = 62,805)					
	Non-IOE (N = 51,551)	IOE (N = 11,254)	OR (95% CI)	p value	AOR (95% CI)	P value
Composite outcome	743 (1.43)	131 (1.17)	0.81 (0.67,0.97)	**0.023**	0.78 (0.65,0.94)	**0.009**
Sepsis	192 (0.37)	24 (0.21)	0.57 (0.37,0.87)	**0.009**	0.55 (0.36,0.84)	**0.006**
Organ space infection	218 (0.42)	41 (0.36)	0.86 (0.62,1.20)	0.38	0.83 (0.59,1.15)	0.26
Bleeding	413 (0.8)	79 (0.7)	0.88 (0.69,1.12)	0.28	0.86 (0.67,1.10)	0.22
Unplanned reoperation	300 (0.58)	42 (0.38)	0.64 (0.46,0.88)	**0.006**	0.61 (0.44,0.85)	**0.003**
Mortality	48 (0.09)	7 (0.06)	0.67 (0.30,1.48)	0.38	0.66 (0.30,1.46)	0.30
PLOS ≥ 3 days	7688 (14.9)	1576 (14.0)	0.93 (0.88,0.99)	**0.014**	0.87 (0.82,0.92)	< **0.001**
Unplanned readmission	1444 (2.8)	306 (2.7)	0.96 (0.84,1.08)	0.48	0.92 (0.81,1.04)	0.17

Mean ± SD for continuous variables. Frequency (%) for categorical variables

IOE intraoperative endoscopy, *PLOS* prolonged length of stay, *OR (95% CI)* odds ratio (95% confidence interval), *AOR (95% CI)* adjusted odds ratio (95% confidence interval)

Significant p values (< 0.05) are in bold

Table 4 Postoperative complications for IOE vs. non-IOE among LRYGB patients

Complications	LRYGB (N = 50,047)					
	Non-IOE (N = 40,193)	IOE (N = 9854)	OR (95% CI)	p value	AOR (95% CI)	p value
Composite outcome	1298 (3.26)	301 (3.08)	0.95 (0.83,1.07)	0.39	0.94 (0.82,1.06)	0.30
Sepsis	263 (0.65)	66 (0.67)	1.02 (0.78,1.34)	0.87	0.99 (0.75,1.30)	0.93
Organ space infection	266 (0.66)	69 (0.70)	1.06 (0.81,1.38)	0.68	1.03 (0.79,1.34)	0.84
Bleeding	620 (1.54)	149 (1.51)	0.98 (0.82,1.17)	0.83	0.98 (0.82,1.17)	0.82
Unplanned reoperation	641 (1.61)	163 (1.67)	1.04 (0.87,1.24)	0.67	1.03 (0.87,1.23)	0.73
Mortality	58 (0.14)	8 (0.08)	0.56 (0.27,1.18)	0.12	0.54 (0.26,1.14)	0.11
PLOS ≥ 3 days	8983 (22.4)	2024 (20.6)	0.90 (0.85,0.95)	< **0.001**	0.89 (0.84,0.94)	< **0.001**
Unplanned readmission	2133 (5.4)	498 (5.1)	0.93 (0.85,1.03)	0.18	0.93 (0.84,1.03)	0.15

Mean ± SD for continuous variables. Frequency (%) for categorical variables

IOE intraoperative endoscopy, *PLOS* prolonged length of stay, *OR* odds ratio (95% confidence interval), *AOR* adjusted odds ratio (95% confidence interval)

Significant p values (< 0.05) are in bold

Discussion

Routine use of IOE has been supported by some bariatric surgeons to decrease the incidence of gastrointestinal leakage, bleeding, and stenosis [2–7]. Most of the available literature on the utility of IOE in bariatric surgery represents a small patient population and a single center experience [4–16]. Our study aims to estimate the utilization of IOE in the practice of bariatric surgery and test its effectiveness in decreasing postoperative complications using a large representative sample of patients.

Our results report that 17.9% of LSG and 19.7% of LRYGB cases during the period of 2011 till 2016 were assisted with endoscopy. This implies that IOE, while utilized by a considerable portion of bariatric surgeons across the US, is still underutilized by the majority. The outcomes also show a statistically significant decrease in complications after endoscopy-assisted LSG. IOE was independently associated with decrease in sepsis [0.37% vs. 0.21%, (AOR) = 0.55 (0.36, 0.84)], unplanned reoperations [0.58% vs. 0.38%, AOR = 0.61 (0.44, 0.85)], prolonged length of stay [14.9% vs. 14.0%, AOR = 0.87 (0.82, 0.92)], and composite complications [1.43% vs. 1.17%, AOR = 0.78 (0.65, 0.94)].

The risk of leakage, based on large published series after LSG and LRYGB, has been estimated to be 0.7% and 0.8%, respectively [22]. IOE in LSG has been studied and recommended to be routinely used for air leak test mainly based on expert opinion [3, 4, 23]. In LRYGB, IOE has frequently been studied as well and recommended to test the integrity of the gastric pouch and gastrojejunostomy anastomosis [2, 5–14]. A study by Alaedeen et al. [2] compared outcomes of IOE in LRYGB to orogastric tube methylene blue test and concluded that IOE is superior in decreasing postoperative leaks. A recently published randomized control trial tested IOE in LRYGB [24]. The study recruited 50 patients in the endoscopy arm and 50 patients in the non-endoscopy arm. The trial reported a significant decrease in postoperative leaks (0% vs. 8%), reoperations (0% vs. 8%), and length of stay with IOE. On the other hand, it also reported more than 30 min increase in operative time with the use of IOE. Despite the significance of the results, outcomes of the trial cannot be generalized due to the variability in surgical technique and consequently in outcomes and complications. For example, the trial reported a leak rate of 8% in the non-endoscopy group which is relatively very high compared to LRYGB literature-reported leak rate at 0.8% [22]. In our study, we did not specifically measure leakage rates as it is not reported in ACS-NSQIP database. Nonetheless, we measured outcomes such as sepsis, mortality, organ space infections, bleeding, unplanned reoperations, and readmissions, which can be indicators of gastrointestinal leakage and stenosis. Our results showed no major difference in outcomes between IOE and non-IOE patients except for a slightly decreased prolonged length of stay. An explanation for the discrepancy between our results and the literature could be that intraoperative endoscopies were not always routinely performed. Some surgeons selectively perform intraoperative endoscopies based on the difficulty and complexity of cases, which could increase complications in IOE group. Therefore, the effect of routine IOE in LRYGB and LSG is expected to be greater as selective IOE might be masking the decrease in complications.

IOE was also reported to have benefits other than prevention of leak. Some surgeons support the use of endoscopy during LSG for the calibration of the gastric tube size instead of bougie and have reported good weight loss outcomes [15, 16, 23, 25, 26]. Other studies have also proposed IOE for the prevention of postoperative stenosis [4, 5]. With the privilege of lumen visualization, IOE also might help in the detection of intraluminal bleeding in LSG or LRYGB, which could be controlled endoscopically or laparoscopically [7, 8, 23]. Endoscopy may also assist in guiding the correct placement of stapling instruments, as the endoscopy light illuminates through the gastric wall [3]. Despite the safety of IOE in bariatric surgery, few complications as iatrogenic injury and lacerations have been reported [6, 16]. Ruiz-Tovar et al. [23] also reported a decrease in major postoperative complications with the use of IOE in comparison with bougie but his study was limited with a small sample size of 50 LSGs.

Our study is the first to report large dataset outcomes of endoscopy-assisted bariatric procedures. It is also the first to estimate the prevalence of IOE utilization in bariatric surgery. A relatively low percentage ranging around 18–20% of bariatric surgeries are assisted with IOE. The lack of strong evidence supporting the utility of IOE might have contributed to its underutilization in bariatric surgery. Our study results powered by a significantly large number of patients show a decrease in complications associated with the utilization of IOE, specifically in LSG. Those results may be generalizable as well to other foregut procedures. Moreover, our study shows that the increase in intraoperative time with IOE is reasonable and lower than previous studies [24].

This study also has some limitations. Our paper focuses on the impact of IOE on postoperative complications but does not study other potential uses of IOE. In addition, the NSQIP database was not designed to be a bariatric specific database, thus lacking parameters including weight loss outcomes and complications such as leak or stenosis. NSQIP also inherently report data up to 30-day postoperatively; therefore, we could not assess late complications. Although our results do not explicitly measure the risk of leak, all our studied outcomes can be direct complications of leakage especially sepsis which is a major and potentially life-threatening morbidity. Large multicenter prospective studies are needed to explore the benefits of IOE in bariatric surgery, particularly the intermediate or long-term benefits beyond 30 days.

Conclusion

IOE is generally underutilized in bariatric procedures. IOE is associated with decreased risk of postoperative complications particularly sepsis, unplanned reoperations, prolonged hospital stay, and composite complications after LSG; and hospital stay after LRYGB. Large multicenter prospective studies are needed to explore the benefits of IOE in bariatric surgery, particularly the intermediate or long-term benefits.

Compliance with ethical standards

Disclosure Drs. Minhem, Safadi, Tamim, Alami, and Ms. Mailhac have no conflicts of interest or financial ties to disclose.

References

1. Khorgami Z, Shoar S, Andalib A, Aminian A, Brethauer SA, Schauer PR (2017) Trends in utilization of bariatric surgery, 2010–2014: sleeve gastrectomy dominates. Surg Obes Relat Dis 13:774–778

2. Alaedeen D, Madan AK, Ro CY, Khan KA, Martinez JM, Tichansky DS (2009) Intraoperative endoscopy and leaks after laparoscopic Roux-en-Y gastric bypass. Am Surg 75:485–488
3. Athanasiou A, Spartalis E, Moris D, Alexandrou A, Liakakos T (2016) Laparoscopic sleeve gastrectomy with intraoperative endoscopic guidance: the importance of this technique. Obes Surg 26:862–863
4. Nimeri A, Maasher A, Salim E, Ibrahim M, Hadad M (2016) The use of intraoperative endoscopy may decrease postoperative stenosis in laparoscopic sleeve gastrectomy. Obes Surg 26:1398–1401
5. Al Hadad M, Dehni N, Elamin D, Ibrahim M, Ghabra S, Nimeri A (2015) Intraoperative endoscopy decreases postoperative complications in laparoscopic Roux-en-Y gastric bypass. Obes Surg 25:1711–1715
6. Haddad A, Tapazoglou N, Singh K, Averbach A (2012) Role of intraoperative esophagogastroenteroscopy in minimizing gastrojejunostomy-related morbidity: experience with 2,311 laparoscopic gastric bypasses with linear stapler anastomosis. Obes Surg 22:1928–1933
7. Alasfar F, Chand B (2010) Intraoperative endoscopy for laparoscopic Roux-en-Y gastric bypass: leak test and beyond. Surg Laparosc Endosc Percutan Tech 20:424–427
8. Mohos E, Schmaldienst E, Richter D, Prager M (2011) Examination of the efficacy and safety of intraoperative gastroscopic testing of the gastrojejunal anastomosis in laparoscopic Roux Y gastric bypass surgery. Obes Surg 21:1592
9. Rovito PF, Rovito PV (2013) Intraoperative endoscopic evaluation of the gastrojejunal anastomosis during laparoscopic Roux-en-Y gastric bypass. Am Surg 79:E360–E361
10. Kligman M (2007) Intraoperative endoscopic pneumatic testing for gastrojejunal anastomotic integrity during laparoscopic Roux-en-Y gastric bypass. Surg Endosc 21:1403–1405
11. Sekhar N, Torquati A, Lutfi R, Richards W (2006) Endoscopic evaluation of the gastrojejunostomy in laparoscopic gastric bypass. Surg Endosc Other Interven Tech 20:199–201
12. Shin RB (2004) Intraoperative endoscopic test resulting in no postoperative leaks from the gastric pouch and gastrojejunal anastomosis in 366 laparoscopic Roux-en-Y gastric bypasses. Obes Surg 14:1067–1069
13. Champion J, Hunt T, DeLisle N (2002) Role of routine intraoperative endoscopy in laparoscopic bariatric surgery. Surg Endosc 16:1663–1665
14. Ramanathan R, Ikramuddin S, Gourash W, Schauer P (2000) The value of intraoperative endoscopy during laparoscopic Roux-en-Y gastric bypass. Surg Endosc 14:s212
15. Andreas A, Adamantios M, Antonios A, Theofilos R, Christos T, Theodoros D (2015) Laparoscopic sleeve gastrectomy for morbid obesity with intra-operative endoscopy: lessons we learned after 100 consecutive patients. Obes Surg 25:1223–1228
16. Diamantis T, Alexandrou A, Pikoulis E, Diamantis D, Griniatsos J, Felekouras E, Papalambros E (2010) Laparoscopic sleeve gastrectomy for morbid obesity with intra-operative endoscopic guidance. Immediate peri-operative and 1-year results after 25 patients. Obes Surg 20:1164–1170
17. Kim J, Azagury D, Eisenberg D, DeMaria E, Campos GM, American Society for M, Bariatric Surgery Clinical Issues C (2015) ASMBS position statement on prevention, detection, and treatment of gastrointestinal leak after gastric bypass and sleeve gastrectomy, including the roles of imaging, surgical exploration, and nonoperative management. Surg Obes Relat Dis 11:739–748
18. Shiloach M, Frencher SK Jr, Steeger JE, Rowell KS, Bartzokis K, Tomeh MG, Richards KE, Ko CY, Hall BL (2010) Toward robust information: data quality and inter-rater reliability in the American College of Surgeons National Surgical Quality Improvement Program. J Am Coll Surg 210:6–16
19. American College of Surgeons User Guide for the 2016 ACS NSQIP Participant Use Data File (PUF). ACS. https://www.facs.org/~/media/files/quality%20programs/nsqip/nsqip_puf_userguide_2016.ashx. Accessed 31 Dec 2017
20. Dakour-Aridi HN, El-Rayess HM, Abou-Abbass H, Abu-Gheida I, Habib RH, Safadi BY (2017) Safety of concomitant cholecystectomy at the time of laparoscopic sleeve gastrectomy: analysis of the American College of Surgeons National Surgical Quality Improvement Program database. Surg Obes Relat Dis 13:934–941
21. Ramly EP, Alami RS, Tamim H, Kantar R, Elias E, Safadi BY (2016) Concomitant removal of gastric band and sleeve gastrectomy: analysis of outcomes and complications from the ACS-NSQIP database. Surg Obes Relat Dis 12:984–988
22. Hutter MM, Schirmer BD, Jones DB, Ko CY, Cohen ME, Merkow RP, Nguyen NT (2011) First report from the American College of Surgeons Bariatric Surgery Center Network: laparoscopic sleeve gastrectomy has morbidity and effectiveness positioned between the band and the bypass. Ann Surg 254:410–420
23. Ruiz-Tovar J, Sola-Vera J, Miranda E, Munoz JL, Perez-Rabasco E, Arroyo A, Calpena R, Group O (2014) Laparoscopic sleeve gastrectomy with endoscopic versus bougie calibration: results of a prospective study. J Laparoendosc Adv Surg Tech A 24:671–675
24. Valenzuela-Salazar C, Rojano-Rodriguez ME, Romero-Loera S, Trejo-Avila ME, Banuelos-Mancilla J, Delano-Alonso R, Moreno-Portillo M (2017) Intraoperative endoscopy prevents technical defect related leaks in laparoscopic Roux-en-Y gastric bypass: a randomized control trial. Int J Surg 50:17–21
25. Kockerling F, Schug-Pass C (2009) Gastroscopically controlled laparoscopic sleeve gastrectomy. Obes Facts 2 Suppl 1:15–18
26. Frezza EE, Barton A, Herbert H, Wachtel MS (2008) Laparoscopic sleeve gastrectomy with endoscopic guidance in morbid obesity. Surg Obes Relat Dis 4:575–579