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Original article

International Sleeve Gastrectomy Expert Panel Consensus Statement: best practice guidelines based on experience of >12,000 cases

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Abstract

Background: Laparoscopic sleeve gastrectomy (LSG) is an emerging surgical approach, but 1 that has seen a surge in popularity because of its perceived technical simplicity, feasibility, and good outcomes. An international expert panel was convened in Coral Gables, Florida on March 25 and 26, 2011, with the purpose of providing best practice guidelines through consensus regarding the performance of LSG. The panel comprised 24 centers and represented 11 countries, spanning all major regions of the world and all 6 populated continents, with a collective experience of >12,000 cases. It was thought prudent to hold an expert consensus meeting of some of the surgeons across the globe who have performed the largest volume of cases to discuss and provide consensus on the indications, contraindications, and procedural aspects of LSG. The panel undertook this consensus effort to help the surgical community improve the efficacy, lower the complication rates, and move toward adoption of standardized techniques and measures. The meeting took place at on-site meeting facilities, Biltmore Hotel, Coral Gables, Florida.

Methods: Expert panelists were invited to participate according to their publications, knowledge and experience, and identification as surgeons who had performed >500 cases. The topics for consensus encompassed patient selection, contraindications, surgical technique, and the prevention and management of complications. The responses were calculated and defined as achieving consensus (≥70% agreement) or no consensus (<70% agreement).

Results: Full consensus was obtained for the essential aspects of the indications and contraindications, surgical technique, management, and prevention of complications. Consensus was achieved for 69 key questions.

Conclusion: The present consensus report represents the best practice guidelines for the performance of LSG, with recommendations in the 3 aforementioned areas. This report and its findings support a first effort toward the standardization of techniques and adoption of working recommendations formulated according to expert experience. (Surg Obes Relat Dis 2012;8:8–19.)

Keywords: Consensus statement; Laparoscopic sleeve gastrectomy; International Sleeve Gastrectomy Expert Panel; Morbid obesity; Bariatric surgery; Outcomes

Laparoscopic sleeve gastrectomy (LSG) is a relatively new surgical approach in the weight loss surgeon's armamentarium, but 1 that has seen growth in popularity because of the perceived simplicity of the surgical technique, resolution of co-morbidities, and excellent weight loss outcomes. The indications for LSG as a primary procedure

A complete list of the International Sleeve Gastrectomy Expert Panel can found in Appendix A.

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were published in 2008 [1], and a host of reports on the topic have been published since [2–30], with significant 3- and 5-year data and experience justifying its recommendation by the American Society for Metabolic and Bariatric Surgery as an approved bariatric procedure [31].

Because of its growth in popularity and use as a single-stage procedure by many internationally, it was determined that a consensus meeting of a group of surgeons who, globally, have performed a high volume of cases could effectively address aspects of the procedure that need definition, standardization, and clarification. The goals included the following: (1) to conduct discussion and evaluation of various procedural aspects of LSG (inclusive of indications/contraindications, surgical technique, and prevention and management of complications) that included and considered the collective experience of participants and current published data; (2) to achieve consensus on topics in LSG from the discussion and evaluation; and (3) to aid the surgical community and improve the safety of performance with minimal morbidity and high efficacy using the resulting best practice guidelines.

An international expert panel was convened on March 25 and 26, 2011 in Coral Gables, Florida, to achieve consensus regarding various predetermined aspects of LSG. The panel of experts, who represented 11 countries that span all 6 populated continents and comprise 24 surgical centers, had a collective total experience of >12,000 LSGs.

LSG was first conceived as a restrictive component of biliopancreatic diversion and duodenal switch when bariatric surgery was only performed using an open approach. The procedure creates a sleeve or tubular stomach along the lesser curvature, with weight loss achieved by both restrictive and still not clearly defined endocrine mechanisms.

Initially proposed as a first-step procedure in high-risk patients followed by second-step laparoscopic biliopancreatic diversion and duodenal switch or laparoscopic Roux-en-Y gastric bypass, LSG has, with minimally invasive techniques and an increase in surgical experience, become widely considered as a primary restrictive bariatric procedure. The early findings from prospective and retrospective studies have been encouraging, and the potential advantages include excellent weight loss outcomes, co-morbidity resolution, the relative ease of the technique, the avoidance of a foreign body or adjustments, a shortened operating time, and immediate restriction of caloric intake [2].

Many surgical approaches contain variations in technique, which, with a lack of standardization, can predispose to poor outcomes. For LSG, however, the hazard also exists that, because of a misperception that LSG is technically undemanding, surgeons who do not posses the required experience, discipline, and technical knowledge to avoid serious procedure-related complications (e.g., leaks and strictures) might perform it. Because of this hazard and the lack of standardization associated with LSG, the panel determined that an immediate need exists to craft and disseminate expert recommendations from the available data and experience, with a resulting drive toward standardization.

The areas identified as those with a need for expert guidance and consensus included certain key technical aspects of the surgery, indications and contraindications, and the management and prevention of complications. This has not been accomplished for the various other bariatric procedures currently being performed, and this set of expert consensus guidelines is, to our knowledge, the first of its kind in surgery for morbid obesity. It is the hope of the expert panel that providing guidance on these critical aspects of the procedure through a guidelines consensus document will result in safer performance and better outcomes and, hence, the successful establishment of LSG as a valid surgical option in the weight loss surgery community. The present resulting consensus report reflects the integration of the panelists' individual clinical expertise with the most current published data and provides a strong foundation for the formulation of valid guidelines to be used as a framework for individual clinical judgment and application.

Panel data

A questionnaire was sent to all panelists before the consensus meeting to compile various data on the total number of LSG cases performed by the group (Table 1). These data comprise a total of 12,799 LSG cases. The data are reported as the mean ± SD, where appropriate. In addition to providing a rich source of information from which insights and conclusions could be drawn beyond the confines of the present consensus report, it reflects the panel's breadth and depth of experience with both the broad and technically specific aspects of LSG addressed in this consensus.

The total number of LSG cases performed by those panelists who shared data was 12,799. The mean patient age was 42 years, with 26% male and 73% female. The mean body mass index of the patients was 44 ± 4.47 kg/m^2. The mean bougie size was 37F ± 5.92F. The average length of hospital stay was 2.5 ± .93 days. The conversion rate was 1.05% ± 1.85%. On average, patients experienced a 1.06% leak rate and .35% stricture rate. The postoperative gastroesophageal reflux rate was 12.11% ± 8.97%.

These data reflect the experience of the panelists in LSG and were compiled from a large body of work that comprises, to our knowledge, 1 of the greatest levels of volume and skilled experience reported. Deviations among the reported series can be rationalized by volume dependency, the complexity of the primary cases, and referral cases—some of which were complex primary cases and some of which were failed cases that involved complex revisions or complications of primary cases performed by other surgeons. The differences in the expert caseload versus the average surgeon's caseload serve to highlight the strength of the panel's technical expertise and ability to provide insight on the highly technical aspects of the procedure and can there-

Table 1
International Sleeve Gastrectomy Expert Panel Data

Surgeon	Cases (n)	Average age (yr)	Male (%)	Female (%)	Average BMI (kg/m^2)	Bougie size (F)	Reinforcement type	Average hospital stay (d)	Stricture rate (%)	Leak rate (%)	Postoperative GERD rate (%)	Conversions (%)	Procedure conversion (%)	Average weight loss failure or weight regain	Leak management methods
N. Zundel	892	33	34	67	42	34	Suture	1.4	1.00	0.00	1.00	3.00	Bypass 45 Resleeve 51 Other 4	12% <45% of EWL	Laparoscopy only if unstable; stent and pyloric dilation
R. Baker	828	47	28	71	54	34	Buttress	2.0	.12	.50	15.00	3.00	RYGB 50, DS 35%, band on sleeve 12, resleeve 4	15% started to gain 3 y postoperatively	1 Stent, 2 Roux limb on leak, injection of sclerotherapy agent at fistula opening
M. Jacobs	526	44	24	75	45	36	Suture/buttress	1.1	.19	1.50		.19	RYGB	32 patients converted from band to sleeve, 28% had <40% EWL	
S. Shah/J. Todkar	498	45	32	68	49	36	Suture	3.5	.20	.40	28.00	.80	Resleeve 75 Gastrojejunostomy 25	Weight regain 3, weight loss failure 1	Relaparoscopy, stent, revisional surgery
G. Jossart	617	42	21	78	47	32	Suture	1.2	0	.60	20.00	.50	RYGB	10	
R. Rosenthal	547	46	49	50	45	42	Suture	3.0	.20	.36	27.00	.18			Relaparoscopy, drainage, TPN
A. Aceves	1127	43	19	81	42	36	Suture	3.0	.35	.62	18.00	.35	DS 1, RYGB 2, resleeve 1	6% regained 11–40 lb	<15-d drainage + tube feeding, >15-d stent + NJ feeding or NJ feeding only, >1 NJ feeding only
M. France	716	47	22	77	43	34	Buttress	2.6	1.40	.70	7.00	.30	Gastric bypass 1, band on sleeve 1	8% weight loss failure (did not lose ≥50% EWL)	3 stent + drainage, 2 drainage only
D. Noca	700	42	19	80	46	36	None	4.0	0	3.90	15.00	1.00	RYGB	20 at 3 yr	
D. Bellanger	675	44	18	81	44	34	None	1.8	0	0	5.00	0	NA	23% Failed to achieve >50% EWL at 3 yr	
J. Himpens	710	43	50	50	43	32	Suture/none	2.2	1.00	2.90	23.00	0			Percutaneous drain + stent
M. Lakdawala	484	38	36	63	44	36	None/suture	2.0	0	1.20	10.00	.60	LYRGB 1, DS 1	3.30	7 Relaparoscopy + drainage + stent, 5 stent + NJ feeding only

Table 1
Continued.

Surgeon	Cases (n)	Average age (yr)	Male (%)	Female (%)	Average BMI (kg/m^2)	Bougie size (F)	Reinforcement type	Average hospital stay (d)	Stricture rate (%)	Leak rate (%)	Postoperative GERD rate (%)	Conversions (%)	Procedure conversion (%)	Average weight loss failure or weight regain	Leak management methods
A. Ramos/M. Galvao Neto	714	43	34	65	45	32	Suture	1.5	.14	.42	6.02	0	NA	.84	<30 d, 32 with stent with or without pneumatic dilation; >30 d, 23 with endoscopic dilation with
C. Boza	1431	37	21	79	37	50	Suture	2.8	.06	.50	.50	.40	LRYGB .4, Endobarrier .07	9.1 at 1 yr, 11.6 at 2 yr, 18.5 at 3 yr	
N. Basso	505	42	25	75	47	48	No reinforcement 80, 23 Peristrips 292	4.3	0	2.70	10.00	.40	Re-sleeve 1; BPDDS 30	6.10 failed to achieve >50% EWL	Drainage + stent + TPN or enteral nutrition, glue
D. Arvidsson	700	45	10	90	35	32	Suture	2.0	.30	1.10	10.00	.40	RYGB 2, DS 1		
M. Vix	350	40	25	75	46	36	Suture	3.0	.50	3.00	10.00	5.00	Bypass	10	Drainage by CT, reoperation if necessary, stent in all cases
G. Prager	267	44	47	53	50	48	9× Duett	5.1	.80	3.30	31.00	10.90	Bypass	13 patients converted to RYGB	
J. Jorgenson	512	45	25	74	45	36	Buttress	3.0	.50	0	10.00	0	RYGB 1		
Average		42.20	27.00	72.58	43.86	37.20		2.50	.35	1.06	12.11	1.05			
SD		3.83	10.28	10.25	4.47	5.92		.93	.41	1.13	8.97	1.85			
Total (n)		12,799	12,799	12,799	12,799	12,799		12,799	12,799	12,799	12,273	12,799			

BMI = body mass index; GERD = gastroesophageal reflux disease; EWL = excess weight loss; RYGB = Roux-en-Y gastric bypass; DS = duodenal switch; TPN = total parenteral nutrition; NJ = nasojejunal; NA = not applicable; LRYGB = laparoscopic RYGB; BPD = biliopancreatic diversion; CT = computed tomography.

fore serve to strengthen the consensus statements. The surgical community can be guided by these experts, who have performed a high caseload and have encountered a variety of possible perioperative and postoperative events surrounding the indications, contraindications, technical aspects, and complication concerns addressed in the present report.

Methods

Four chairpersons, who are surgeons with vast experience in LSG, convened and set the goals and panel inclusion criteria for this consensus endeavor. These 4 have collectively performed almost 2500 LSG cases and represent 4 different regional surgical societies (United States, Latin America, Europe, and Asia Pacific). The chairpersons determined the makeup of the expert international panel of surgeons, whom they invited to participate in this consensus meeting because of their individual level of experience and knowledge regarding LSG. Specifically, the threshold for inclusion was set at a minimum of 500 LSGs performed, and the chairpersons attempted to identify as many surgeons meeting this criterion as possible. Among all surgeons eligible according to their experience level, the panel strove for global balance, avoiding over-representation of any 1 region. In addition to the surgeons with the most LSG experience, the chairpersons invited a small number of expert bariatric surgeons and an expert endoscopist for their technical expertise and general experience to provide an even more informed, objective perspective. Also, to avoid any perceived bias regarding the use of instrumentation and other matters of surgical technique, no consideration was given to these attributes when selecting the panelists, and the panel therefore included surgeons with various product and manufacturer preferences, as well as various surgical approaches.

Each panelist was invited to share data, which was not a requirement to participate, for the purposes of formulating a table of information (Table 1). All participants made their own choice to submit data without consultation with other members of the group. Most of the invited panel chose to share their experience for the purposes, and the information provided in Table 1 consequently includes data from approximately 12,800 LSG cases. The variation in the results is a testament to the veracity of the representative nature of the tabular data. Table 1 was made available to the panelists for review during the consensus conference.

The chairpersons predetermined the categories of questions posed for consensus, which correlated with the factors and data points outlined in Table 1, and consisted of patient selection, contraindications, surgical technique, and the perioperative and postoperative prevention and management of complications. A limited agenda in the 1.5-day closed session meeting consisted of the following:

> Day 1 (short working session): program presentation; working strategy and review of submitted experience by invited panelists; a review of the collective data of all invited experts; a review of the day 2 procedures concerning the consensus process; a short overview of the categories of the predetermined questions; and 1 round of questions and responses. Strictly limited time was allowed to present and review data, direct topics, and a general review of the consensus process.
>
> Day 2 (full-day working session): the process included discussion, published data review, viewing of predetermined questions, and rapid responses using an electronic voting system (Option Technologies Interactive, Audience Response System, Orlando, FL).

An interactive, evidence-based approach was used to obtain consensus statements from the panel regarding patient selection, contraindications, surgical technique, and the perioperative and postoperative prevention and management of complications of LSG. After a review of the categories of questions, the process was as follows: for each category, a published data review, table/data review, and discussion were conducted. Next, all questions, organized by category, were presented individually and viewed using a large monitor.

After the rapid response was conducted using the anonymous electronic voting system, the group's responses were calculated and defined as consensus ($\geq$70% agreement) or no consensus ($<$70% agreement). The distribution of the group's responses was immediately reviewed by the entire panel after each individual question.

The consensus process incorporated a premeeting detailed review of the published data on LSG. This body of data guided the chairpersons as background material in the prioritization and formulation of each topic for consensus consideration. The discussion also encompassed the evidence provided by the panel's shared collective tabular data (Table 1), all of which were open forums for dialogue. The panel shared opinions and perspectives from the literature's existing data but also from their own expert clinical experience and through discussion. Finally, by electronic and anonymous vote, they determined what procedural aspects of LSG they agreed on, achieving shared consensus on topics, or in some cases on the finite aspects of topics.

Results

The consensus statements determined from the question responses are detailed in the following sections, and those statements of consensus considered the most critical by the expert panel are listed in Table 2. Consensus was obtained for the essential aspects of indications and contraindications, proper surgical technique, and the prevention and management of perioperative and postoperative complications (Tables 3–5). In addition, consensus was achieved on certain points categorized as general and special considerations (Table 6).

Table 2
Key consensus points at a glance

Category	Topic	Consensus statement	Consensus (%)
I/C	Patient selection	LSG is a valid stand-alone procedure	90
		LSG is a valid option for patients considered high risk	96
		LSG is a valid option for transplant candidates (kidney and liver).	96
		LSG is a valid option for morbidly obese patients with metabolic syndrome	91
		LSG is a valid option in patients with BMI 30–35 kg/m^2 with associated co-morbidities	95
		LSG is a valid option for patients with inflammatory bowel disease	86
		LSG is valid for adolescent morbidly obese patients	77
		LSG is valid for elderly morbidly obese patients	100
		Barrett's esophagus is an absolute contraindication for LSG	81
Technique	Sizing sleeve	Optimal bougie size is 32–36F	87
		Invaginating staple line reduces lumen size	83
	Staple height	It is not appropriate to use staples with closed height less than that of a blue load (1.5 mm) on any part of sleeve gastrectomy	81
		When using buttressing materials, surgeon should never use any staple with closed height less than that of a green load (2.0 mm)	79
		When resecting the antrum, surgeon should never use any staple with closed height less than that of a green load (2.0 mm)	87
	First firing	Transection should begin 2–6 cm from pylorus	92
	Last firing	It is important to stay away from GE junction on last firing	96
	Mobilization	It is important to completely mobilize the fundus before transection	96
	Reinforcement	Staple line reinforcement will reduce bleeding along staple line	100
Complications	Managing	A chronic leak is a leak that has lasted >12 wk	72
		Leaks can be classified as acute, early, late, and chronic	73
		In a patient in whom endoscopic dilation has failed for 6 wk, reoperation is indicated	80
		Gastric bypass is always the last treatment option for leaks	83
		A patient with uncontained, symptomatic leak requires immediate reoperation	86
		Roux-en-Y reconstruction is treatment of choice after failed reinterventions for chronic stricture	88
		Early leaks are those observed 1–6 weeks from primary procedure	89
		Stenting has limited utility for chronic leaks	89
		Patients with fever and tachycardia with normal UGI or other studies require immediate reoperation or reintervention	90
		Roux-en-Y reconstruction is a valid option in proximal chronic leaks	90
		The use of a stent for an acute proximal leak is a valid treatment option	93
		The surgeon should wait ≥12 wk of conservative therapy before reoperating to convert or revise proximal leak (assumes patient is stable)	94
		Staple line disruptions can be classified as proximal or distal and they behave differently	95
		Staple line disruptions can be divided into early and late	95
		The use of a stent is a valid treatment for an acute proximal leak that has failed conservative therapy	95
		Staple line disruptions can be classified as proximal or distal.	100
		Staple line disruptions behave differently based on anatomic location	100
		Acute leaks are those observed within 7 d of primary procedure	100
		Late leaks are those observed after 6 wk	100
		Early strictures are symptomatic in first 6 weeks after surgery	100
		The smaller the bougie size, the tighter the sleeve, the greater the stricture rate	78
	Avoiding	The smaller the bougie size, the tighter the sleeve, the greater the incidence of leaks	70
		When oversewing, the surgeon should always oversew with the bougie in place	78
		Maintaining symmetric lateral traction while stapling will reduce the potential for strictures	75
Special considerations	Hiatal hernia	Aggressive identification of hiatal hernia intraoperatively is appropriate	83
		Diaphragmatic defect should be closed after sleeve procedure is completed	71
	Postoperative diet	Patients should not begin eating solid food until ≥2 wk postoperatively	100

I/C = indications/contraindications; LSG = laparoscopic sleeve gastrectomy; BMI = body mass index; GE = gastroesophageal; UGI = upper gastrointestinal.

Table 3
Indications/contraindications: consensus points

Consensus statement	Consensus (%)
Patient selection	
LSG is a valid stand-alone procedure	90
LSG is a valid option for patients considered high risk	96
LSG is a valid option for transplant candidates (kidney and liver)	96
LSG is valid option for morbidly obese patients with the metabolic syndrome	91
LSG is a valid option in patients with BMI 30–35 kg/m^2 with associated co-morbidities	95
LSG is a valid option for patients with inflammatory bowel disease	86
LSG is valid for adolescent morbidly obese patients	77
LSG is valid for elderly morbidly obese patients	100
Barrett's esophagus is an absolute contraindication for LSG	81
RYGB is the best option to convert failed LAGB	71
As first stage of 2-step approach, sleeve is only appropriate for super morbidly obese patients	75
LSG is a valid treatment option in a patient with Child's A or B	78
LSG is an acceptable option to convert successful but complicated LAGB	95
General	
When a patient is converted from band to sleeve, the operation should be done in 1-step; 1-step approach is a valid approach	72
The two-step approach is also valid	79
Even if 30% of LSG patients will need a second procedure, it is an excellent procedure	90

LSG = laparoscopic sleeve gastrectomy; BMI = body mass index; RYGB = Roux-en-Y gastric bypass; LAGB = laparoscopic adjustable gastric banding.

Indications/contraindications

Patient selection. In addition to reaching consensus on LSG as a valid stand-alone procedure (90%), the panelists identified LSG as a valid treatment option for the following categories of patients (Table 3): patients considered high risk (96%); transplant candidates (kidney and liver) (96%); morbidly obese patients with the metabolic syndrome (91%); patients with a body mass index of 30–35 kg/m^2 with associated co-morbidities (95%); patients with inflammatory bowel disease (86%); morbidly obese patients in adolescence (77%); morbidly obese patients who are elderly (100%); and patients with Child's A or B liver cirrhosis (78%). As the first stage of a 2-step approach, LSG is only appropriate for the super morbidly obese patient (75%).

Panelists also reached consensus that the presence of Barrett's esophagus is an absolute contraindication for LSG (81%).

Revisions. Panelists also reached consensus on several points regarding revisions. Although consensus was reached on the point that Roux-en-Y gastric bypass, not LSG, is the best option to convert a failed gastric band (71%), the panelists also determined that LSG is an acceptable option to convert a successful, but complicated, gastric band (95%). When a patient undergoes conversion from gastric banding to LSG, the operation can be done in 1 step, which is a valid approach (72%). The 2-step approach is also valid (79%). Even assuming that ≤30% of LSG patients will need a second procedure, the panel agreed that it is still an excellent procedure (90%).

Surgical technique

The panel achieved consensus on the technical aspects of the performance of LSG (Table 4), which can be categorized as follows.

Sizing the sleeve. Consensus was reached on critical points regarding sizing the sleeve. The panelists determined that, in addition to it being important when performing LSG to use a bougie to size the sleeve (100%), the optimal bougie size is 32F–36F (87%). The panel arrived at this consensus over concerns that using a bougie <32F might increase complications significantly and that using a bougie >36F could lead to the lack

Table 4
Surgical technique: consensus points

Consensus statement	Consensus (%)
Sizing the sleeve	
Optimal bougie size is 32–36F	87
Invaginating staple line reduces lumen size	83
It is important when performing LSG to use a bougie to size the sleeve	100
Staple heights	
It is not appropriate to use staples with a closed height less than that of a blue load (1.5mm) on any part of sleeve gastrectomy	81
When using buttressing materials, surgeon should never use any staple with closed height less than that of a green load (2.0 mm)	79
When resecting antrum, surgeon should never use any staple with closed height less than that of a green load (2.0mm)	87
When performing revision surgery, the last firings (across the site of previous intervention) should be green or greater	71
First firing	
Transection should begin 2 to 6 cm from the pylorus	92
Last firing	
It is important to stay away from the GE junction on the last firing	96
Mobilization	
It is important to completely mobilize the fundus before transection	96
It is important to take down the short gastric before resection	82
Reinforcement	
Staple line reinforcement will reduce bleeding along the staple line	100
It is acceptable to buttress the staple line	77
It is acceptable to oversew	95

LSG = laparoscopic sleeve gastrectomy; GE = gastroesophageal.

Table 5
Complications: consensus points

Consensus statement	Consensus (%)
Managing complications	
A chronic leak is a leak that has lasted >12 wk	72
Leaks can be classified into acute, early, late, and chronic	73
In a patient in whom endoscopic dilation for 6 wk has failed, reoperation is indicated	80
Gastric bypass is always the last treatment option for leaks	83
A patient with an uncontained, symptomatic leak requires immediate reoperation	86
Roux-en-Y reconstruction is the treatment of choice after failed reinterventions for chronic stricture	88
Early leaks are those observed 1–6 wk after primary procedure	89
Stenting has limited utility for chronic leaks	89
In a patient with a fever and tachycardia with normal UGI or other studies, the patient requires immediate reoperation or reintervention	90
Roux-en-Y reconstruction is a valid option in proximal chronic leaks	90
The use of a stent for an acute proximal leak is a valid treatment option	93
The surgeon should wait ≥12 wk of conservative therapy before reoperating to convert or revise a proximal leak (assumes patient is stable)	94
Staple line disruptions can be classified as proximal or distal and they behave differently	95
Staple line disruptions can be divided into early and late	95
The use of a stent for an acute proximal leak is a valid treatment that has failed conservative therapy	95
Staple line disruptions can be classified as proximal or distal	100
Staple line disruptions behave differently according to anatomic location	100
Acute leaks are those observed within 7 days of primary procedure	100
Late leaks are those observed after 6 wk	100
Early strictures are symptomatic in first 6 wk after surgery	100
The smaller the bougie size, the tighter the sleeve, the greater the incidence of strictures	78
The smaller the bougie size and the tighter the sleeve, the higher the incidence of leaks	70
Avoiding complications	
When oversewing, the surgeon should always oversew with bougie in place	78
Maintaining symmetric lateral traction while stapling will reduce potential for strictures	75
Using bougie when stapling incisura angularis will result in decreased incidence of strictures	82
The incisura angularis is a potential stricture site	100

of long-term restriction and possible dilation of the sleeve, resulting in failure of weight loss or long-term weight regain. Invaginating the staple line with sutures might result in temporary or permanent reduction of the lumen size (83%), depending on the suture type used (absorbable versus nonabsorbable).

Staple heights and firings. Staple heights were an area of wide discussion. Although the observation was made that many variables are present in an operation that make this particular area of discussion difficult to distill into consensus, consensus was achieved for some points, including that it is not appropriate to use staples with a closed height less than that of a blue load (1.5 mm) on any part of a sleeve gastrectomy (81%). It is noteworthy that some dissenters voted against because they did not agree that anything less than a green load should be used. When using buttressing materials, the surgeon should never use any staple with a closed height less than that of a green load (2.0 mm) (79%). When resecting the antrum, the surgeon should never use any staple with a closed height less than that of a green load (2.0 mm) (87%), because the gastric antrum wall is the thickest part of the stomach. General guidance from the panel on this area of technical discussion is that nothing less than a green load up to the incisura angularis should be used; nothing less than blue from the incisura angularis to the angle of His should be used; and nothing less than green when performing revisions should be used.

Table 6
General and special considerations: consensus points

Consensus statement	Consensus (%)
Special considerations	
Hiatal hernia	
Aggressive identification of hiatal hernia intraoperatively is appropriate	83
Hernia should always be repaired if found	82
The diaphragmatic defect should be closed after the sleeve procedure is completed	71
Postoperative diet	
Patients should not begin eating solid food until at least 2 wk postoperatively	100
GERD	
In patients with GERD, proton pump inhibitors should be the first line of treatment	85
General	
Standardization	
Lack of standardization leads to confusion	100
If all surgeons followed known best-practice techniques, outcomes would be better	95
An ideal technique exists that maximizes outcomes	70
An ideal technique exists that guarantees patient safety	89
High complications for sleeve gastrectomy would be harmful for all bariatric surgery	85
There will be more complications as more surgeons perform sleeve gastrectomy	95
Surgeon qualification	
Sleeve gastrectomies should only be performed by bariatric surgeons	85
Preoperative workup	
Endoscopy should routinely be performed in sleeve gastrectomy patients	70

GERD = gastroesophageal reflux disease.

Table 7
Leak classifications

Classification	Time of presentation*
Acute leak	Within 7 d
Early leak	Within 1–6 wk
Late leak	After 6 wk
Chronic leak	After 12 wk

* Observation after primary procedure.

When performing revision surgery, the last firings (across the thickened site of the previous intervention) should be green or larger (71%). The transection should begin 2–6 cm from the pylorus (92%); and it is important to be cautious and maintain a reasonable distance from the gastroesophageal junction on the last firings (96%). Although some surgeons considered the fat pad located near the gastroesophageal junction an acceptable landmark to identify the esophagus, others disagreed that this anatomic structure was a reliable landmark.

Mobilization. Regarding mobilization, the following 2 critical points of consensus were reached. It is important to completely mobilize the fundus before transection (96%). Otherwise, the surgeon might miss a hiatal hernia and leave behind too much stomach, decreasing the restrictive component of the operation. It is also important to take down the short gastric vessels before resection (82%).

Managing and avoiding complications

Leaks, strictures, bleeding, and gastroesophageal reflux disease were the most prevalent complications observed after LSG (Table 1). The panel achieved consensus on many critical points regarding the complications of this procedure (Table 5), which could be categorized into the following areas.

Leaks. Consensus was reached on several points regarding leaks, including defining leak classifications according to observation periods (Table 7). Leaks can be classified into acute, early, late, and chronic (73%). Additional points of consensus included that the use of a stent is a valid treatment option for an acute proximal leak for which conservative therapy has failed (95%). Also, panel discussion arrived at consensus that after 30 days the likelihood of a leak to seal by exclusion using a stent is very low. The surgeon should wait until $\geq$12 weeks after conservative therapy to allow the body to heal and avoid thick adhesions during reoperation before reoperating to repair a proximal leak (converting to bypass or revising sleeve) (94%). The use of a stent is a valid treatment option for an acute proximal leak (93%). An unstable patient with a contained or uncontained symptomatic leak requires immediate reoperation (86%). A patient with fever and tachycardia with normal findings from upper gastrointestinal or other studies needs immediate reoperation or reintervention (90%). Stenting has limited utility for chronic leaks (89%). When oversewing, the surgeon should oversew with the bougie in place (78%). Roux-en-Y reconstruction is a valid treatment option in proximal chronic leaks (90%). This converts the high-pressure system with distal obstruction of LSG to the lower pressure system of Roux-en-Y gastric bypass. Gastric bypass is always the last treatment option for leaks (83%). The smaller the bougie size and, thus, the tighter the sleeve, the greater the incidence of leaks (70%).

Strictures. Consensus was also reached on several points regarding strictures. Early strictures are symptomatic in the first 6 weeks after surgery (100%). The treatment options for strictures were classified in the order of implementation (Table 8).

Roux-en-Y reconstruction is the treatment of choice after failed reinterventions for a persistent stricture (88%). The discussion determined that observation, followed by endoscopic dilation, followed by seromyotomy, and finally Roux-en-Y gastric bypass are the preferred treatment options (Table 8). In a patient in whom endoscopic dilation for 6 weeks has failed, reoperation is indicated (80%). The smaller the bougie size and, thus, the tighter the sleeve, is related to a greater incidence of stricture (78%). After mobilization and takedown of the short gastric vessels, maintaining symmetric lateral traction while stapling will reduce the potential for strictures (75%). The incisura angularis is the site with the greatest potential for stricture development (100%). Using an appropriately sized bougie when stapling the incisura angularis will result in decreased stricture formation (82%).

Staple line reinforcement. Some general observations were made regarding staple line reinforcement. The use of staple line reinforcement will reduce bleeding along the staple line (100%). It is acceptable to buttress the staple line (77%). It is acceptable to oversew the staple line (95%). Notably, consensus was not achieved on the topics of whether to buttress or on whether buttressing reduces leaks. This should serve as a focus for future directions of clinical investigation.

General. The following statements also reached consensus. Staple line disruptions can be classified as proximal or distal (100%), and they behave differently depending on the anatomic location (100%). Finally, staple line disruptions can be classified as early and late (95%).

Table 8
Treatment options for strictures in order of implementation

1. Observation
2. Endoscopic dilation
3. Seromyotomy
4. Conversion to RYGB

RYGB = Roux-en-Y gastric bypass.

Table 9
Points of no consensus (by decreasing percentage)

Topic	Statement	%
Managing complications	Strictureplasty (seromyotomy) is a valid treatment option for patients who have failed endoscopic dilation for 6 wk	69
General	LSG will become the most frequently performed procedure	68
Patient Selection	LSG is a valid option to convert a failed LAGB	67
General	LSG should be indicated as a final step (i.e. single stage operation), regardless of BMI	65
Avoiding complications	The lower the bougie size, the tighter the sleeve, the greater the incidence of strictures and leaks	65
Mechanism of action	The most likely hormonal mechanism of action is both ghrelin and GLP-1	60
Postoperative diet	Patients should not eat solid foods for 4–6 wk after surgery	60
Avoiding complications	One should not use nonabsorbable sutures to oversew	59
Mechanism of action	The most likely mechanism of action of sleeve gastrectomy is the increase in intragastric pressure	58
Reinforcement	The use of staple line reinforcement will reduce the leak rate, provided the green or greater load is used	58
Warm-up	There is an ideal technique that guarantees better weight loss	58
First firing	The transection should begin 4–6 cm from the pylorus	57
Last firing	It is important to mobilize the fat pad before the most proximal firing	57
Patient Selection	GERD is a relative contraindication for LSG	57
Reinforcement	If buttressing material did not add cost to the procedure, one would use it routinely for staple line reinforcement	57
Hiatal hernia repair	Do the sleeve first, then fix the hernia	52
Sizing the sleeve	It is important to not staple tight to the bougie	52
Managing complications	Observation is a valid treatment option for strictures in the first 6 wk after surgery	50
Preoperative workup	All patients who complain of reflux should have pH-metry and manometry before LSG	50
Avoiding complications	One should routinely perform a intraoperative leak test	48
Managing complications	A conservative approach is a valid treatment option for a acute or early leak	48
Reinforcement	The use of staple line reinforcement will reduce the leak rate	48
Surgeon qualification	To be proficient, a surgeon must complete >30 sleeves	48
General	LSG should be indicated as the first step of a 2-stage procedure	47
Patient selection	The best procedure for a failed LSG is BPD/DS	44
Patient selection	The best procedure for a failed LSG is RYGB	44

LAGB = laparoscopic adjustable gastric bypass; BMI = body mass index; GLP-1 = glucagon-like peptide-1; GERD = gastroesophageal reflux disease; LSG = laparoscopic sleeve gastrectomy; BPD/DS = biliopancreatic diversion/duodenal switch; RYGB = Roux-en-Y gastric bypass.

General and special considerations

The panel discussed and achieved consensus on various critical general and special considerations of LSG (Table 6), including the following.

Hiatal hernias and gastroesophageal reflux disease. The general points of consensus outside the specific areas of LSG indications, technique, and complications included the following. Aggressive identification of hiatal hernia intraoperatively is appropriate (83%). On this point, the panel concluded that surgeons should always dissect the phrenesophageal membrane and inspect the greater curvature side of the stomach for the presence of a hiatal hernia. If a hiatal hernia is identified, dissection should be carried posteriorly to achieve appropriate closure of the crus. If a hernia is found, it should be repaired (82%). The diaphragmatic defect should be closed after the sleeve procedure has been completed (71%). Patients undergoing sleeve gastrectomy with or without repair of a hiatal hernia should not begin eating solid food until ≥2 weeks postoperatively (100%). In patients with new-onset gastroesophageal reflux disease after sleeve gastrectomy, proton pump inhibitors should be the first line of treatment (85%).

Special considerations for surgeons. A lack of standardization leads to confusion (100%). If surgeons followed known best-practice techniques, the outcomes would be better (95%). An ideal technique exists that promotes patient safety (89%). A high complication rate of sleeve gastrectomy would be harmful for the reputation of all bariatric surgery (85%). More complications will occur as more surgeons perform sleeve gastrectomy (95%).

The consensus statements best categorized as special considerations in LSG include the following. Sleeve gastrectomies should only be performed by bariatric surgeons (85%). Endoscopy should routinely be performed in patients undergoing sleeve gastrectomy (70%).

Notably, the panel reached consensus on almost all topics, providing a basis for current technical and clinical approaches and the development of future guidelines. However, those topics that did not reach consensus (Table 9) emphasize the need for additional studies and long-term data, especially within the specific areas of staple line reinforcement, patient selection, and specific points about the management of complications.

Conclusions

The present consensus report was predicated on the collective knowledge and proficiency of a select group of very experienced surgeons performing LSG, case data collected

from the expert panel, and a review of existing published data. As such, the present report can serve as a summary of consensus statements that can be used as best practice guidelines in the performance of LSG.

The durability of this procedure is evidenced in the 3- and 5-year data [2], and the number of procedures is expected to increase, as is the number of surgeons who perform this operation. Standardization of the technique of LSG is paramount to improving the safety and maintaining the minimal morbidity and high weight loss efficacy rates. The report also addresses the prevention and proper management of complications.

This consensus statement represents a position paper for performance of the surgical approach of LSG. The weaknesses include that the panel data include midterm rather than long-term results, because not all investigators' long-term results are available for publication; the panel data were determined by retrospective review; and the status of multiple investigators, although strengthening the power of consensus, prohibited our ability to provide uniform or standard results from which we can draw concrete conclusions (because with multiple investigators, multiple variations were present in technique). Although not meant to establish a standard of practice, this consensus statement supports and encourages surgeons and surgical societies to develop standardized guidelines and highlights the areas in need of additional study and long-term experience and data. The publication and implementation of determined best practices is the ultimate aim of this consensus effort, which is intended to guide clinical practice, surgical technique, and the future research regarding LSG.

Disclosures

The authors have no commercial associations that might be a conflict of interest in relation to this article.

Appendix A

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