Laparoscopic sleeve gastrectomy versus endoscopic sleeve gastroplasty: a systematic review and meta-analysis

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ABSTRACT
Background and study aims Laparoscopic sleeve gastrectomy (LSG) is the current standard for bariatric surgery, but it is affected by several postoperative complications. Endoscopic sleeve gastroplasty (ESG) was created as a less invasive alternative to LSG. However, its efficacy and safety compared with LSG is unclear.

Materials and methods Relevant publications were identified in MEDLINE/Cochrane/EMBASE/OVID/PROSPERO and NIH up to January 2020. Studies were selected that included obese patients with a baseline body mass index (BMI) between 30 and 40 kg/m² with a minimum of 12 months of follow-up and with reported incidence of complications. The mean difference in percentage of excess weight loss (%EWL) at 12 months between LSG and ESG represented the primary endpoint. We also assessed the difference in pooled rate of adverse events. The quality of the studies and heterogeneity among them was analyzed.

Results Sixteen studies were selected for a total of 2188 patients (LSG: 1429; ESG: 759) with a mean BMI 34.34 and 34.72 kg/m² for LSG and ESG, respectively. Mean %EWL was 80.32 % (± 12.20; 95 % CI; \( P = 0.001 \); \( I^2 = 98.88 \)) and 62.20 % (± 4.38; 95 % CI; \( P = 0.005 \); \( I^2 = 65.52 \)) for the LSG and ESG groups, respectively, corresponding to an absolute difference of 18.12% (±0.89; 95 % CI, \( P = 0.0001 \)). The difference in terms of mean rate of adverse events was 0.19 % (± 0.37; 95 %CI; \( \chi^2 = 1.602; P = 0.2056 \)).

Conclusions Our analysis showed a moderate superiority of LSG versus ESG. No difference in terms of safety was shown between the two groups. ESG is a less-invasive, repeatable and reversible and acceptable option for mild-moderate obese patients.

Introduction
Obesity – defined as body mass index (BMI) ≥30 kg/m² – is a chronic and multifactorial condition characterized by abnormal weight gain due to excessive adipose tissue accumulation that represents a worldwide growing challenge for public health. In Europe, a total of €81 billion has been estimated to be spent per year for bariatric patients’ management [1].

Obesity requires a multidisciplinary approach to both prevention and treatment. Surgery has been demonstrated to be the most effective treatment for severe obesity in terms of long-term weight loss, comorbidities, and quality of life (QoL) improvements and overall mortality decrease [2]. Laparoscopic sleeve gastrectomy (LSG) represents the most common procedure, accounting for 59.4 % of the 228,000 annual bariatric sur-
gical procedures performed in the United States [3]. LSG is re-
section of the gastric greater curvature and of the fundus of the
stomach through a partial vertical gastrectomy, which leads to
a gastric tubulation. The final result is effective body weight
loss and improvement in QoL and comorbidities. However, LSG
is associated with acute and chronic postoperative complica-
tions, such as bleeding, leakage, and gastric fistulae [4], which
sometimes discourage patients and make it less desirable to
them.

The recent emergence of bariatric endoscopic techniques
promises less invasive, more cost-effective, and repeatable [5]
approaches to the treatment of obesity. Endoscopic sleeve gas-
 troplasty (ESG) consists of tubularization of the gastric cavity
created by placing full-thickness sutures in a triangle and in a
top-to-bottom direction from the gastric angulus towards the
gastric fundus, preserving the area of the pyloric antrum and a
part of the fundus itself. This procedure limits the amount of
food that can be introduced into the stomach and reduces the
number of calories consumed, so it was thought to potentially
achieve the same results obtained through surgery. Scientific
evidence related to the outcomes of ESG is still limited, but ac-
cording to the latest studies, this endoscopic procedure is asso-
ciated with a low rate of adverse events (AEs) (1.1 %) [6].

ESG was created as a less invasive and more cost-effective
endoscopic alternative to LSG, but very few comparative stud-
ies are available. Therefore, a proper meta-analysis that com-

Materials and methods

Patients and PICO model

The meta-analysis was planned according to PICO format: the
P-population included samples of patients with a mean baseline
BMI between 30 and 40 kg/m² and with a minimum follow-up
time of 12 months after the endoscopic or surgical interven-
tion; LSG was considered as the I-intervention performed on
the population involved and ESG was identified as the C-com-
parison; the main O-outcome evaluated was the difference be-
tween the procedures in terms of efficacy (expressed by the
percentage of Excess of Weight Loss (%EWL) at 12 months);
the secondary O-outcome was the difference between the pro-
cedures in terms of safety (expressed by the rate of peri-proce-
dural major and/or minor adverse events).

Research methods and articles inclusion criteria

The Cochrane Highly Sensitive Search Strategy [7] was used to
conduct a systematic literature research about studies pub-
lished till January 2020 on MEDLINE [Pubmed], OVID, Cochrane
CENTRAL, EMBASE, PROSPERO and NIH. Other researches have
been performed on ClinicalTrials.gov, World Health Organiza-
tion (WHO) and International Clinical Trials Registry Platform
(ICTRIP). Additional information was retrieved through a Google
research and a Gray literature research was performed. The ar-
ticles selection was conducted using the MeSH terms: "Weight
loss", "Obesity", "Bariatric", "Gastroplasty", "Overstitch", "Endoscopic
estedevieoteastroplasty", "ESG", "Bariatric endoscopy",
"Endobariatrics", "Bariatric surgery", "Laparoscopic sleeve gas-
troctomy", "LSG", "SG", "Sleeve", "Gastrectomy"; these key
words were used in all possible combinations to collect the max-
imum number of articles. Among all articles identified, only
published articles about ESG or LSG on humans, written in En-
lish, with full text based on their title and abstract were included.
Non-human studies, unpublished studies, experimental studies
in animal models, single case reports, technical reports, reviews,
abstracts, editorials and studies in other languages than English
were not included. Studies conducted on groups of patients with
a mean baseline BMI < 30 kg/m² or > 40 kg/m² were excluded, as
well as studies with < 12 months follow-up and/or not reporting
the rate of peri-procedural AEs.

This systematic review and meta-analysis was performed in
accordance with the Preferred Reporting Items for Systematic
Review and Meta-analysis (PRISMA) statement [8] and Co-
chrane Handbook for Systematic Reviews of Intervention [9].
Eligibility criteria were determined by two authors (G.M. and
C.G.), who independently evaluated the studies.

Data collection and statistical analysis

All data identified were downloaded and combined into a refer-
ence manager database (EndNote X9) and any duplicate cita-
tion identified was removed. A standardized data extraction
form was developed based on the Data Extraction and Assess-
ment Template from the The Cochrane Public Health Group
[10]. For some studies, data were extracted indirectly using
WebPlotDigitizer version 3.10. Two authors (G.M. and C.G.) in-
dependently collected all relevant data in spreadsheets: study
design; total study duration; inclusion and exclusion criteria;
age, sex, mean baseline BMI and total number of participants;
type of intervention and device used; mean 12 months %EWL;
number and type of peri-procedural AEs. Any discrepancies
were resolved by group discussion.

The meta-analysis was performed by computing continuous
and dichotomous outcomes for each study. Mean percent of ex-
cess weight loss (%EWL) at 12 months after LSG or ESG and
standard deviations (SD) with 95% confidence intervals (CIs)
pooled and used as weighted means (WM) in Der Simonian
and Laird random effects model for both groups [11]. Weighted
mean difference (WMD) was used between the two pooled
means; pooled standard deviations with 95% CI and P values
were calculated [12]. Peri-procedural AE rate was pooled using
random effects model, and comparison of proportions was
computed using chi-squared test [13, 14] and the mean differ-
ence between the two arms was computed as above. Both ma-
jor and minor AEs were considered, in accordance with Clavien-
Dindo classification [15].

To evaluate the quality of the studies included, the Revised
Cochrane Risk-Of-Bias (ROB) tool for randomized trials [16]
was applied to randomized studies. The Cochrane ROB com-
bines information in five bias domains (bias arising from the
randomization process, bias due to deviations from the intend-
ed interventions, missing outcome data, bias in measurement
of the outcome and bias in selection of the reported result), to divide trials into categories of “low” or “high” quality studies. The NIH Quality Assessment Tool for Before-After (Pre-Post) Studies with No Control Group [17] was used to evaluate the quality of non-randomized studies. It is composed of 12 questions that focus on key concepts for evaluating the internal validity of a study. The assessment of the study heterogeneity was expressed by the Higgins I² index (0–30% low heterogeneity, 30–75% moderate heterogeneity and 75–100% high heterogeneity). A χ² based Q test was also performed to check between-study heterogeneity considering the cut-off for significance at P<0.10. Egger’s regression test [18] was used to estimate the asymmetry of data and to elaborate Funnel Plots. The estimation of the Random effect was done by through the tau-squared (τ²).

Statistical analysis was conducted with Comprehensive Meta-Analysis Software (Version 3.3.070 – November 21, 2014), also used to develop the Forest Plots. Review Manager Software (Revman; The Cochrane Collaboration, Oxford, United Kingdom; version 5.3 – June 2014) was used to elaborate the Funnel Plots.

Results

Study selection

A total of 4,872 potentially relevant citations were identified. References were exported to Endnote for duplicates removal and were subsequently screened for relevance according to predefined inclusion and exclusion criteria. A total of 1,433 duplicate citations were removed and 3,209 studies were not included because they were clearly not in line with the meta-analysis eligibility criteria. Two interesting randomized LSG studies were excluded due to excessive mean baseline BMI [19, 20]. One observational ESG study was not selected because of its inclusion criteria [21]. One captivating manuscript on ESG was not originally written in English, so it was not included in our collection of studies [22]. Two studies met our inclusion criteria but had too short follow-up time [23, 24]. Two studies were excluded due to too small sample size [25, 26]. Many that met our inclusion criteria did not provide data on 12 months follow up EWL%, so their authors were contacted to get more detailed information; for some of them, we were kindly given a comprehensive answer [27–30].

One randomized study [31] and seven observational studies [27, 32–37] on LSG were eventually selected. Likewise, a total of eight observational studies [28–30, 38–42] on ESG were included in the analysis (Fig.1, Table 1).

Patient characteristics

As regarding the analysis of efficacy, the statistical analysis was conducted considering only groups of patients with a mean baseline BMI between 30 and 40 kg/m² who had completed 12 months follow-up after the procedure. Two Studies [33, 40] stratified their patient sample for classes of BMI; only class 1 (BMI between 30 kg/m² and 35 kg/m²) and class 2 (BMI between 35 kg/m² and 40 kg/m²) were included in our study sample. Relative to the analysis of safety, the statistical analysis was conducted considering all patients involved in the 16 studies included.

Overall, a total of 2188 participants were included in the analysis of the efficacy, defined as 12-month %EWL; 1429 of them underwent LSG and 759 underwent ESG. A total of 3707 patients were included in the analysis of safety; 1929 of them underwent LSG and 1778 of them underwent ESG.

Mean age was 35.51 ± 10.03 years for the LSG group and 38.51 ± 9.81 years for the ESG group, with a mean difference of 3.00 years (±0.64 CI; SE 0.326 P=0.0001). 79.6% of the total population included were female. Mean preoperative BMI was 34.34 ± 3.36 kg/m² for the LSG group and 34.72 ± 4.73 kg/m² for the ESG group with a difference of 0.38 kg/m² (±0.26; 95% CI; P=0.0046).

Results of efficacy

The details of our overall pooled mean %EWL at 12 months in the LSG group (1429 patients) are shown in Fig.2a. The pooled mean %EWL was 80.32% (±12.20; 95% CI; Cochran’s Q test P=0.001), with a high grade of heterogeneity (I²=98.88, r2=56.62).
## Table 1 Spreadsheet reporting the characteristics of all studies included

| Study            | Year  | Study design | Duration | Procedure | Age (years) | Mean preoperative BMI | Total number of patients | Sex | Patient 12-month follow-up | 12 months % EWL | Adverse events | NIH Quality Assessment Tool |
|------------------|-------|--------------|----------|-----------|-------------|------------------------|--------------------------|-----|-----------------------------|-----------------|----------------|----------------------------|
| Alqahtani A.     | 2019  | Observational| 18 months| ESG       | 344 ± 95    | 333 ± 45               | 1000                     | M103 F897 | 216                         | 675 ± 523       | Major AE 6; minor AE 961 | 8/12                       |
| Lopez-Nava G.    | 2017  | Observational| 2 years  | ESG       | 449 ± 95    | 383 ± 55               | 154                      | M46 F108 | 64                          | 526 ± 313       | Major AE 0; minor AE N/R  | 10/12                      |
| Barrichello S.   | 2019  | Observational| 1 year   | ESG       | 423 ± 96    | 341 ± 3                | 193 (165)^2              | M45 (36)^2 F148 (129)^2 | 121 | 594 ± 257                   | Major AE 2; minor AE 103 | 10/12                       |
| Abu Dayyeh B. K. | 2017  | Observational| 20 months| ESG       | 47 ± 10     | 355 ± 26               | 25                       | M4 F21   | 25                          | 54 ± 40          | Major AE 2; minor AE 18  | 11/12                      |
| James T. W.      | 2019  | Observational| 1 year   | ESG       | 45 ± 9      | 384 ± 54               | 100                      | M14 F86  | 100                         | 661 ± 215       | Major AE 2; minor AE 2    | 10/12                      |
| Grau Morales J.  | 2018  | Observational| 1 year   | ESG       | 415 ± 10    | 351 ± 55               | 148                      | M27 F121 | 148                         | 754 ± 85         | Major AE 0; minor AE 2    | 11/12                      |
| Bhandari M.      | 2019  | Observational| 1 year   | ESG       | 405 ± 138   | 348 ± 52               | 53                       | M10 F43  | 42                          | 662 ± 255        | Major AE 0; minor AE 47   | 11/12                      |
| Cheskin L. J.    | 2020  | Observational| 1 year   | ESG       | 480 ± 121   | 400 ± 77               | 105                      | M30 F75  | 43                          | 57 ± 259         | Major AE 1; minor AE 4    | 9/12                       |
| Berry M. A.      | 2018  | Observational| 56 months| LSG       | 39 ± 117    | 3239 ± 12             | 252                      | M64 F188 | 219                         | 97 ± 214         | Major AE 3; minor AE 3    | 11/12                      |
| Noun R.          | 2012  | Observational| 2 years  | LSG       | 33 ± 10     | 332 ± 25              | 122                      | M17 F105 | 122                         | 765 ± 17         | Major AE 0; minor AE 4    | 9/12                       |
| Maiz C.          | 2015  | Observational| 1 year   | LSG       | 372 ± 111   | 331 ± 18              | 836                      | M107 F729 | 557                         | 1072 ± 371       | Major AE 66; minor AE 33  | 9/12                       |
| Zhang Y.         | 2014  | Randomized Controlled Trial | 5 years | LSG       | 293 ± 98    | 385 ± 42              | 32                       | M12 F20  | 26                          | 739 ± 243        | Major AE 0; minor AE 4    | 4/5^1                      |
| Ismail M.        | 2019  | Observational| 7 years  | LSG       | 337 ± 112   | 376 ± 16              | 95 (35)^2               | M43 F52  | 90 (35)^2                   | 686 ± 27         | Major AE 0; minor AE N/R  | 11/12                      |
The details of our overall pooled mean %EWL at 12 months in the ESG group (759 patients) are shown in ▶ Fig. 2b. The pooled mean %EWL was 62.20 % (±4.38; 95 % CI; Cochran’s Q test \( P = 0.005 \)), with a moderate grade of heterogeneity (\( I^2 = 65.52 \), \( \tau^2 = 24.68 \)).

The difference in terms of %EWL between the two samples was 18.12 % (±0.89; 95 % CI; \( P = 0.0001 \)).

**Results of safety**

The details of our overall pooled mean rate of major and/or minor AEs for the LSG group (1929 patients) are shown in ▶ Fig. 3a. The pooled mean peri-procedural complications rate was 0.30 % (±0.16; 95 % CI; Cochran’s Q test \( P = 0.0001 \)), with a moderate grade of heterogeneity (\( I^2 = 62.26 \)).

The details of our overall pooled mean rate of major and/or minor AEs for the ESG group (1778 patients) are shown in ▶ Fig. 3b. The pooled mean peri-procedural complications rate was 0.15 % (±0.07; 95 % CI; \( P = 0.0001 \)) with a moderate grade of heterogeneity (\( I^2 = 42.81 \)).

The difference in terms of mean rate of major and/or minor AEs was 0.19 % (±0.37; 95 % CI; \( \chi^2 = 1.602 \)) and it was not statistically significant (\( P = 0.2056 \)).

**Risk of bias, study quality and heterogeneity**

The ROB tool\(^\text{13}\) and the NIH Quality Assessment Tool\(^\text{14}\) were used to assess the risk of bias for the randomized trials and the observational studies, respectively. The majority of the studies included revealed a moderate-to-high risk of bias, which translates to a rating of fair-to-poor quality of the studies. The main biases found in the selected studies were inevitably associated with the type of design: the people assessing the outcomes in all study considered were not blinded to the participants’ interventions; eligibility/selection criteria for the study population were not often prespecified nor clearly described [28, 30, 34, 35, 37]; the participants in the study were frequently not representative of those who would be eligible for the intervention in the clinical population of interest [32–36]; sometimes the loss to follow-up rate was not reported or it was more than 20 % [34–36, 38–40]; occasionally, outcome measures of interest were not taken multiple times before and after the intervention and statistical tests didn’t provide \( P \) values for the pre-to-post changes [32, 36, 38]. One study did not respect its own selection criteria, with a reported average BMI that was lower than the minimum value set [38].

With reference to the Clavien-Dindo classification [15], which deals with the stratification of peri-procedural complications, two studies did not report the rate of minor complications [33, 39]. Despite not being analyzed, further complications may occasionally have occurred.

Egger’s regression test [18] used to estimate the asymmetry of 12 months %EWL data among the enrolled articles about LSG and ESG led to the processing funnel plots shown in ▶ Fig. 4 and ▶ Fig. 5, respectively. Both the LSG and ESG plots are asymmetrical, visually confirming the moderate-to-high grade of heterogeneity expressed by the Higgins \( I^2 \) index. Heterogeneity was higher among the LSG studies.

### Table 1 (Continuation)

| Study | Year | Study design | Duration | Procedure | Age (years) | Mean preoperative BMI | Total number of patients | Sex | Patient 12-month follow-up | 12 months %EWL | Adverse events | NIH Quality Assessment Tool |
|-------|------|--------------|----------|-----------|-------------|-----------------------|-------------------------|-----|---------------------------|----------------|-----------------|---------------------------|
| Hains P. K. [34] | 2018 | Observational | 5 years | LSG | 292 ± 73 | 313 ± 62 | 218 | M88 F150 | 8/12 | 62 ± 169 | Major AE; minor AE 35 | 8/17 | Major AE; minor AE 6 | 10/12 |
| Park Y. H. [35] | 2017 | Observational | 2 years | LSG | 304 ± 79 | 347 ± 53 | 74 | M16 F58 | 7/4 | 878 ± 251 | Major AE; minor AE 6 | 8/17 | Major AE; minor AE 1 | 10/12 |
| Lakdawala M. [37] | 2015 | Observational | 2 years | LSG | 355 ± 78 | 399 ± 51 | 300 | M150 F150 | 300 | 683 ± 24 | Major AE; minor AE 6 | 8/17 | Major AE; minor AE 1 | 10/12 |

AE, adverse events; ESG, endoscopic sleeve gastroplasty; LSG, laparoscopic sleeve gastrectomy; BMI, body mass index; %EWL, percentage of excess weight loss; STBMI, percentage of total body weight loss; NR, not reported; NIH, National Heart, Lung, and Blood Institute.

1 Considering Clavien Dindo grade I and II as minor adverse events, while grade III, IV and V as major adverse events
2 Obesity class I and II
3 Revised Cochrane Risk-Of-Bias (ROB) tool for randomized trials

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Marincola Giuseppe et al. Laparoscopic sleeve gastrectomy... Endoscopy International Open 2021; 09: E87–E95 | © 2021. The Author(s).
**Discussion**

LSG is the most popular bariatric surgery, providing effective weight loss and comorbidity improvement. With the progress of technology, less invasive endoscopic alternatives such as ESG have been proposed, whose initial purpose is to obtain the same results in terms of efficacy together with fewer complications. ESG is mainly proposed for patients with mild-to-moderate obesity, but there are still no guidelines that specify its applicability criteria. To compare for the first time the efficacy and safety of the endoscopic technique with the surgical one, we selected a cohort of patients affected by class I and class II obesity (BMI between 30 and 40 kg/m²). Our result shows a statistically significant modest superiority for LSG compared with ESG in terms of excess weight loss after 12 months from the bariatric intervention. This can be attributed to the different mechanism of action of the two interventions. The surgical procedure irreversibly removes part of the gastric wall and, despite the elasticity of the remaining wall, it irreparably reduces the gastric volume. The endoscopic intervention, in contrast, does not deprive the gastric wall of any of its parts and provides the possibility of a suture failure, especially in conjunction with inadequate eating behavior of the patient. According to the results obtained, the incidence rate for AEs is not statistically different between the two groups. LSG leads to superior weight loss outcomes at 12 months with a similarly low AE rate compared with ESG.

The level of experience that has been achieved over time with regard to the surgical technique is, however, incomparable to the lack of confidence that we still have today with the endoscopic technique. This implies that a standardization of the endoscopic suture pattern and further refinements of the technology can lead to more satisfying results, both in terms of efficacy and safety.

The quality of the studies for which results were obtained often was poor. The design of most of the studies, in fact, revealed a moderate-to-high risk of bias. It appears that LSG is often proposed as a therapeutic approach for patients with class I obesity without comorbidities, not according to what is suggested by guidelines. The loss-to-follow-up rate after baseline is frequently high, especially in the ESG group, suggesting an inherent bias when analyzing the procedure outcomes. Furthermore, rates of minor AEs were not available for every study included; the lack of information can lead to miscalculated results.

The high grade of heterogeneity among the studies, which is more evident in the LSG group, testifies to the need for high-quality double-blind randomized trials with adequate follow-up and post-procedural information, further standardization of the techniques, and specific guidelines to achieve uniformity in the surgery.

Based on our experience and on scientific evidence, we are facing a scenario in which ESG and LSG can be interpreted as therapeutic strategies applicable to different subclasses of ob-

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| Study name             | Mean  | Lower limit | Upper limit | Mean and 95% CI |
|------------------------|-------|-------------|-------------|-----------------|
| Zhang Y.               | 73.90 | 64.56       | 83.24       |                 |
| Noun R.                | 76.50 | 73.48       | 79.52       |                 |
| Ismail M.              | 68.59 | 63.02       | 74.16       |                 |
| Hans P. K.             | 62.80 | 59.42       | 66.18       |                 |
| Park Y. H.             | 87.80 | 82.08       | 93.52       |                 |
| Berry M. A.            | 96.97 | 94.14       | 99.80       |                 |
| Maiz C.                | 107.20| 104.12      | 110.28      |                 |
| Lakdawala M.           | 68.30 | 65.58       | 71.02       |                 |
|                        | 80.32 | 68.12       | 92.52       |                 |
| Alqahtani A.           | 67.50 | 60.53       | 74.47       |                 |
| Lopez-Navar G.         | 52.60 | 44.93       | 60.27       |                 |
| Barrichello S.         | 59.40 | 54.82       | 63.98       |                 |
| Abu Dayyeh BK          | 54.00 | 38.32       | 69.68       |                 |
| James T. W.            | 66.10 | 61.89       | 70.31       |                 |
| Grau Morales J.        | 75.40 | 61.71       | 89.09       |                 |
| Bhandari M.            | 66.20 | 58.49       | 73.91       |                 |
| Cheskin L. J.          | 57.00 | 49.26       | 64.74       |                 |
|                        | 62.20 | 57.82       | 66.58       |                 |

Fig. 2 Forest Plot reporting 12 m %EWL (percentage of excess weight loss) a after LSG (laparoscopic sleeve gastrectomy) and b after ESG (endoscopic sleeve gastroplasty).
ese populations. LSG can be thought of as a treatment best suited for moderate-to-severe obesity and ESG as a therapeutic option for mild-to-moderate obesity. This provocative proposal could gain scientific validity if the correlation between the stratification of patients based on baseline BMI and the %EWL obtained after ESG was demonstrated. It is possible, in fact, that patients subjected to ESG with lower baseline BMI have better outcomes in terms of %EWL compared with patients with higher baseline BMI. In this scientific panorama, ESG could be considered not as a less-invasive and cost-effective alternative to LSG, but rather, as a procedure that improves the metabolic condition in patients suffering from mild-moderate obesity who did not get satisfying results through conservative therapeutic alternatives.

The multidisciplinary assessment of each patient facing any bariatric treatment option is mandatory.

Conclusions

In patients affected by mild or moderate obesity, %EWL reported 12 months after LSG is moderately higher than that measured after ESG. The incidence of complications is not significantly different after the two procedures. The quality of the studies available is poor and further valid studies on which to base guidelines and, consequently, choices in daily clinical practice are an unmet need. We propose that surgical and endoscopic bariatric approaches should be considered as interventions whose therapeutic targets might be represented by distinct obese subpopulations.

Competing interests

Professor Guido Costamagna is consultant for Cook Medical, Boston Scientific and Olympus. Dr. Ivo Boškoski is consultant for Apollo Endosurgery, Cook Medical, Boston Scientific and Endo Tools, and is Apollo Endosurgery Research Grant Holder.
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