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ORIGINAL CONTRIBUTIONS

Barrett's Oesophagus and Bariatric/Metabolic Surgery—IFSO 2020 Position Statement

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Abstract

The International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) has been playing an integral role in educating both the metabolic surgical and the medical community at large about the importance of surgical and/or endoscopic interventions in treating adiposity-based chronic diseases. The occurrence of chronic conditions following bariatric/metabolic surgery (BMS), such as gastro-oesophageal reflux disease (GERD) and columnar (intestinal) epithelial metaplasia of the distal oesophagus (also known as Barrett's oesophagus (BE)), has long been discussed in the metabolic surgical and medical community. Equally, the risk of neoplastic progression of Barrett's oesophagus to oesophageal adenocarcinoma (EAC) and the resulting requirement for surgery are the source of some concern for many involved in the care of these patients, as the surgical alteration of the gastrointestinal tract may lead to impaired reconstructive options. As such, there is a requirement for guidance of the community.The IFSO commissioned a task force to elucidate three aspects of the presenting problem: First, to determine what the estimated incidence of Barrett's oesophagus is in patients presenting for BMS; second, to determine the frequency at which Barrett's oesophagus may develop following BMS (with a particular focus on the laparoscopic sleeve gastrectomy (LSG)); and third, to determine if regression of Barrett's oesophagus may occur following BMS given the close relationship of obesity and the development of BE/EAC. Based on these findings, a position statement regarding the management of this pathology in the context of BMS was developed. The following position statement is issued by the IFSO Barrett's Oesophagus task force andapproved by the IFSO Scientific Committee and Executive Board. This statement is based on current clinical knowledge, expert opinion and published peer-reviewed scientific evidence. It will be reviewed regularly.

Keywords Barrett's oesophagus · Bariatric/metabolic surgery · Obesity · Sleeve gastrectomy · Gastric bypass · Weight loss surgery

Preamble

The International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) has been playing an integral role in educating both the metabolic surgical and the medical community at large about the importance of surgical and/or endoscopic interventions in treating adiposity-based chronic diseases. The occurrence of chronic conditions following bariatric/metabolic surgery (BMS), such as gastro-oesophageal reflux disease (GERD) and columnar (intestinal) epithelial metaplasia of the distal oesophagus (also known as Barrett's oesophagus (BE)), has long been discussed in the metabolic surgical and medical community. Equally, the risk of neoplastic progression of Barrett's oesophagus to oesophageal adenocarcinoma (EAC) and the resulting requirement for surgery are the source of some concern for many involved in the care of these patients, as the surgical alteration of the gastrointestinal tract may lead to impaired reconstructive options. As such, there is a requirement for guidance of the community. The IFSO commissioned a task force to elucidate three aspects of the presenting problem: First, to determine what the estimated incidence of Barrett's oesophagus is in patients presenting for BMS; second, to determine the frequency at which Barrett's oesophagus may develop following BMS (with a particular focus on the laparoscopic sleeve

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gastrectomy (LSG)); and third, to determine if regression of Barrett's oesophagus may occur following BMS given the close relationship of obesity and the development of BE/EAC. Based on these findings, a position statement regarding the management of this pathology in the context of BMS was developed. The following position statement is issued by the IFSO Barrett's Oesophagus task force and approved by the IFSO Scientific Committee and Executive Board. This statement is based on current clinical knowledge, expert opinion and published peer-reviewed scientific evidence. It will be reviewed regularly.

Background

Bariatric/metabolic surgery (BMS) has gained substantial popularity to treat the obesity epidemic, with hundreds of thousands of procedures being performed worldwide every year [1]. The subsequent alterations in the anatomy of the gastrointestinal tract may result in chronic conditions such as gastro-oesophageal reflux disease (GERD), which may in turn confer a risk of changes in the distal oesophagus such as Barrett's oesophagus (BE) or oesophageal adenocarcinoma (EAC). Equally, patients with obesity have higher rates of pre-existing GERD [2, 3], and obesity is a recognised risk factor for both BE and EAC [4]. Thus, patients presenting for BMS may already bear changes in their distal oesophagus putting them at increased risk of EAC formation. As the role of systematic preoperative screening as well as postoperative surveillance endoscopy for patients presenting for or undergoing BMS remains to be elucidated, the magnitude of the presenting problem remains poorly understood. Accordingly, treatment decisions are largely guided by some higher level data as well as anecdotal evidence and small case-series, which indicate that performing laparoscopic sleeve gastrectomy (LSG) results in higher rates of postoperative de novo GERD compared to laparoscopic Roux-en-Y gastric bypass (RYGB) procedures [5, 6]. Equally, to what extent other procedures, such as laparoscopic adjustable-gastric banding (LAGB) or one-anastomosis mini-gastric bypass procedures (OAGB), induce chronic alterations of the distal oesophagus that may be deleterious to long-term patient outcomes remains largely unclear.

Therefore, the task force undertook a systematic review to summarise the current evidence on the incidence of Barrett's oesophagus both before and after BMS with the aim of providing the most up-to-date information to guide practice.

Methods

Literature Search Strategy

The electronic bibliographic databases MEDLINE, EMBASE, PubMed and Cochrane Library were searched to identify eligible studies published between January 1990 and September 2019 using broad Medical Subject Heading (MeSH) terms and text words to encompass all studies relating to Barrett's oesophagus and any BMS procedure. Procedure-specifying terms were also used (i.e. *gastric band*, *sleeve gastrectomy*, *gastric bypass*). A full list of search terms is provided in Appendix. To minimise the risk of publication bias, conference abstracts and proceedings were searched through Web of Science, EMBASE and Scopus. Furthermore, the following major gastrointestinal and bariatric conferences were manually searched for relevant reports: Digestive Disease Week (DDW/SSAT), Society of American Gastrointestinal and Endoscopic Surgeons (SAGES), International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) and American Society of Metabolic and Bariatric Surgery (ASMBS). Manual searching of reference lists from reviews, as well as references from selected primary studies, was performed to identify any relevant additional studies. The search was done in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [7].

Inclusion and Exclusion Criteria

Studies were selected based on the reporting of the pre- or postoperative occurrence as well as regression of Barrett's oesophagus in the context of patients presenting for or undergoing BMS. All study designs, study sizes, procedure types and follow-up time frames were accepted. Abstracts were included, but separated from full manuscript publications in subsequent sensitivity analyses. However, case reports on the occurrence of EAC were excluded, as the current review focussed on the management of patients with BE. Equally, studies that did not report adequate information to determine study eligibility or to assess study methods for risk of bias were also excluded. If the same group (identified from author names and institution) published multiple reports with potentially overlapping patient recruitment time periods, BE estimates were extracted from the most recent publication with the largest patient numbers to avoid duplication of data.

Data Extraction

Information extracted from eligible studies included basic study data (year, country, design, study size), demographic data, surgical technique, weight loss and follow-up time. Barrett's oesophagus specific questions included the following: adjustment of studies for the preoperative presence of BE (i.e. systematic performing of preoperative upper gastrointestinal endoscopy), definitions of BE used (i.e. endoscopic aspect vs. histologically proven as defined by local diagnostic criteria as well as biopsy locations), the length of BE segments (short-segment BE (SSBE) vs. long-segment BE (LSBE)) and the presence/resolution of dysplasia. When assessing BE regression, regression definitions

of the corresponding articles were used. These included either a decrease in the length of the BE segment, a regression from dysplastic to non-dysplastic BE or a complete disappearance of BE during follow-up endoscopy.

Risk of Bias Assessment, Subgroup and Sensitivity Analyses

All studies were assessed for their risk of bias based on the Newcastle-Ottawa Scale [8]. Each study was assessed independently by two investigators regarding study selection, comparability, and outcomes. The Newcastle-Ottawa Scale consists of 3 subscales which contribute to a maximum total score of 9. Studies scoring < 3 were regarded as being at high, between 4 and 6 moderate and > 6 at low risk of bias. Equally, predefined subgroup and sensitivity analyses were performed according to study design (abstracts vs. full-text articles and prospective vs. retrospective studies) and aspects relevant to the pathology of interest (procedure type for the postoperative occurrence of BE, adjustment for preoperative presence of BE, length of follow-up).

Statistical Analysis

We performed a meta-analysis of proportions with the goal of obtaining a precise estimate of the overall proportion of patients with BE in the context of BMS (i.e. presenting for, developing after and/or regressing after BMS). Logit transformations were used to make the transformed proportions follow a normal distribution. For final reporting, the transformed summary proportions and corresponding 95% confidence intervals were converted back to regular proportions for ease of interpretation. The inverse-variance method was used to weigh effect sizes according to study size. Because we expected heterogeneity in study estimates across the included studies, we applied a random-effects model for the calculation of the summary prevalence of BE patients [9]. Heterogeneity was tested using Cochran's Q statistic, with $p < 0.1$ indicating heterogeneity. The degree of heterogeneity was quantified using the I^2 statistic [10]. Sensitivity analysis was performed according to the plan outlined above. Differences between subgroups were assessed with a test for interaction [11]. Publication bias was quantified using the Egger's regression model and visualised using funnel plot analyses [12]. All data were analysed using the R Programming Software [13] using the *metafor* and *meta* packages.

Results

Literature Search

Using the described search strategy, we initially identified 570 records and six further articles during an

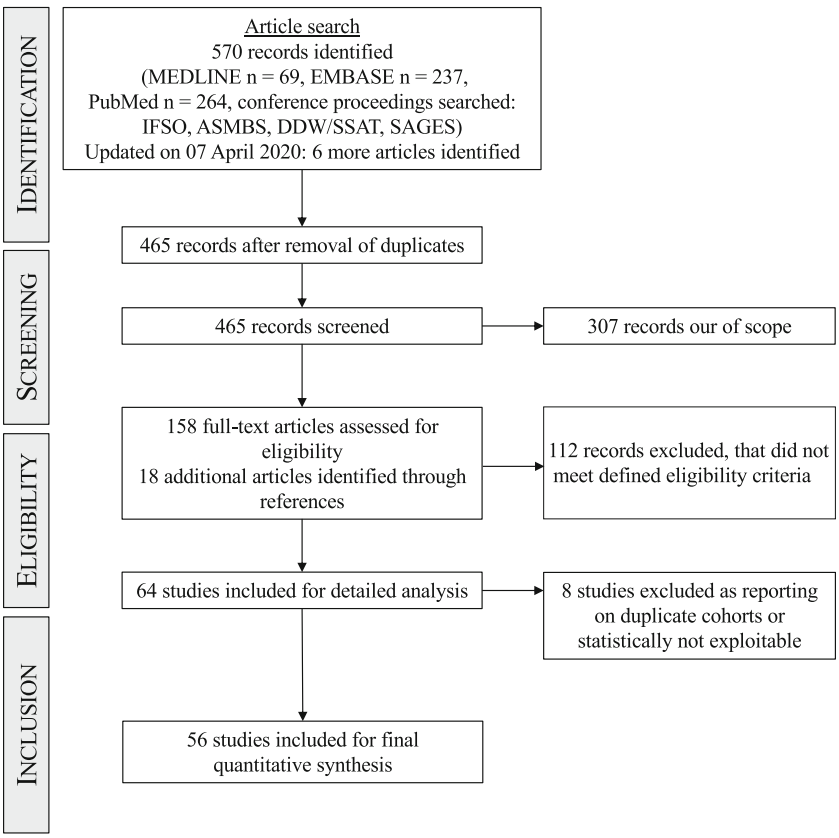

Fig. 1 PRISMA flowchart

Table 1 Basic study characteristics, their corresponding references and cohort demographic data

First author	Year of publication	Article type	Study type	Study design	Barrett's assessment time	Country	Number of patients assessed	Bariatric surgery type	Number of patients with Barrett's analysed	Barrett's confirmed with histopathology	Barrett's with dysplasia
Aguirre A. [14]	2017	Abstract	Cohort	Retrospective	Preoperative incidence	USA	204	LSG	3	–	–
Almontashery A. [15]	2017	Abstract	Cohort	Retrospective	Postoperative incidence	Saudi Arabia	562	LSG	1	–	–
Andrew B. [16]	2018	Article	Cohort	Retrospective	Preoperative incidence + progression/regression	USA	494	RYGB	14	Yes	Yes
Azagury D. [17]	2006	Article	Cohort	Retrospective	Preoperative incidence	Switzerland	319	RYGB	4	Yes	No
Balsiger B. [18]	2000	Article	Cohort	Retrospective	Preoperative + postoperative incidence + progression/regression	USA	24	VBG	7	Yes	–
Ben-Meir A. [19]	2010	Abstract	Cohort	Retrospective	Preoperative incidence + progression/regression	USA	5916	RYGB	14	–	–
Berry M. [20]	2016	Article	Cohort	Retrospective	Postoperative incidence	Chile	252	LSG	2	–	–
Braghetto I. [21]	2016	Article	Cohort	Prospective	Postoperative incidence	Chile	231	LSG	3	Yes	–
Braghetto I. [22]	2012	Article	Cohort	Prospective	Progression/regression	Chile	21	RYGB	21	Yes	0
Caravelli G. [23]	2017	Abstract	Cohort	Prospective	Preoperative incidence	Italy	50	NA	4	Yes	–
Chaudhry U. [24]	2014	Abstract	Cohort	Prospective	Preoperative incidence	USA	249	NA	18	–	–
Chang V. [25]	2020	Article	Cohort	Retrospective	Preoperative incidence	USA	631	Multiple	29	Yes	–
Chen G. [26]	2017	Abstract	Cohort	Retrospective	Preoperative + postop incidence + progression/regression	USA	132	RYGB	9	Yes	No
Csendes A. [27]	2007	Article	Cohort	Prospective	Preoperative incidence	Chile	190	Multiple	11	Yes	–
Csendes A. [28]	2006	Article	Cohort	Prospective	Preoperative + postoperative incidence + progression/regression	Chile	557	RYGB	12	Yes	Yes
D'Hondt M. [29]	2013	Article	Cohort	Retrospective	Preoperative incidence	Belgium	652	RYGB	5	Yes	–
D'Silva M. [30]	2018	Article	Cohort	Retrospective	Preoperative incidence	India	675	Multiple	12	Yes	–
Dova G. [31]	2016	Abstract	Cohort	Retrospective	Progression/regression	Argentina	26	RYGB	13	Yes	Yes
Endo Y. [32]	2019	Article	Cohort	Retrospective	Preoperative + postoperative incidence	Japan	155	Multiple	1	–	–
Estevez-Fernandez S. [33]	2015	Article	Cohort	Retrospective	Preoperative incidence	Spain	331	Multiple	2	–	–
Felsenreich D. [34]	2018	Article	Cohort	Retrospective	Postoperative incidence	Austria	44	LSG	6	Yes	–
Felsenreich D. [35]	2020	Article	Cohort	Prospective	Progression/regression	Austria	10	RYGB	10	Yes	Yes
Gomez V. [36]	2014	Article	Cohort	Retrospective	Preoperative incidence	USA	232	Multiple	24	Yes	Yes
Gorodner V. [37]	2017	Article	Cohort	Retrospective	Preoperative + postoperative incidence + progression/regression	Argentina	1681	RYGB	11	Yes	No
Heimgartner B. [38]	2017	Article	Cohort	Prospective	Preoperative incidence	Switzerland	100	NA	6	Yes	–
Houghton S. [39]	2008	Article	Cohort	Retrospective	Progression/regression	USA	1500	RYGB	5	Yes	Yes

Table 1 (continued)

Humphreys L. [40]	2012	Article	Cohort	Retrospective	Preoperative incidence	UK	371	LAGB	3	–	–
Jouet P. [41]	2011	Abstract	Cohort	Prospective	Preoperative incidence	France	288	NA	5	No	–
Kazantsev G. [42]	2005	Abstract	Cohort	Retrospective	Preoperative incidence	USA	81	RYGB	2	–	–
Küper M. [43]	2010	Article	Cohort	Prospective	Preoperative incidence	Germany	69	Multiple	1	Yes	–
Masci E. [44]	2011	Article	Cohort	Retrospective	Preoperative incidence	Italy	1049	LAGB	0	–	–
Matar R. [45]	2020	Article	Cohort	Retrospective	Progression/regression	USA	517	Multiple	16	Yes	Yes
Mong C. [46]	2008	Article	Cohort	Retrospective	Preoperative incidence	USA	272	RYGB	10	–	–
Moulla Y. [47]	2020	Article	Cohort	Retrospective	Preoperative incidence	Germany	616	Multiple	95	Yes	–
Munoz R. [48]	2009	Article	Cohort	Retrospective	Preoperative incidence	Chile	626	NA	1	Yes	Yes
Naslund E. [49]	1996	Article	Cohort	Retrospective	Postoperative incidence	Sweden	290	Multiple	6	6	No
Ozeki K. [50]	2020	Article	Cohort	Retrospective	Preoperative incidence	USA	260	Multiple	19	No	–
Peromaa-Haapisto P. [51]	2013	Article	Cohort	Retrospective	Preoperative incidence	Finland	342	RYGB	4	Yes	No
Rosenthal R. [52]	2006	Article	Cohort	Retrospective	Postoperative incidence	USA	152	LAGB	1	–	–
Saarinen T. [53]	2018	Article	Cohort	Retrospective	Preoperative incidence	Finland	1275	Multiple	47	–	–
Salama T. [54]	2017	Article	Cohort	Retrospective	Postoperative incidence	Egypt	50	OAGB	NA	–	–
Saleh M. [55]	2017	Abstract	Population-based study	Retrospective	Postoperative incidence	USA	16,620	NA	270	–	–
Santo M. [56]	2015	Article	Cohort	Retrospective	Preoperative incidence	Brazil	717	NA	2	–	–
Schigt A. [57]	2014	Article	Cohort	Retrospective	Preoperative incidence	Netherlands	523	Multiple	7	Yes	Yes
Schirmer B. [58]	2002	Article	Cohort	Retrospective	Preoperative incidence	USA	536	RYGB	1	Yes	Yes
Schneider R. [59]	2018	Article	Cohort	Retrospective	Preoperative incidence	Switzerland	1200	Multiple	5	–	Yes
Sebastianelli L. [60]	2019	Article	Cohort	Prospective	Postoperative incidence	France & Italy	90	LSG	17	Yes	0
Sharaf R. [61]	2004	Article	Cohort	Retrospective	Preoperative incidence	USA	195	Multiple	6	–	–
Signorini F. [62]	2020	Article	Cohort	Retrospective	Progression/regression	Argentina	64	RYGB	9	Yes	No
Sheppard C. [63]	2015	Article	Cohort	Retrospective	Preoperative incidence	Canada	236	Multiple	3	–	–
Silva L. [64]	2014	Abstract	Cohort	Retrospective	Postoperative incidence	Brazil	512	OAGB + fundoplication	4	–	–
Soricelli E. [65]	2018	Article	Cohort	Prospective	Postoperative incidence	Italy	144	LSG	19	Yes	No
Teiveilis M. [66]	2007	Article	Cohort	Prospective	Preoperative + postoperative incidence	Brazil	52	RYGB	1	–	–
Velotti N. [67]	2017	Abstract	Cohort	Prospective	Postoperative incidence	Italy	80	OAGB	0	0	–
Wolter S. [68]	2017	Article	Cohort	Retrospective	Preoperative incidence	Germany	801	Multiple	17	–	–
Zeni T. [69]	2006	Article	Cohort	Retrospective	Preoperative incidence	USA	169	RYGB	2	Yes	No

First author	Dysplasia type	Preoperative endoscopy	Preoperative incidence study	Postoperative incidence study	Progression study	Regression study	Preoperative BMI	Postoperative BMI	Age	Number of females	Follow-up (months)	Comments
Aguirre A. [14]	–	Yes	Yes	No	No	No	44 (SD 6.54)	–	45 (SD 12.3-9)	161	–	
Almontashery A. [15]	–	–	No	Yes	No	No	–	–	–	–	16	
Andrew B. [16]	LGD	Yes	Yes	No	Yes	Yes		30.3 (4.8)	51.4	–	11.4	

Table 1 (continued)

							46.6 (SD 6.5)					Majority of BE patients were female (78.6%).
Azagury D. [17]	–	Yes	Yes	No	No	No	–	–	–	–	–	
Balsiger B. [18]	–	Yes	Yes	Yes	Yes	No	33 (SD 2)	28 (SD 1)	–	22	37	Postop FU was after VBG -> RYGB. Nil progression was noted for any of the histopathologically confirmed BE patients after conversion
Ben-Meir A. [19]	–	Yes	Yes	No	Yes	Yes	–	–	–	–	–	
Berry M. [20]	–	Yes	No	Yes	No	No	32.3 (30–34.3)	–	39	188		
Braghetto I. [21]	–	Yes	No	Yes	No	No	38.4 (SD 3.1)	25.3 (SD 3.8)	–	168	60	BE developed 3 and 5 years postoperatively.
Braghetto I. [22]	–	Yes	No	No	Yes	Yes	41.5 (4.3)	25.7 (1.3)	–	–	12	Note that this was not a standard RYGB, but a resectional RYGB where the remnant stomach was also removed.
Caravelli G. [23]	–	Yes	Yes	No	No	No	46 (39–70)	–	42.3 (2-1–5-7)	16	–	
Chaudhry U. [24]	–	Yes	Yes	No	No	No	50.5	–	43.95	189	–	
Chang V. [25]	–	Yes	Yes	No	No	No	46	–	44	457	–	
Chen G. [26]	–	Yes	Yes	Yes	Yes	Yes	45.4	31.6	57	–	78	Average time to regression was 7.2 years.
Csendes A. [27]	–	Yes	Yes	No	No	No	46.8	–	39.5	148	–	Note: Upon endoscopy, 54/426 patients (12.6%) were diagnosed with "columnar type mucosa" of the distal oesophagus. However, in the 190 patients who actually underwent biopsies, the actual incidence of BE was half of what was seen on endoscopy. Demographics of those with biopsies were not reported. Overall cohort percentage of females was 77.9%.
Csendes A. [28]	LGD	Yes	Yes	Yes	Yes	Yes	43.2	29.4	47.4	–	24	RYGB was open-resectional RYGB. A critical review of papers from the same

Table 1 (continued)

												institution suggests that there is not an overlap/duplication of cohorts.
D'Hondt M. [29]	–	Yes	Yes	No	No	No	42.8	–	39.5	462	–	
D'Silva M. [30]	–	Yes	Yes	No	No	No	43.94	–	45	383	–	
Dova G. [31]	LGD	Yes	No	No	Yes	Yes	43.5	29.1	52.9	9	28.5	Based on the abstract, it is unclear if only 13 patients were followed-up endoscopically/-histologically or if all 26 patients had results. The authors state that 13 patients had no postoperative changes and that 13 had data on endoscopic and histologic changes. Accordingly, a regression rate of 8/13 (62%) is being used.
Endo Y. [32]	–	Yes	Yes	Yes	No	No	45	–	40	93	43	Only 54/155 patients had follow-up endoscopy. The patient with Barrett's is said to have had FU endoscopy with no further details recorded.
Estevez-Fernandez S. [33]	–	Yes	Yes	No	No	No	47.5	–	39.9	271	–	
Felsenreich D. [34]	–	Yes	No	Yes	No	No	48.7	35.5	38.8	33	131.8	Note: The paper reports on 103 patients treated over a 10+ year time-frame, but then reduces the studied cohort to only non-converted SG patients (33% conversion rate). Of the remaining 65 patients, only 44 had follow-up endoscopy. Hence, the actual study population for BE incidence determination is only 44 patients.
Felsenreich D. [35]	LGD	Yes	No	No	Yes	Yes	45.1	27.9	49.4	10	33.4	This is a multicentre study specifically analysing the outcomes of patients who developed de novo BE following LSG who

Table 1 (continued)

												subsequently underwent RYGB conversion for reflux control and/or treatment of their BE. They report an 80% remission rate including the remission of one patient who had LGD to no dysplasia.
Gomez V. [36]	–	Yes	Yes	No	No	No	42.4	–	51	191	–	Only information that one patient had LGD, but no information on the other patient. Of note was that the diagnoses of LGD were not known prior to the screening endoscopy.
Gorodner V. [37]	–	Yes	Yes	Yes	Yes	Yes	44 (SD 6.54)	–	49	6	41	? Duplication to Dova et al. As far as can be determined, this study does not represent a duplication of the cohort described by Dova et al. First, the author list is almost completely different. Secondly, the patient numbers are different as well. Accordingly, data from both studies are included in the meta-analysis.
Heimgartner B. [38]	–	Yes	Yes	No	No	No	45	–	40	68	–	
Houghton S. [39]	LGD	Yes	No	No	No	Yes	43	33	59	2	34	Study was limited to patients with LSBE.
Humphreys L. [40]	–	Yes	Yes	No	No	No	50.7	–	43	116	–	
Jouet P. [41]	–	Yes	Yes	No	No	No	46	–	39.58	–	–	
Kazantsev G. [42]	–	Yes	Yes	No	No	No	46	–	46	72	–	
Küper M. [43]	–	Yes	Yes	No	No	No	43.4	–	47.6	43	–	
Masci E. [44]	–	–	Yes	No	No	No	45.2	–	41	816	–	This is the only study not to identify any patients with BE upon routine preoperative endoscopy.
Matar R. [45]	–	No	No	Yes	No	No	–	34	49	434	48	This study showed a higher incidence of BE following RYGB (5.1%) compared to LSG (1.1%). However, the RYGB cohort also had a

Table 1 (continued)

												median FU time (until the endoscopy) of 8 vs. 2 years for the patients with LSG. Note: This study provided separate estimates for LSG and RYGB. Accordingly, the estimates are taken separately and used for each of the procedures.
Mong C. [46]	–	Yes	Yes	No	No	No	48.65	–	43.29	235	–	It is unclear if BE diagnoses were supported by histopathology or not.
Moulla Y. [47]	–	Yes	Yes	No	No	No	49	–	49	422	–	
Munoz R. [48]	–	Yes	Yes	No	No	No	42	–	38.5	452	–	
Naslund E. [49]	–	–	No	Yes	No	No	43	31	51	5	83	LAGB + VBG
Ozeki K. [50]	–	Yes	Yes	No	No	No	44.9	–	54	65	–	How BE was diagnosed is not documented within this study. It seems as if the diagnosis was simply made upon endoscopic appearance alone.
Peromaa-Haapisto P. [51]	–	Yes	Yes	No	No	No	–	–	–	–	–	
Rosenthal R. [52]	–	–	No	Yes	No	No	40.2	–	54	–	–	Overall study population was 1001 of which 844 had RYGB and 152 had LAGB. Only the incidence of BE is reported for LAGB, assuming that there was no incidence of BE in the RYGB group.
Saarinen T. [53]	–	Yes	Yes	No	No	No	46.1	–	48.5	926	–	
Salama T. [54]	–	Yes	No	Yes	No	No	–	–	35.5	32	18	
Saleh M. [55]	–	–	No	Yes	No	No	–	–	–	–	12	This is a population-based study from the USA comparing the incidence of BE after LSG and RYGB. The first incidence of BE after LSG was 20/12690 (0.16%) and 20/3930 (0.51%) after RYGB. An issue with the study is that it does not collect for any baseline symptoms or pre-existing pathologies,

Table 1 (continued)

												and accordingly, the authors found a higher risk of GERD and BE after RYGB. Equally, no data on the proportion of revisional cases (e.g. LSG -> RYGB) was found. Note: This study provided separate estimates for LSG and RYGB. Accordingly, the estimates are taken separately and used for each of the procedures.
Santo M. [56]	–	–	Yes	No	No	No	–	–	–	–	–	
Schigt A. [57]	HGD/IMC	Yes	Yes	No	No	No	46.5	–	44.3	401	–	Procedures were RYGB and LSG; because there is a detailed account of the consequences of the diagnosis of BE (including the detection of one IMC), it is assumed that all BE diagnoses were confirmed by histopathology.
Schirmer B. [58]	HGD/IMC	Yes	Yes	No	–	No	–	–	–	–	–	
Schneider R. [59]	HGD/IMC	Yes	Yes	No	No	No	44.4	–	42.2	855	–	Operations performed were RYGB and LSG.
Sebastianelli L. [60]	–	Yes	No	Yes	No	No	46	34	41	66	–	This is probably the highest quality study included on the incidence of BE after LSG as it includes data from 5 centres. Aside from a fairly high incidence of SSBE, it also found that inadequate weight loss was associated with a higher incidence of BE. 70.6% of patients with weight loss failure had BE.
Sharaf R. [61]	–	Yes	Yes	No	No	No	48.9	–	41.2	153	–	
Signorini F. [62]	–	Yes	No	No	Yes	Yes	44.3	27.23	46.9	37	15	
Sheppard C. [63]	–	Yes	Yes	–	No	No	48.9	–	43.7	–	–	Procedures were RYGB and LSG. Although the original study population included 387 cases, not all patients had systematic preoperative

Table 1 (continued)

												endoscopies. Accordingly, the demographic and preoperative GERD data could not be extracted for the endoscoped subgroup.
Silva L. [64]	–	–	No	Yes	No	No	44	–	42	–	–	The procedure performed was a variation of the OAGB with a so-called Collis-Nissen like addition, although the description of the surgery seems like the authors used the remnant fundus for a fundoplication; e.g. this is a non-standard bariatric procedure. There is not enough data to know if patients had preoperative endoscopy or not, accordingly the rate of "de novo" BE formation is unclear.
Soricelli E. [65]	–	Yes	No	Yes	No	No	46.2	–	–	–	66	CAVE: Duplication of the study by published Genco et al. Importantly, in this updated analysis, the authors report that no new cases of BE was detected. This study will be used for the meta-analysis to avoid duplication of data.
Teiveilis M. [66]	–	Yes	Yes	Yes	No	No	51.4	35.2	42	–	16.8	Preoperative endoscopy data was only available for 32/52 subjects undergoing postoperative endoscopy. Accordingly, it is not clear if the one case BE that is described was true de novo BE or if this may have been pre-existing BE.
Velotti N. [67]	–	Yes	No	Yes	No	No	–	–	–	–	28.5	Whilst not specifically mentioned, the abstract suggests that "no dysplasia or intestinal metaplasia was detected" and "study documents... LMGB (OAGB) does not cause

Table 1 (continued)

												worrying changes of the gastro-oesophageal mucosa". Accordingly, it is assumed from the abstract, that no cases of BE following OAGB were found.
Wolter S. [68]	–	Yes	Yes	No	No	No	50.1	–	43.8	518	–	Note: Two cases of invasive oesophageal adenocarcinoma were also detected. Equally, some cases of revisional BS (previous LAGB or SG) were included. One of the EAC patients had a previous LAGB.
Zeni T. [69]	–	Yes	Yes	No	No	No	49.7	–	41.1	138	–	

updated search on 7 April 2020. Following the removal of 111 duplicates, 465 titles and abstracts were screened. Subsequently, 158 full-text articles were assessed for eligibility, with 18 further studies identified by screening relevant reference lists. One hundred and twelve articles were excluded, and consequently 64 studies were included for detailed analysis. Following the removal of studies reporting on duplicate cohorts or being deemed as not statistically exploitable, 56 studies were included in the final quantitative analysis (Fig. 1).

Overall Summary

A total of 56 studies were included, of which 18 were deemed as being at low, 37 intermediate and 4 high risk of bias. Of the included studies, 30 included only data for the calculation of preoperative BE incidence rates, 12 had only data on postoperative BE incidence and the remaining 14 studies provided data which could be exploited for either preoperative or postoperative BE incidence rates and/or the incidence of Barrett's progression/regression following BMS ($n = 8$). Basic study characteristics, their corresponding references and cohort demographic data are provided in Table 1.

Preoperative Incidence of Barrett's Oesophagus

Thirty-eight studies including 22,270 patients reported on the incidence of BE in patients undergoing systematic preoperative endoscopy. The overall cumulative incidence of BE prior to BMS was 2.1% (95% CI 1.4–3.2%, I^2 = 94%, Fig. 2). When sensitivity analysis was performed and one outlier study (Balsiger et al. [18] which reported a preoperative incidence of 29.2% in highly symptomatic VBG-patients) was excluded, the cumulative preoperative incidence was 2.0% (95% CI 1.3–3.0%, I^2 = 93%, Supplementary Fig. 1).

In a subsequent sensitivity analysis, the preoperative incidence of BE was adjusted for whether BE had been diagnosed endoscopically or through histopathologic analyses of biopsy specimens. Twenty studies including 8618 patients in which the presence of BE was confirmed by histology provided a cumulative preoperative incidence of BE of 3.0% (95%CI 1.8–4.9%, I^2 = 94%, Supplementary Fig. 2). Equally, if the analysis was adjusted for study design (i.e. retrospective vs. prospective studies), the eight prospective studies including 1555 patients reported a cumulative 3.8% (95%CI 1.7–8.3%, I^2 = 66%, Supplementary Fig. 3) preoperative incidence of BE. Finally, when only those studies deemed as being at low risk of bias ($n = 6$, 3510 patients) were included, the cumulative preoperative incidence of BE was 5.9% (95% CI 2.6–12.9%, I^2 = 96%, Supplementary Fig. 4).

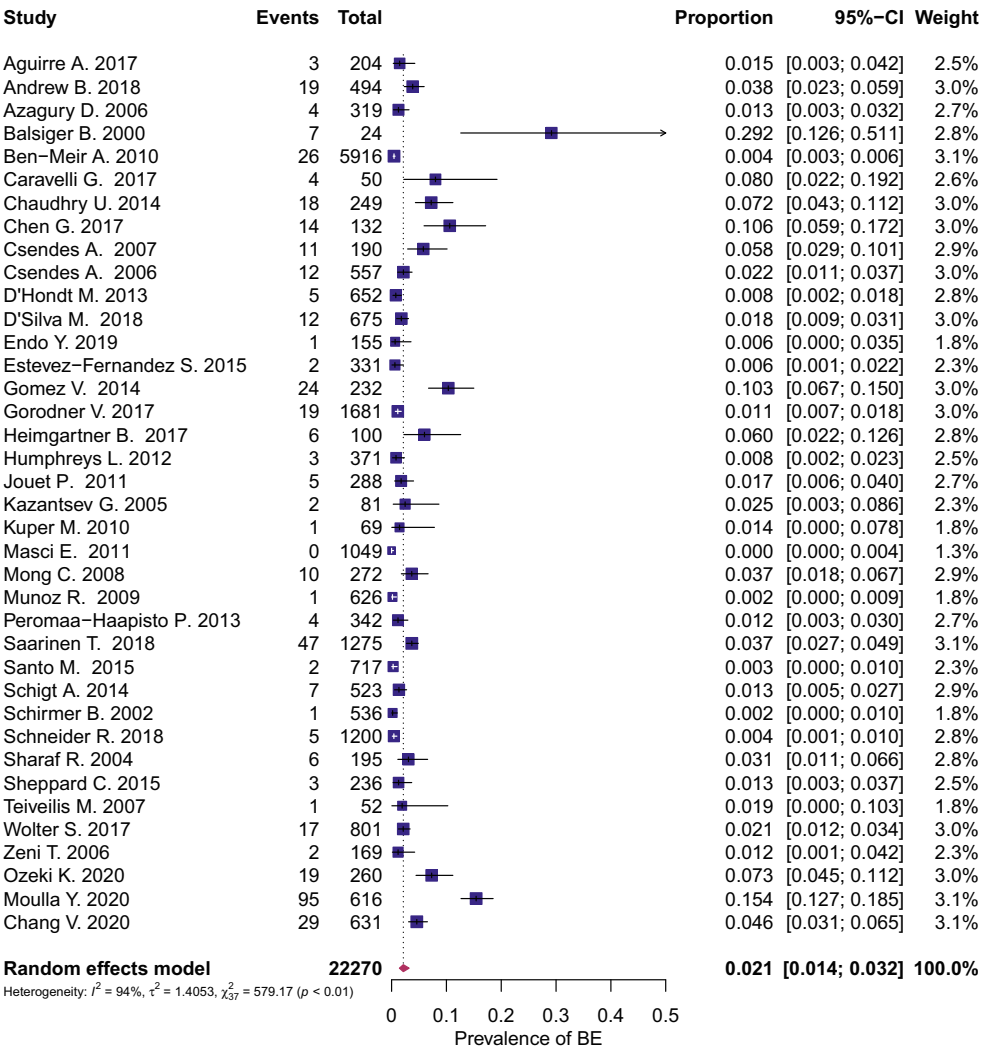

Fig. 2 Preoperative incidence of BE (all studies)

Postoperative Incidence of Barrett's Oesophagus

Eighteen studies including 19,775 patients provided postoperative BE incidence estimates. The overall postoperative incidence of BE was 1.9% (95% CI 0.8–4.1%, $I^2 = 96\%$, Fig. 3) irrespective of the type of bariatric procedure performed. When only studies were included, in which all patients analysed had also undergone preoperative endoscopy (and thus were deemed true de novo BE patients, $n = 15$; 19,751 patients), the rate of postoperative BE was 2.6% (95% CI 0.1–5.6%, $I^2 = 94\%$, Supplementary Fig. 5). When studies were stratified according to the duration of follow-up, studies with longer follow-up (≥ 2 years, $n = 10$ of which one study provided separate estimates for LSG vs. RYGB, n total patients = 1827) showed a postoperative BE incidence rate of 4.2% (95% CI 1.9–9.2%, $I^2 = 89\%$, Supplementary Fig. 6). When the study by Balsiger et al. was again excluded due to its particular patient cohort, then the cumulative postoperative incidence of BE in studies with a follow-up ≥ 2 years was 3.4% (95% CI 1.5–7.4%, $I^2 = 88\%$, Supplementary Fig. 7).

Postoperative Incidence of Barrett's Oesophagus Following Laparoscopic Sleeve Gastrectomy

Eight studies including 14,274 patients provided postoperative BE incidence estimates for patients undergoing LSG. The overall postoperative BE incidence was 2.0% (95% CI 0.4–10.2%, $I^2 = 98\%$, Fig. 4a). However, when only those studies were included in which patients had undergone systematic preoperative endoscopy and therefore true de novo patients were captured (n studies = 5, n patients = 761), the postoperative BE incidence rate increased to 6% (95% CI 1.8–17.8%, $I^2 = 89\%$, Fig. 4b). Equally, when the data that was reported in abstract form only was excluded, the postoperative BE incidence was estimated at 4.6% (95% CI 1.5–13.1%, $I^2 = 90\%$, Fig. 4c). Finally, when length of follow-up was taken into account, those studies with a patient follow-up ≥ 2 years ($n = 6$, n patients = 1022) provided a combined postoperative BE incidence estimate of 4.6% (95% CI 1.5–13.1%, $I^2 =$ 90%, Fig. 4d).

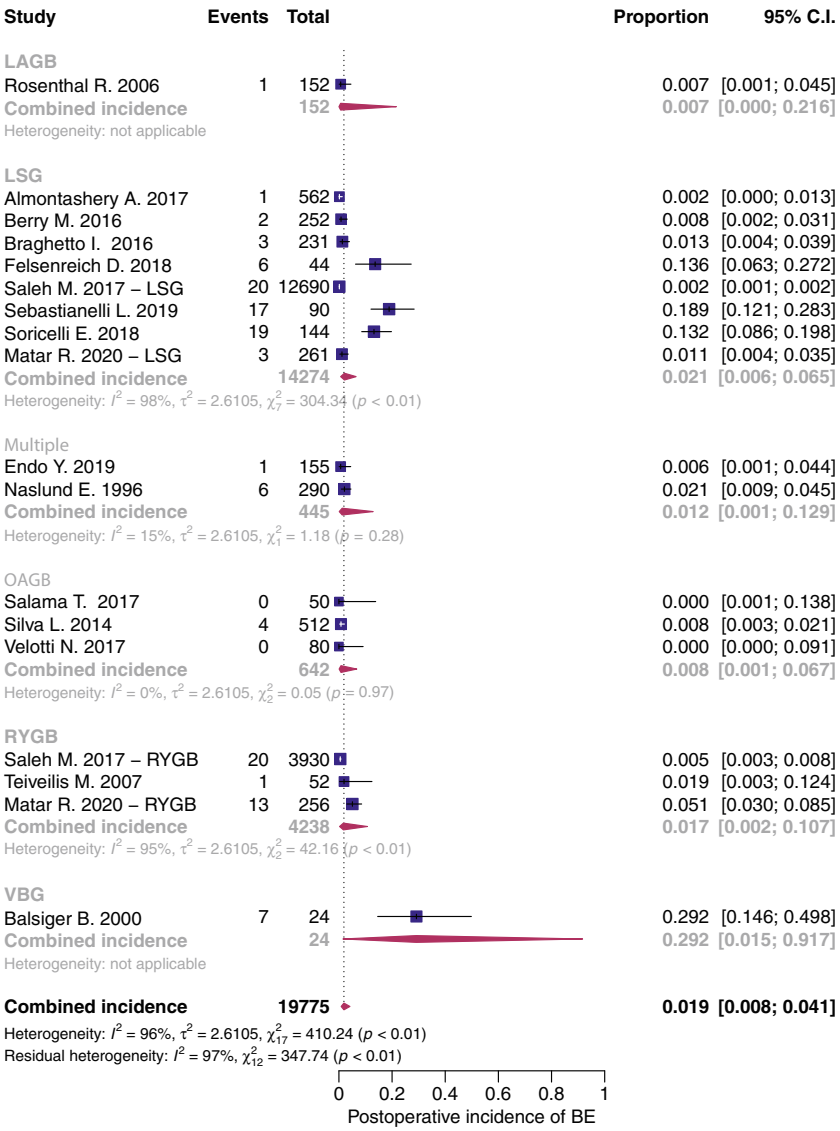

Fig. 3 Postoperative incidence of BE (all studies) stratified by bariatric procedure type

Barrett's Oesophagus Regression Following BMS

Ten studies including 118 patients reported on the incidence of BE regression following BMS, all of which only included patients having undergone laparoscopic Roux-en-Y gastric bypass (LRYGB). Only studies in which patients had been preoperatively diagnosed by endoscopy were included, and the median length of follow-up of these patients was 28.5 months (IQR 18–37.5 months). In total 62.9% (95% CI 53.4–71.6%) showed signs of BE regression during follow-up endoscopy (Fig. 5). No study reporting on the incidence of BE regression following LSG could be identified during our literature review.

Publication and Small Study Bias Assessment

Publication bias was assessed by creating funnel plots and performing Egger's regression upon which we found significant evidence for publication and small study bias in the studies on preoperative BE estimates, whereas there was no significant publication or small study bias in those studies reporting postoperative BE incidence rates (Supplementary Fig. 8a and b, Egger's p for asymmetry < 0.001 and 0.52 respectively).

Discussion

The current evidence demonstrates that up to 3.8% of patients presenting for and undergoing BMS have Barrett's oesophagus. Equally, the present study shows that approximately 1.9% of patients will go on to develop BE irrespective of their type of bariatric procedure, but for patients undergoing LSG, the incidence of de novo BE may be as high as 4.6% within 5 years after surgery. These figures are offset by interesting data, albeit

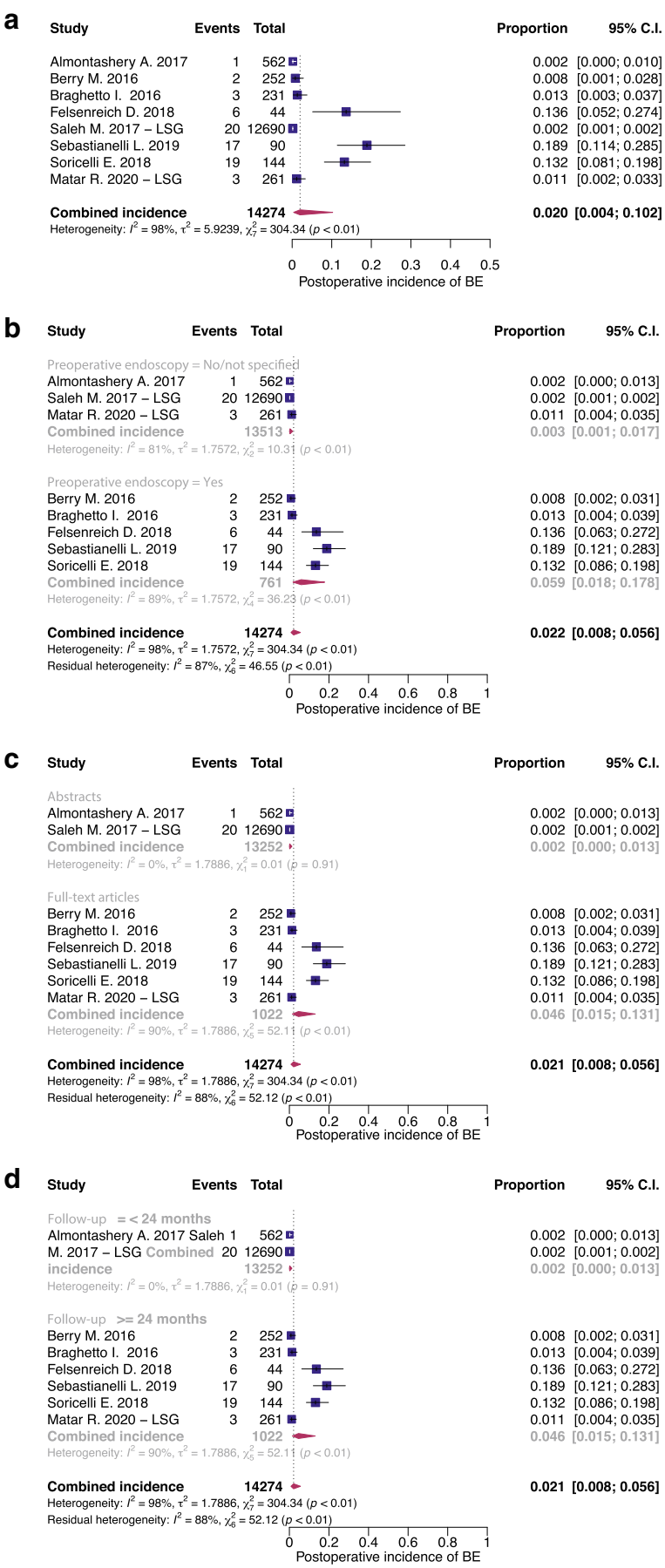

Fig. 4 Laparoscopic sleeve gastrectomy and BE incidence rates

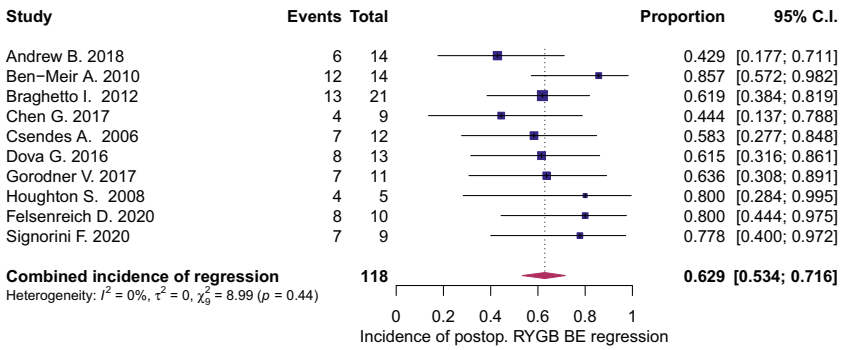

Fig. 5 BE regression following LRYGB

from just over 100 patients, which suggest that BE regression may also occur following LRYGB in up to 63% of patients. However, the present analysis limited by the quality of the included studies which is highly variable, many of which are retrospective cohort studies and this is in turn reflected by the very high inter-study heterogeneity as well as significant publication and small study bias that was identified. Equally, readers should be aware that this study incorporated data from all published sources, including conference abstracts as is recommended by current guidelines [70, 71], and therefore, final estimates may be slightly different to other published series due to alternate search strategies and inclusion/exclusion criteria. Accordingly, the estimates provided in this analysis should be interpreted with caution. Equally, the guidance provided in this position statement is subject to further review as the body of evidence on this topic is set to grow.

The main concern that exists within the bariatric surgical community regarding BE relates to the popularity of the LSG. According to the 5th IFSO Global registry report, LSG was the most frequently performed bariatric procedure from 2014 to 2019 (58.5% of all captured procedures) [1]. Whilst similar excess body weight loss and co-morbidity resolution is achieved with a LSG compared to a RYGB [6, 72], rates of particularly de novo reflux are reported to be substantially higher after LSG [5, 6, 72, 73]. Accordingly, valid concerns exist that the short-term up-sides to performing LSG such as shorter operating times, potentially less perioperative morbidity and improved scalability may be offset by the long-term increased risk of GERD, Barrett's formation and potential subsequent development of oesophageal adenocarcinoma [74, 75]. The issues surrounding this are twofold: First, because of the increased uptake of BMS throughout the world, by performing mainly LSG, we may be creating a novel patient population with an unprecedented incidence rate of BE. The risk of BE in the general populations is only 1–2% [76]; thus, if the estimates from the present study are correct, then by performing LSG, we would be creating a true "at-risk" population, with an up to 6× higher risk of BE development. Secondly, if the LSG patients subsequently progress from BE to EAC, then the surgical reconstructive options for patients who require more than endoscopic therapy are usually limited to colonic interpositioning. Although this presents a viable reconstructive option with some advantages, the procedure tends to be more complex with longer operating times and higher blood loss and with increased morbidity when compared to gastric transposition [77].

However, whilst these concerns are valid, they remain largely hypothetical. To date, there is no data suggesting that any of this is actually set to occur, and particularly oesophageal cancer development following BMS is limited to case reports [78]. Conversely, whilst some studies suggest a reduced incidence of EAC development following BMS [79], other population-based studies indicate that there is no change in the overall incidence of oesophageal cancer following BMS, but also caution that the incidence rates of oesophageal cancer may be too low to perform time-dependent analyses [80]. This latter aspect is important to consider, because in patients with BE, the risk of EAC development is approximately 0.33% per annum for non-dysplastic BE and as low as 0.19% per annum for short-segment BE [81]. Thus, there remains the risk of a substantial delay between the index surgery and cancer development and the risk-mitigating effects of bariatric surgery–induced weight loss on EAC development are incompletely understood.

Equally, the issue of performing BMS in qualifying patients with obesity who have established BE needs to be considered. Whilst the presented data suggest that RYGB may lead to BE regression, they need to be interpreted with caution. Regression definitions used was either a decrease in length or a reduction in dysplasia severity. Whereas Barrett's length assessment is subject to observer bias, field effects affecting dysplasia assessment are equally well-established [82]. Accordingly, whilst some studies have aimed to elucidate the physiological changes that may occur in the distal oesophagus following BMS [45, 83], the true impact of RYGB on the natural history of BE development and progression remains unclear. Despite these limitations, there also remains the surgical technical advantage of performing a RYGB, as the remnant stomach may be used as a gastric-conduit for reconstructive purposes, should the patients progress to EAC requiring surgical therapy. Thus, the present data and considerations may encourage a general recommendation of RYGB in the presence of BE. However, some patients may not want or qualify for RYGB for a variety of reasons. Accordingly, the potential health benefits of metabolic

and weight loss surgery must be weighed against the potential risk of particularly EAC development. This is a valid debate, particularly when the causes for mortality in patients with BE are considered: Numerous population-based studies suggest that only a minority of BE patients actually die of EAC, whereas the more common causes of mortality are ischaemic heart disease, other non-oesophageal cancers, respiratory and other digestive system diseases [84–87]. Taken together with the potentially reduced risk of EAC development following BMS, and that data exist that chemoprophylaxis with aspirin and high-dose proton-pump inhibitor therapy may also reduce the risk of high-grade dysplasia and invasive cancer development [88], denying obese patients BE an effective weight loss procedure such as LSG seems somewhat scientifically problematic in view of the paucity of high-quality data. Although extreme caution is mandated when evaluating such therapies in what is effectively an "evidence-free zone", the 2020 task force has identified an important knowledge gap that mandates further research.

Furthermore, the present data may be seen as a direct argument to support systematic screening of patients either before BS or following LSG; however, these calls need to be considered carefully. For example, systematic preoperative screening of patients presenting for BMS remains somewhat controversial as some studies report that the proportion of preoperative endoscopies resulting in a change of management is < 10% [89], whereas the recently commissioned 2020 IFSO task force found systematic preoperative endoscopy resulting in a change in practice in 25.3% of cases [90]. Whilst there is no data on the value of systematic postoperative endoscopic surveillance of BMS patients, the general screening and surveillance of non-dysplastic Barrett's oesophagus patients may not be cost-effective [91]. However, surveillance of high-risk populations may provide a cost benefit and also translate to a survival advantage, in cases of EAC development [92]. Accordingly, offering patients a screening endoscopy at 1 year following a "high-risk" bariatric procedure such as LSG and then every 2–3 years depending on its outcome may be prudent, but warrants further investigation in prospective clinical trials.

Recommendation of the IFSO Barrett's Oesophagus Task Force

Based on the existing data, the 2020 IFSO task force recommends the following:

1. Patients presenting for BMS need to be carefully assessed for the presence of GERD and complications from GERD such as BE. Particular focus should be placed on the duration of symptoms, any previous upper endoscopies and the use of anti-acid medication. If the patient reviewed represents a potential "at-risk" population according to conventional gastro-enterological guidelines, this patient should undergo preoperative screening endoscopy. However, given that BE patients typically are void of symptom indications for preoperative screening endoscopy should be made generously.
2. If a patient has the presence of "salmon-coloured" mucosa and/or an irregular z-line upon upper endoscopy, then the exact length and circumference according to the Prague Classification needs to be documented as well as the segment of Barrett's systematically biopsied according to the Seattle Protocol to capture any potential areas of dysplasia.
3. If the patient has any dysplastic BE, then the patient should be considered for evaluation of preoperative BE-therapy.
4. In the presence of long-segment or dysplastic BE, then procedures where the distal oesophagus may subsequently be exposed to higher concentrations of acid or bile (such as LSG or OAGB) should not be performed.
5. If the patient has short-segment BE, then after careful discussion with the patients the benefits of LSG vs. RYGB should be discussed. In general, RYGB is the preferred procedure due to evidence of BE regression; however, a LSG cannot be categorically discouraged due to the potential long-term health benefits of bariatric/metabolic surgery. However, given the lack of high-quality data, the 2020 task force recommends practitioners proceed with extreme caution if considering this option together with their patients, and it is recommended that all such cases be systematically captured and screened in a prospective fashion. This statement cannot be viewed as a blanket approval to perform LSG in patients with BE, but is reflective of the paucity of data regarding the outcomes of patients with BE undergoing potentially refluxogenic bariatric procedures.
6. Given the current evidence suggesting higher incidence rates of BE following LSG compared to the general population, a single screening endoscopy at 1 year postoperatively and then every 2–3 years, depending on its outcome, is recommended.
7. The current analysis mainly includes studies comprising of Caucasian, Middle-Eastern or South-American populations. Accordingly, how the present findings apply to patients of Asian heritage/undergoing BMS in Asian countries is unclear and warrants further research.
8. IFSO supports further high-quality studies in the field, mainly prospective and/or population-based studies to help elucidate the exact magnitude of the issue as well as provide further guidance to the community as necessary. In particular, researchers should pay attention to also identifying potentially confounding factors, such as the presence of hiatus hernia (and how this was addressed intra/postoperatively), pouch sizes and potential pouch

pathologies (such as strictures/distal obstructions) when assessing the impact of certain procedures on the development and/or progression of BE.

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Compliance with Ethical Standards

Conflict of Interest Oliver M. Fisher reports personal fees for GORE and Fisher & Paykel Healthcare outside the submitted work. Michael Talbot reports grants from Johnson and Johnson, grants from Medtronic, grants from GORE, grants from Olympus and personal fees from Merck Sharpe and Dohme, outside the submitted work. Kelvin Higa reports speakerships for Ethicon Endosurgery and Medtronic. Wendy A. Brown reports grants from Johnson and Johnson, grants from Medtronic, grants from GORE, personal fees from GORE, grants from Applied Medical, grants from Apollo Endosurgery, grants and personal fees from Novo Nordisc and personal fees from Merck Sharpe and Dohme, outside the submitted work, and I am a bariatric surgeon so I earn my living from performing these procedures. Scott Shikora reports that he is the editor-in-chief for Obesity Surgery. The rest of the authors declare no conflict of interest.

References

1. A. Ramos, W. Brown, R. Welbourn, J. Dixon, R. Kinsman, P. Walton, 5th IFSO Global Registry Report. 2019, IFSO p 46.
2. Thrift AP et al. Obesity and risk of esophageal adenocarcinoma and Barrett's esophagus: a Mendelian randomization study. J Natl Cancer Inst. 2014;106(11):dju252.
3. Kendall BJ, Thrift AP. Unravelling the riddle of gastroesophageal reflux disease, obesity, and Barrett's esophagus. Clin Gastroenterol Hepatol. 2015;13(13):2273–5.
4. Spechler SJ, Souza RF. Barrett's esophagus. N Engl J Med. 2014;371(9):836–45.
5. Peterli R, Borbély Y, Kern B, et al. Early results of the Swiss Multicentre Bypass or Sleeve Study (SM-BOSS): a prospective randomized trial comparing laparoscopic sleeve gastrectomy and Roux-en-Y gastric bypass. Ann Surg. 2013;258(5):690–4. discussion 695
6. Salminen P, Helmiö M, Ovaska J, et al. Effect of laparoscopic sleeve gastrectomy vs laparoscopic Roux-en-Y gastric bypass on weight loss at 5 years among patients with morbid obesity: the SLEEVEPASS randomized clinical trial. JAMA. 2018;319(3):241–54.
7. Moher D, Liberati A, Tetzlaff J, et al. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. BMJ. 2009;339:b2535.
8. GA Wells, D O'Connell, J Peterson, V Welch, M Losos, P Tugwell. The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses 2018; Available from: http://www.ohri.ca/programs/clinical_epidemiology/oxford.asp. Accessed 20 Sep 2019.
9. DerSimonian R, Laird N. Meta-analysis in clinical trials. Control Clin Trials. 1986;7(3):177–88.
10. Higgins JP, Thompson SG, Deeks JJ, et al. Measuring inconsistency in meta-analyses. BMJ. 2003;327(7414):557–60.
11. Altman DG, Bland JM. Interaction revisited: the difference between two estimates. BMJ. 2003;326(7382):219.
12. Egger M, Smith GD, Schneider M, et al. Bias in meta-analysis detected by a simple, graphical test. BMJ. 1997;315(7109):629–34.
13. Team, R.C. R: a language and environment for statistical computing. Vienna: R Foundation for Statistical Computing; 2013.
14. Alejandro Pantoja Aguirre, HK, Rivas H, Morton JM, *Su2048:* Prevalence of pre-operative endoscopic findings for sleeve gastrectomy patients. Gastroenterology, 2017: p. S-1260.
15. Almontashery A. Evidence of objective endoscopic gastroesophageal reflux post sleeve gastrectomy. In: in *International Federation for the Surgery of Obesity and Metabolic Disorders 22nd World Congress*. London: IFSO; 2017. p. 155. https://link.springer.com/content/pdf/10.1007%2Fs11695-017-2774-7.pdf. Accessed 01 Sep 2019.
16. Andrew B, Alley JB, Aguilar CE, et al. Barrett's esophagus before and after Roux-en-Y gastric bypass for severe obesity. Surg Endosc. 2018;32(2):930–6.
17. Azagury D, Dumonceau JM, Morel P, et al. Preoperative work-up in asymptomatic patients undergoing Roux-en-Y gastric bypass: is endoscopy mandatory? Obes Surg. 2006;16(10):1304–11.
18. Balsiger BM, Murr MM, Mai J, et al. Gastroesophageal reflux after intact vertical banded gastroplasty: correction by conversion to Roux-en-Y gastric bypass. J Gastrointest Surg. 2000;4(3):276–81.
19. Aviv Ben-Meir IS, Salomone MG. P-62: Roux-en-Y gastric bypass (RYGB) improves Barrett's esophagus. Surg Obes Relat Dis. 2010;6(3):S48–9.
20. Berry MA, Urrutia L, Lamoza P, et al. Sleeve gastrectomy outcomes in patients with BMI between 30 and 35-3 years of follow-up. Obes Surg. 2018;28(3):649–55.
21. Braghetto I, Csendes A. Prevalence of Barrett's esophagus in bariatric patients undergoing sleeve gastrectomy. Obes Surg. 2016;26(4):710–4.
22. Braghetto I, Korn O, Csendes A, et al. Laparoscopic treatment of obese patients with gastroesophageal reflux disease and Barrett's esophagus: a prospective study. Obes Surg. 2012;22(5):764–72.
23. Caravelli G, Di Pierro M, Morace F, Verde C, Amalfi G , *P.12.13:* Advantages of transnasal esophagogastroduodenoscopy in preoperative evaluation of patients undergoing bariatric surgery. Dig Liver Dis, 2017: p. e73–e223.
24. Umer I Chaudhry DJM, Needleman BJ, Melvin WS, Noria SF, *Routine preoperative esophagogastroduodenoscopy in patients undergoing bariatric surgery.* SAGES 2014 Abstracts, 2014. https://www.sages.org/meetings/annual-meeting/abstracts-archive/routine-preoperative-esophagogastroduodenoscopy-in-patients-undergoing-bariatric-surgery/. Accessed 01 Sep 2019.
25. Chang VC, Pan P, Shah SK, et al. Routine preoperative endoscopy in patients undergoing bariatric surgery. Surg Obes Relat Dis. 2020;16:745–50.
26. Gao L Chen DE, Kubat E, P010: laparoscopic Roux-en-Y gastric bypass in veterans with Barrett's esophagus. SAGES 2017 Abstracts, 2017. https://www.sages.org/meetings/annual-meeting/abstracts-archive/laparoscopic-roux-en-y-gastric-bypass-in-veterans-with-barretts-esophagus/. Accessed 01 Sep 2019.
27. Csendes A, Burgos AM, Smok G, et al. Endoscopic and histologic findings of the foregut in 426 patients with morbid obesity. Obes Surg. 2007;17(1):28–34.
28. Csendes A et al. Effect of gastric bypass on Barrett's esophagus and intestinal metaplasia of the cardia in patients with morbid obesity. J Gastrointest Surg. 2006;10(2):259–64.
29. D'Hondt M et al. Value of preoperative esophagogastroduodenoscopy in morbidly obese patients undergoing laparoscopic Roux-en-Y gastric bypass. Acta Chir Belg. 2013;113(4):249–53.

30. D'Silva M et al. High-percentage pathological findings in obese patients suggest that esophago-gastro-duodenoscopy should be made mandatory prior to bariatric surgery. Obes Surg. 2018;28(9):2753–9.
31. Dova G, Caro LE, Brasesco O, et al. Tu1141: effects of gastric bypass in obese patients with Barrett's esophagus. Gastrointest Endosc. 2016;83:AB551.
32. Endo Y, Ohta M, Tada K, et al. Clinical significance of upper gastrointestinal endoscopy before laparoscopic bariatric procedures in Japanese patients. Surg Today. 2019;49(1):27–31.
33. Estevez-Fernandez S et al. Esophagogastric pathology in morbid obese patient: preoperative diagnosis, influence in the selection of surgical technique. Rev Esp Enferm Dig. 2015;107(7):408–12.
34. Felsenreich DM, Ladinig LM, Beckerhinn P, et al. Update: 10 years of sleeve gastrectomy-the first 103 patients. Obes Surg. 2018;28(11):3586–94.
35. Felsenreich DM, Langer FB, Bichler C, et al. Roux-en-Y gastric bypass as a treatment for Barrett's esophagus after sleeve gastrectomy. Obes Surg. 2020;30(4):1273–9.
36. Gomez V et al. Routine screening endoscopy before bariatric surgery: is it necessary? Bariatr Surg Pract Patient Care. 2014;9(4):143–9.
37. Gorodner V, Buxhoeveden R, Clemente G, et al. Barrett's esophagus after Roux-en-Y gastric bypass: does regression occur? Surg Endosc. 2017;31(4):1849–54.
38. Heimgartner B, Herzig M, Borbély Y, et al. Symptoms, endoscopic findings and reflux monitoring results in candidates for bariatric surgery. Dig Liver Dis. 2017;49(7):750–6.
39. Houghton SG, Romero Y, Sarr MG. Effect of Roux-en-Y gastric bypass in obese patients with Barrett's esophagus: attempts to eliminate duodenogastric reflux. Surg Obes Relat Dis. 2008;4(1):1–4. discussion 4-5
40. Humphreys LM, Meredith H, Morgan J, et al. Detection of asymptomatic adenocarcinoma at endoscopy prior to gastric banding justifies routine endoscopy. Obes Surg. 2012;22(4):594–6.
41. Pauline Jouet JB, Coffin B, Msika S, et al. Results of routine endoscopy performed in patients with morbid obesity before bariatric surgery and prevalence of Helicobacter pylori: a single center study in 288 patients. Gastroenterology. 2011;140(5):S-563.
42. Kazantsev G. M2073: preoperative endoscopy in patients undergoing Roux-en-Y gastric bypass for morbid obesity: is it necessary? Gastroenterology. 2005;128(4):A1–A821. (817)
43. Kuper MA et al. Effort, safety, and findings of routine preoperative endoscopic evaluation of morbidly obese patients undergoing bariatric surgery. Surg Endosc. 2010;24(8):1996–2001.
44. Masci E, Viaggi P, Mangiavillano B, et al. No increase in prevalence of Barrett's oesophagus in a surgical series of obese patients referred for laparoscopic gastric banding. Dig Liver Dis. 2011;43(8):613–5.
45. Matar R, Maselli D, Vargas E, et al. Esophagitis after bariatric surgery: large cross-sectional assessment of an endoscopic database. Obes Surg. 2020;30(1):161–8.
46. Mong C, van Dam J, Morton J, et al. Preoperative endoscopic screening for laparoscopic Roux-en-Y gastric bypass has a low yield for anatomic findings. Obes Surg. 2008;18(9):1067–73.
47. Moulla Y, Lyros O, Mehdorn M, et al. Preoperative upper-GI endoscopy prior to bariatric surgery: essential or optional? Obes Surg. 2020;30(6):2076–84.
48. Munoz R et al. Importance of routine preoperative upper GI endoscopy: why all patients should be evaluated? Obes Surg. 2009;19(4):427–31.
49. Naslund E et al. Six cases of Barrett's esophagus after gastric restrictive surgery for massive obesity: an extended case report. Obes Surg. 1996;6(2):155–8.
50. Ozeki KA, Tran SA, Cheung R, et al. Preoperative endoscopic findings in veterans undergoing bariatric surgery: prevalence and predictors of Barrett's esophagus. Obes Surg. 2020;30(2):657–63.
51. Peromaa-Haavisto P, Victorzon M. Is routine preoperative upper GI endoscopy needed prior to gastric bypass? Obes Surg. 2013;23(6):736–9.
52. Rosenthal RJ et al. Laparoscopic surgery for morbid obesity: 1,001 consecutive bariatric operations performed at The Bariatric Institute, Cleveland Clinic Florida. Obes Surg. 2006;16(2):119–24.
53. Saarinen T, Kettunen U, Pietiläinen KH, et al. Is preoperative gastroscopy necessary before sleeve gastrectomy and Roux-en-Y gastric bypass? Surg Obes Relat Dis. 2018;14(6):757–62.
54. Salama TMS, Hassan MI. Incidence of biliary reflux esophagitis after laparoscopic omega loop gastric bypass in morbidly obese patients. J Laparoendosc Adv Surg Tech A. 2017;27(6):618–22.
55. Mohannad Abou Saleh EM, Perry Y, Lee PJ, et al. Proportion of gastroesophageal reflux disease and Barrett's esophagus in laparoscopic sleeve gastrectomy vs. Roux-en-Y gastrojejunostomy: a population based study. Gastroenterology. 2017;152(5):S453.
56. Santo MA et al. Endoscopic changes related to gastroesophageal reflux disease: comparative study among bariatric surgery patients. Arq Bras Cir Dig. 2015;28(Suppl 1):36–8.
57. Schigt A, Coblijn U, Lagarde S, et al. Is esophagogastrod uodenoscopy before Roux-en-Y gastric bypass or sleeve gastrectomy mandatory? Surg Obes Relat Dis. 2014;10(3):411–7. quiz 565-6
58. Schirmer B, Erenoglu C, Miller A. Flexible endoscopy in the management of patients undergoing roux-en-Y gastric bypass. Obes Surg. 2002;12(5):634–8.
59. Schneider R, Lazaridis I, Kraljević M, et al. The impact of preoperative investigations on the management of bariatric patients; results of a cohort of more than 1200 cases. Surg Obes Relat Dis. 2018;14(5):693–9.
60. Sebastianelli L, Benois M, Vanbiervliet G, et al. Systematic endoscopy 5 years after sleeve gastrectomy results in a high rate of Barrett's esophagus: results of a multicenter study. Obes Surg. 2019;29(5):1462–9.
61. Sharaf RN, Weinshel EH, Bini EJ, et al. Endoscopy plays an important preoperative role in bariatric surgery. Obes Surg. 2004;14(10):1367–72.
62. Signorini F, Viscido G, Bocco MCA, et al. Impact of gastric bypass on erosive esophagitis and Barret's esophagus. Obes Surg. 2020;30(4):1194–9.
63. Sheppard CE, Sadowski DC, de Gara CJ, et al. Rates of reflux before and after laparoscopic sleeve gastrectomy for severe obesity. Obes Surg. 2015;25(5):763–8.
64. Silva LE, Cruz Jr RJ, Alves MM, et al. P.260: simple, safe and effective. the omega loop gastric bypass added to "collis-nissen" like surgery (OLGBCN): 5-years outcomes of 512 cases from a single surgeon. Obes Surg. 2014;24:1136–378.
65. Soricelli E, Casella G, Baglio G, et al. Lack of correlation between gastroesophageal reflux disease symptoms and esophageal lesions after sleeve gastrectomy. Surg Obes Relat Dis. 2018;14(6):751–6.
66. Teivelis MP, Faintuch J, Ishida R, et al. Endoscopic and ultrasonographic evaluation before and after roux-en-Y gastric bypass for morbid obesity. Arq Gastroenterol. 2007;44(1):8–13.
67. Velotti N, Bianco P, Russo T, et al. Evaluation of the gastroesophageal mucosa with endoscopic (EGD) computed virtual chromoendoscopy technologies (CVCT) in patients undergoing mini gastric bypass. gastric bypass procedures including Roux-en-y gastric bypass (RYGB) and one anastomosis gastric bypass (OAGB)/MGB. In: in *International Federation for the Surgery of Obesity and Metabolic Disorders 22nd World Congress*. London: IFSO; 2017. https://link.springer.com/content/pdf/10.1007%2Fs11695-017-2774-7.pdf. Accessed 01 Sep 2019.

68. Wolter S, Duprée A, Miro J, et al. Upper gastrointestinal endoscopy prior to bariatric surgery-mandatory or expendable? An analysis of 801 cases. Obes Surg. 2017;27(8):1938–43.
69. Zeni TM et al. Value of preoperative upper endoscopy in patients undergoing laparoscopic gastric bypass. Obes Surg. 2006;16(2):142–6.
70. Scherer RW, Saldanha IJ. How should systematic reviewers handle conference abstracts? A view from the trenches. Syst Rev. 2019;8(1):264.
71. Higgins JPT, Thomas J., Chandler J, Cumpston M, Li T, Page MJ, Welch VA (editors). Cochrane handbook for systematic reviews of interventions version 6.0 (updated July 2019). 2019 [cited 2020; 6.0: Available from: www.training.cochrane.org/handbook. Accessed 01 Sep 2019.
72. Peterli R, Wölnerhanssen BK, Peters T, et al. Effect of laparoscopic sleeve gastrectomy vs laparoscopic Roux-en-Y gastric bypass on weight loss in patients with morbid obesity: the SM-BOSS randomized clinical trial. JAMA. 2018;319(3):255–65.
73. Arman GA, Himpens J, Dhaenens J, et al. Long-term (11+years) outcomes in weight, patient satisfaction, comorbidities, and gastroesophageal reflux treatment after laparoscopic sleeve gastrectomy. Surg Obes Relat Dis. 2016;12(10):1778–86.
74. Felsenreich DM, Kefurt R, Schermann M, et al. Reflux, sleeve dilation, and Barrett's esophagus after laparoscopic sleeve gastrectomy: long-term follow-up. Obes Surg. 2017;27(12):3092–101.
75. Genco A, Soricelli E, Casella G, et al. Gastroesophageal reflux disease and Barrett's esophagus after laparoscopic sleeve gastrectomy: a possible, underestimated long-term complication. Surg Obes Relat Dis. 2017;13(4):568–74.
76. Ronkainen J, Aro P, Storskrubb T, et al. Prevalence of Barrett's esophagus in the general population: an endoscopic study. Gastroenterology. 2005;129(6):1825–31.
77. Davis PA, Law S, Wong J. Colonic interposition after esophagectomy for cancer. Arch Surg. 2003;138(3):303–8.
78. El Khoury L et al. Esophageal adenocarcinoma in Barrett's esophagus after sleeve gastrectomy: case report and literature review. Int J Surg Case Rep. 2018;52:132–6.
79. Schauer DP, Feigelson HS, Koebnick C, et al. Bariatric surgery and the risk of cancer in a large multisite cohort. Ann Surg. 2019;269(1):95–101.
80. Mackenzie H, Markar SR, Askari A, et al. Obesity surgery and risk of cancer. Br J Surg. 2018;105(12):1650–7.
81. Fisher O. M., L.R.V., Shackleford's surgery of the alimentary tract. 8th Edition ed. Shackleford's Surgery of the Alimentary Tract, ed. S.R.D. Charles J. Yeo, David W. McFadden, Jeffrey B. Matthews, James W. Fleshman. Vol. 1. 2019, Philadelphia: Elsevier.
82. Contino G, Vaughan TL, Whiteman D, et al. The evolving genomic landscape of Barrett's esophagus and esophageal adenocarcinoma. Gastroenterology. 2017;153(3):657–73. e1
83. Raj PP, Bhattacharya S, Misra S, et al. Gastroesophageal reflux-related physiologic changes after sleeve gastrectomy and Roux-en-Y gastric bypass: a prospective comparative study. Surg Obes Relat Dis. 2019;15(8):1261–9.
84. Anderson LA, Murray LJ, Murphy SJ, et al. Mortality in Barrett's oesophagus: results from a population based study. Gut. 2003;52(8):1081–4.
85. Solaymani-Dodaran M, Card TR, West J. Cause-specific mortality of people with Barrett's esophagus compared with the general population: a population-based cohort study. Gastroenterology. 2013;144(7):1375–83. 1383 e1
86. Erichsen R, Horvath-Puho E, Lund JL, et al. Mortality and cardiovascular diseases risk in patients with Barrett's oesophagus: a population-based nationwide cohort study. Aliment Pharmacol Ther. 2017;45(7):973–82.
87. Cook MB, Coburn SB, Lam JR, et al. Cancer incidence and mortality risks in a large US Barrett's oesophagus cohort. Gut. 2018;67(3):418–529.
88. Jankowski JAZ, de Caestecker J, Love SB, et al. Esomeprazole and aspirin in Barrett's oesophagus (AspECT): a randomised factorial trial. Lancet. 2018;392(10145):400–8.
89. Bennett S, Gostimir M, Shorr R, et al. The role of routine preoperative upper endoscopy in bariatric surgery: a systematic review and meta-analysis. Surg Obes Relat Dis. 2016;12(5):1116–25.
90. Brown WA, Johari Halim Shah Y, Balalis G, et al. IFSO position statement on the role of esophago-gastro-duodenal endoscopy prior to and after bariatric and metabolic surgery procedures. Obes Surg. 2020;30:3135–53.
91. Vaughan TL, Fitzgerald RC. Precision prevention of oesophageal adenocarcinoma. Nat Rev Gastroenterol Hepatol. 2015;12(4):243–8.
92. Inadomi JM, Saxena N. Screening and surveillance for Barrett's esophagus: is it cost-effective? Dig Dis Sci. 2018;63(8):2094–104.