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REVIEW ARTICLE

Preoperative esophagogastroduodenoscopy in pediatric bariatric surgery: A summary of the literature

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Abstract

Our objective was to summarize the available literature on the use of preoperative esophagogastroduodenoscopy (EGD) and its impact on management and/or postoperative outcomes in pediatric patients undergoing metabolic and bariatric surgery. We performed a search using PubMed in February 2023 for articles examining EGD and any clinical correlation in pediatric patients undergoing bariatric surgery. Search results were manually reviewed and included in the study if they examined findings of EGD done prior to bariatric surgery and were excluded if they were not primarily done in pediatric or adolescent patients. Our search yielded 549 distinct articles, with a total of four articles remaining after applying inclusion and exclusion criteria. All four studies were retrospective. A total of 244 patients were studied, with an age range of 9–25 years. Of the patients whose respective findings were reported, 21/150 patients (14%) had esophagitis, 55/150 (37%) had gastritis, 55/244 (23%) had *Helicobacter pylori*, and 18/150 (12%) had duodenitis. There were a total of 60 findings that changed medical management, and one that changed surgical management. A high proportion of positive EGD findings that changed medical management was evident, and one study suggested that mucosal inflammation may be a prognostic indicator for postoperative weight loss. However, there is a paucity of data examining the utility of routine EGD prior to bariatric surgery, specifically in pediatric patients, and more studies are therefore needed to construct the evidence basis for guidelines.

KEYWORDS

acknowledged, metabolic and bariatric surgery, obesity, pediatrics, upper endoscopy

1 | INTRODUCTION

Childhood obesity is a growing epidemic in the United States, with a prevalence that has nearly quadrupled from 5% in the early 1970s to 19% in 2017–2018.[1] Metabolic and bariatric surgery (MBS) has a growing evidence base for efficacy and safety in treating children and adolescents with obesity, and is acknowledged by the American Academy of Pediatrics (AAP) as part of a comprehensive approach to managing severe obesity in the pediatric patient.[2] Roux-en-Y gastric bypass (RYGB) and vertical sleeve gastrectomy (VSG) are the most commonly performed MBS procedures in this age group, although the latter sees greater contemporary use in the United States.[3]

Patients who undergo VSG have an increased risk for developing reflux esophagitis and subsequently Barrett's esophagus, a precursor to cancer.[4] Before surgery, an

Abbreviations: AAP, American Academy of Pediatrics; ASGE, American Society for Gastrointestinal Endoscopy; ASMBS, American Society for Metabolic & Bariatric Surgery; EAES, European Association of Endoscopic Surgery; EGD, esophagogastroduodenoscopy; IFSO, International Federation for the Surgery of Obesity and Metabolic Disorders; MBS, metabolic and bariatric surgery; RYGB, Roux-en-Y gastric bypass; TBWL, total body weight loss; US, United States; VSG, vertical sleeve gastrectomy.

esophagogastroduodenoscopy (EGD, or upper endoscopy) can be performed to assess for anatomic abnormalities (e.g., hiatal hernia) or mucosal pathology (e.g., esophagitis, Barrett's esophagus, peptic ulcer disease, *Helicobacter pylori* infection, celiac disease) that can change medical and/or surgical management.[5] Initially, as VSG was gaining in popularity, this preoperative EGD was used to determine if patients could benefit from RYGB instead of VSG if they had findings of esophagitis or gastritis. Later, as VSG became the preferred form of MBS, preoperative EGDs became unnecessary to select which MBS procedure to perform, and the question of whether to perform preoperative EGD for all patients or for select indications became debated by institutions.

The impetus behind this ongoing controversy stems from conflicting data as to the potential benefits of uncovering findings that would change medical and/or surgical management, the potential risks of undergoing any endoscopic procedure, and therefore the conclusions as to whether or not this should be a routine screening procedure before MBS for all patients. A number of these studies have demonstrated that preoperative EGD resulted in changes to medical and surgical management.[6–9] For example, in a study of 222 patients, researchers found that adults with obesity presented with esophageal pathology significantly more often than in adults with body weights in the desired reference range.[7] A retrospective analysis of 885 patients by Chen et al. found that 83% of patients had observed gross endoscopic abnormalities, with 43% having an identified hernia.[8] In a retrospective analysis of 801 patients conducted by Wolter et al., gastritis was found in 31% of patients and reflux disease in 24%, both of which influenced medical management by way of initiating proton pump inhibitors.[9]

Professional organizations offer a range of recommendations in their published guidelines for adult patients. The American Society for Gastrointestinal Endoscopy (ASGE) published in their 2015 guidelines that preoperative EGD should not be performed routinely, but individually decided on for each patient after thorough consultation with the surgeon.[10] The 2005 guidelines from the European Association of Endoscopic Surgery (EAES) advise that all candidates undergo preoperative evaluation of the upper gastrointestinal tract, whether by fluoroscopy or by EGD.[11] The 2020 position statement from the International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) recommends consideration of preoperative EGD regardless of the presence or absence of symptoms given the prevalence of findings that may impact management.[12] With a similar rationale, 2021 guidelines from the American Society for Metabolic & Bariatric Surgery (ASMBS) published that routine preoperative EGD is justifiable and should be done at the discretion of the surgeon.[13]

The above societies and studies provide differing recommendations on pre-MBS EGD, but they notably share their basis from studies in adult patients. Very little pediatric evidence is included in this conversation, with only one set of societal guidelines to direct the use of preoperative EGD for MBS in pediatric patients. In 2021, the ASMBS published their first set of recommendations for pediatric patients, stating that preoperative EGD should be done routinely for those with significant upper gastrointestinal symptoms, may be considered for patients undergoing RYGB, and should be discussed with surgeons in asymptomatic patients.[5]

The purpose of the present study was to summarize the available literature on the use of pre-MBS EGD and its impact on management and/or postoperative outcomes in the pediatric population.

What is Known

- Bariatric surgery is increasingly recognized as a treatment option for severe obesity in pediatric patients.
- Esophagogastroduodenoscopy (EGD) can be performed preoperatively to assess for anatomic/mucosal abnormalities.
- There are few guidelines on the routine use of preoperative EGD for pediatric patients undergoing bariatric surgery.

What is New

- There was a high proportion of positive EGD findings that changed preoperative medical management.
- One study suggested that mucosal inflammation may be prognostic of postoperative total body weight loss.
- There is still a paucity of data examining the utility of routine EGD before bariatric surgery in pediatric patients.

2 | METHODS

2.1 | Literature search

We created a PubMed search to identify articles studying pre- or intraoperative EGD with any clinical correlation in pediatric bariatric surgery patients. Our search string was as follows: ((“upper endoscopy” [tw] OR “EGD” [tw] OR “esophagogastroduodenoscopy” [tw] OR “duodenoscopy” [tw] OR “gastroscopy” [tw] OR “esophagoscopy” [tw] OR “endoscopy” [tw] OR “colonoscopy” [tw]) AND (“bariatric” [tw] OR “metabolic” [tw] OR “vertical” [tw] OR “sleeve” [tw] OR “gastrectomy” [tw] OR “Roux-en-Y” [tw] OR “gastric bypass” [tw]) AND (“outcome” [tw] OR “complication” [tw] OR “symptom*” [tw] OR “reflux” [tw] OR “GER” [tw] OR “GERD” OR

"Barrett's esophagus" [tw] OR "Barrett's syndrome" [tw] OR "metaplasia" [tw] OR "Nausea" [tw] OR "Dysphagia" [tw] OR "Chest pain" [tw] OR "Abdominal pain" [tw] OR "Regurgitation" [tw] OR "Ulcer" [tw] OR "gastritis" [tw] OR "Helicobacter" [tw] OR "Pylori" [tw] OR "Fistula*" [tw] OR "Stenosis" [tw] OR "Pseudodiverticulum" [tw] OR "hernia" [tw] OR "Torsion" [tw] OR "Kink" [tw] OR "Foreign body" [tw] OR "Bezoar" [tw] OR "Bleed*" [tw]) AND (minors [tw] OR child [tw] OR child* [tw] OR children* [tw] OR schoolchild* [tw] OR "school child" [tw] OR "school children" [tw] OR adolescen* [tw] OR juvenil* [tw] OR youth* [tw] OR teen* [tw] OR "under age" [tw] OR pubescen* [tw] OR prepubesc* [tw] OR pediatric* [tw] OR paediatric* [tw] OR kindergar* [tw] OR "primary school" [tw] OR "secondary school" [tw] OR "elementary school" [tw] OR "high school" [tw] OR "primary schools" [tw] OR "secondary schools" [tw] OR "elementary school" [tw] OR "high schools" [tw] OR highschool* [tw] OR "Child"[mesh] OR "Adolescent"[mesh] OR "Minors" [mesh] OR "Puberty" [mesh] OR "Pediatrics" [mesh] OR pediatrics)).

We then met with a librarian at our institution who independently generated a search to identify articles published in English studying EGD performed at any time in pediatric bariatric surgery patients. Their search string was as follows: (("Bariatric Surgery"[Mesh] OR bariatric [ti]) AND (infan* [tw] OR newborn* [tw] OR "new-born" [tw] OR "new borns" [tw] OR perinat* [tw] OR neonat* [tw] OR baby [tw] OR baby* [tw] OR babies [tw] OR toddler* [tw] OR minors [tw] OR child [tw] OR child* [tw] OR children* [tw] OR schoolchild* [tw] OR "school child" [tw] OR "school children" [tw] OR adolescen* [tw] OR juvenil* [tw] OR youth* [tw] OR teen* [tw] OR "under age" [tw] OR pubescen* [tw] OR prepubesc* [tw] OR pediatric* [tw] OR paediatric* [tw] OR "Nursery school" [tw] OR kindergar* [tw] OR "primary school" [tw] OR "secondary school" [tw] OR "elementary school" [tw] OR "high school" [tw] OR "primary schools" [tw] OR "secondary schools" [tw] OR "elementary school" [tw] OR "high schools" [tw] OR highschool* [tw] OR "infant" [mesh] OR "Child"[mesh] OR "Adolescent"[mesh] OR "Minors" [mesh] OR "Puberty" [mesh] OR "Pediatrics" [mesh] OR pediatrics) AND ("gastrointestinal endoscop*" OR "gi endoscop*" [tw] OR "endoscopy, gastrointestinal" [mesh] OR (preoperative [tw] AND endoscop* [tw])) AND english [lang]).

Both searches were conducted in PubMed in February of 2023. To generate broad search results, both search strings were run without a year limit, with results pooled together for study selection. A summary of our search strategy is outlined in Figure 1. This study did not require approval from our institutional review board.

2.2 | Study selection

Titles, abstracts, and full texts for each study were reviewed as applicable for relevance to the study question. Studies were included if they examined findings of EGD done before bariatric surgery, including EGD done during the same anesthesia event but before the surgery itself. Studies were excluded if they were not primarily done in pediatric or adolescent patients, which was defined as a study mean or median age of 21 years or younger. Studies that had a higher mean or median age that included patients in this age range but did not report findings in this group separately were therefore excluded as well.

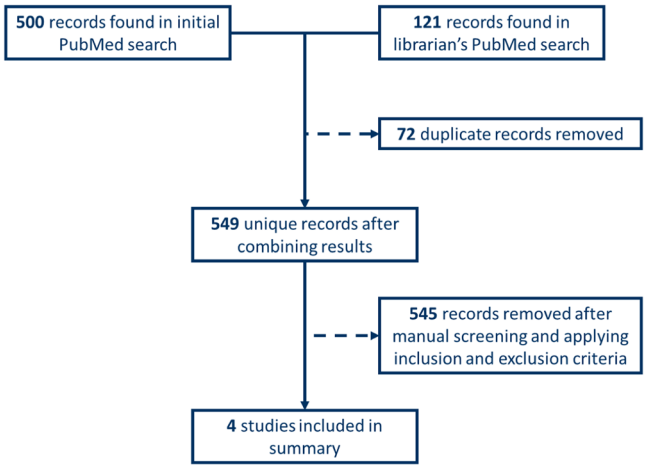

FIGURE 1 Flow diagram of search strategy and study selection. Five hundred and forty-nine unique records were found in PubMed, of which four were selected after applying the inclusion and exclusion criteria.

3 | RESULTS

Our initial search yielded 500 results. After applying inclusion and exclusion criteria, four articles remained. The librarian's search yielded 121 results, 49 of which were not found in our initial search but did not yield additional articles after applying inclusion and exclusion criteria. Our combined search therefore yielded 549 unique articles that were manually reviewed, yielding four total articles after inclusion and exclusion criteria were applied. All four studies were retrospective. Basic study characteristics and findings are summarized in Table 1. A total of 244 patients were studied, with an age range of 9–25 years. Of the patients whose respective findings were reported, 21 patients (14%) had esophagitis, 55 (37%) had gastritis, 55 (23%) had *H. pylori*, and 18 (12%) had duodenitis. There was a total of 60 findings that changed medical management and one that changed surgical management.

Lewit et al. published a retrospective review of 30 patients, 15–20 years of age, who underwent EGD routinely as part of the evaluation before sleeve gastrectomy.[14] They found that 21 patients (70%) had inflammation in at least one area of the esophagus,

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TABLE 1 Summary of basic study characteristics and findings.

Author	Year published	Study institution (location)	Included patients	Female	Age (years) (range)	Esophagitis[a]	Gastritis[a]	*Helicobacter pylori*	Duodenitis[a]	Total findings that changed medical management	Total findings that changed surgical management
Lewit et al.	2022	Le Bonheur Children's Hospital (Memphis, TN)	30	19 (63%)	Mean 17.53 (15–20)	9 (30%)	10 (33%)	5 (17%)	9 (30%)	Not reported	1
Sivan et al.	2021	Schneider Children's Medical Center (Israel)	80	40 (50%)	Median 16.1 (12.0–18.1)	7 (9%)	38 (48%)	35 (44%)	7 (9%)	33[b]	Not reported
Ogle et al.	2020	Children's Hospital Colorado (Aurora, CO)	40	29 (73%)	Mean 17 (14–25)	5 (13%)[c]	7 (18%)	4 (10%)	2 (5%)	6	0
Colman et al.	2019	New York Presbyterian Morgan Stanley Children's Hospital and Columbia University Irving Medical Center (New York City, NY)	94	69 (73%)	Median 16 (9–23)	Not reported	Not reported	11 (12%)	Not reported	21	0
Total			244	64% (157/244)	Range 925	14% (21/150)	37% (55/150)	23% (55/244)	12% (18/150)	60	1

[a]Determined by histology.

[b]Missing data from eight patients.

[c]Includes two cases of eosinophilic esophagitis.

stomach, or duodenum. They also found that patients with preoperative gastritis or duodenitis had less total body weight loss (TBWL) at 12 months postoperatively compared to their counterparts without inflammation in these areas (16.7% vs. 24.6% in patients with gastritis, and 14.1% vs. 25.7% in patients with duodenitis). Five patients (17%) tested positive for *H. pylori*. One patient (3%) had a gastric ulcer delaying surgery.

Sivan et al. published a retrospective chart review of 80 patients 12–18 years of age who underwent EGD routinely as part of the evaluation before bariatric surgery (specific procedure not stated).[15] Forty-three patients (54%) had an abnormality identified after EGD. Forty-two patients (53%) had macroscopic and/or microscopic gastritis, 35 of whom (44%) tested positive for *H. pylori*. Thirteen patients (16%) had gross esophagitis with or without microscopic esophagitis. Ten patients (13%) had gross duodenitis with or without microscopic duodenitis. One patient had a hiatal hernia, and one patient was diagnosed with celiac disease. Of the 43 patients with an identified abnormality, data on treatment was available for 35; of these, 33 received medical treatment before bariatric surgery. Three patients (4%) experienced surgical complications, although none occurred in the group with abnormalities identified on EGD. Serum metabolic profiles are also reported in this study.

Ogle et al. published a retrospective chart review of 40 consecutive patients 14–25 years of age who underwent concurrent EGD and VSG.[16] Only one patient had gross EGD abnormalities (gastric cobblestoning) and patients at their institution are routinely started on proton pump inhibitors postoperatively; therefore, intraoperative EGD did not change immediate medical or surgical management. Five patients (13%) had microscopic esophagitis, two of which involved >15 eosinophils per high-power field. Seven patients (18%) had microscopic gastritis and another four patients (10%) who were asymptomatic tested positive for *H. pylori*. One patient had asymptomatic microscopic duodenitis and another asymptomatic patient had a single duodenal crypt abscess.

Colman et al. published a retrospective cohort study of 134 patients 9–23 years of age who underwent multidisciplinary evaluation for VSG. Seventeen patients were excluded from the study because they did not undergo VSG. Twenty-three patients were excluded from the study because they did not undergo preoperative EGD; these patients had no reported gross abnormalities during intraoperative EGD nor were there any surgical complications. The remaining 94 patients were selected to undergo preoperative EGD (criteria for which was not stated) before VSG.[17] Thirty-six of these patients (38%) had mild mucosal abnormalities (not further specified); those with preoperative gastrointestinal symptoms were five times more likely to have an abnormal EGD. Eleven patients (12%) were treated for *H. pylori*, 10 patients (11%) were treated with proton pump inhibitors, and one patient (1%) had a polypectomy during their EGD. Four patients (4%) had possible hiatal hernias that were not seen during VSG, while three patients (3%) had anatomic changes attributed to prior gastric banding. Thirty-seven patients reported subjective symptoms (predominantly gastrointestinal) up to 6 weeks postoperatively. None of the 94 EGDs resulted in a change in surgical plan, and abnormalities on EGD were not associated with postoperative gastrointestinal symptoms or complications.

4 | DISCUSSION

The routine use of preoperative EGD to screen for anatomic and mucosal abnormalities before MBS is a topic of continued debate. The ASGE, EAES, IFSO, and ASMBS have all produced guidelines on this subject.[10–13] While they share similarities, their recommendations ultimately differ from one another. The ASMBS published the only pediatric guidelines on this topic in 2021, and their recommendations are based largely on evidence from studies on adult patients. We expanded on the pediatric evidence base cited by the ASMBS guidelines and our search yielded only four studies, signifying a continued paucity of literature on this important topic. More data are needed to provide clear guidance on the use of preoperative EGD in this distinct patient population.

Notable EGD findings in the selected studies include two patients who were found to have esophageal eosinophilia,[16] one patient who was found to have a hiatal hernia,[15] one patient who was found to have a gastric ulcer,[14] one patient who was found to have celiac disease,[15] and one patient who underwent a polypectomy during their EGD.[17] While the only finding that delayed surgery was the gastric ulcer, these findings attest to the specific value of the esophageal and duodenal components of the EGD.

Lewit et al. reported a significant decrease in TBWL at 12 months postoperatively when patients were found to have preoperative gastritis or duodenitis. While the generalizability of this finding is unclear given that the other studies did not report on this, this is a novel finding that implies a prognostic value of preoperative EGD that spans beyond what information sending intraoperative gastrectomy samples can provide given the added examination of the duodenum on EGD. The study did not report how and to what extent preoperative mucosal inflammation was treated, and it is unclear whether or not treatment of this mucosal inflammation may improve weight loss; this is an area worthy of further investigation, including with a greater sample size.

Ogle et al. reported that findings from intraoperative EGD did not immediately change medical or surgical

management. However, they did report two cases of eosinophilic esophagitis and four cases of *H. pylori*. While *H. pylori* may be captured from gastric tissue removed during VSG, eosinophilic esophagitis would require an EGD to diagnose, and both conditions would alter postoperative medical management.

Fifty-five patients (23%) of the collective pool of 244 tested positive for *H. pylori*, a high proportion; all for whom data is available were treated. However, none of the studies report whether or not any postoperative outcomes are associated with test positivity. In the adult literature, a meta-analysis of 255,435 patients found that *H. pylori* positivity was the largest independent predictor of marginal ulceration for patients who underwent RYGB.[18] However, pediatric patients undergoing MBS in the United States most frequently undergo VSG and not RYGB,[3] so that study is not generalizable to pediatric patients. The meta-analysis also reported otherwise comparable rates of weight loss, length of stay, leak, and hemorrhage regardless of test positivity.[18] Given this, a positive test for *H. pylori* primarily changes management by way of prompting eradication therapy.

Regarding anatomic abnormalities, Sivan et al. reported one hiatal hernia with severe esophagitis, and Colman et al. reported four patients with possible hiatal hernias that were not visualized during the VSG itself. This is in contrast to a retrospective analysis that reported hernias in 43% of 885 patients with an average age of 44 years undergoing MBS, 44% of whom required concurrent hernia repair.[8] This discrepancy highlights a major difference between pediatric and adult patients in that hiatal hernias increase with body mass index,[19] but are far more prevalent with increasing age.[20,21] One interpretation of this difference is that performing MBS may be more favorable in a younger age group before a hiatal hernia develops when there is no clear consensus as to how the presence of a large hiatal hernia should affect whether a VSG or RYGB should be performed, or even whether or not an antireflux procedure should be done.[22] However, whether or not a clinically significant proportion of hiatal hernias truly exists in the pediatric population remains to be seen, as these pediatric studies were likely underpowered to capture them.

Regarding symptomatology, Colman et al. found that patients with preoperative gastrointestinal symptoms were five times more likely to have an abnormal EGD; however, they still noted abnormal findings among asymptomatic patients. Notably, Ogle et al. reported two asymptomatic patients with eosinophilic esophagitis and four asymptomatic patients with *H. pylori*. This highlights the principal value of EGD in this context as a screening tool rather than a diagnostic one. Whether the value of routine screening outweighs the procedural risk remains to be seen with further study.

Considering that EGD may have prognostic value with respect to TBWL and may uncover findings that alter medical as well as surgical management, performing this procedure should be routinely considered in all pediatric patients with obesity before MBS, though it should remain fundamentally guided by a thoughtful risk–benefit discussion between patient and physician. Furthermore, finding inflammation such as gastritis which can worsen reflux esophagitis by nature, and treating it before VSG may plausibly protect from complications such as Barrett's esophagus seen later in adulthood. Given that histologic findings appear to have a minimal impact on the immediate surgical plan, the surgeon may consider a model that consolidates routine preoperative EGD into the same anesthesia event as the MBS itself, as was done by Ogle et al., to reduce the cumulative burden of sedation on the patient. These considerations arise from our interpretation of the limited pediatric literature; further pediatric studies on this topic are needed before stronger recommendations can be made.

There were several limitations of our study. First, the combined sample from all four studies was too small for a meaningful statistical analysis to be performed. Second, when selecting studies from initial search results, there were studies that included pediatric patients but were primarily conducted on adult patients. These studies did not stratify results to isolate the younger age group, and thus information from these studies could not be included in the present study. Third, the included studies were performed in regions that differ greatly from each other, which may suggest subtle confounders that may account for some of the differences in their conclusions; for example, Sivan et al. performed their study in Israel, which has a higher prevalence of *H. pylori* than in the United States where the other studies were performed,[23] which would increase the relative yield of their preoperative EGDs. Lastly, only Lewit et al. reported on long-term outcomes (TBWL at 12 months postoperatively), and only Colman et al. and Ogle et al. reported preprocedural symptoms; these factors are important to consider when determining the utility of routine preoperative EGD as a screening/prognostic tool and are therefore areas worthy of future study.

In conclusion, the present study summarizes the available literature on preoperative EGD and its effect on the medical management and postoperative outcomes of pediatric patients with obesity undergoing MBS. There is a paucity of data examining the utility of routine EGD before bariatric surgery specifically in pediatric patients, and more studies are therefore needed before clear guidelines can be created for this distinct patient population.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

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