Communication from the ASGE Standards of Practice Committee

GUIDELINE

ASGE American Society for Gastrointestinal Endoscopy

ASGE guideline on the role of endoscopy in the management of benign and malignant gastroduodenal obstruction

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This document was reviewed and approved by the Governing Board of the American Society for Gastrointestinal Endoscopy.

This American Society for Gastrointestinal Endoscopy guideline provides evidence-based recommendations for the endoscopic management of gastric outlet obstruction (GOO). We applied the Grading of Recommendations, Assessment, Development and Evaluation methodology to address key clinical questions. These include the comparison of (1) surgical gastrojejunostomy to the placement of self-expandable metallic stents (SEMS) for malignant GOO, (2) covered versus uncovered SEMS for malignant GOO, and (3) endoscopic and surgical interventions for the management of benign GOO. Recommendations provided in this document were founded on the certainty of the evidence, balance of benefits and harms, considerations of patient and caregiver preferences, resource utilization, and cost-effectiveness. (Gastrointest Endosc 2021;93:309-22.)

The clinical syndrome of gastric outlet obstruction (GOO) occurs as a result of a narrowing in the region of the gastroduodenum resulting in failed or delayed passage of gastric contents from stomach to jejunum. GOO typically presents with early satiety, weight loss, nausea, vomiting, and abdominal pain. Etiologies of GOO include both malignant and benign processes. Historically, peptic ulcer disease (PUD) was the most common cause of GOO. The development and use of acid-suppressing medication and the diagnosis and treatment of *Helicobacter pylori* has decreased the incidence of PUD, and thus malignancy is now the leading cause of GOO.[1-4]

The most common malignant causes of GOO are pancreatic, gastric, and duodenal cancer (Table 1). The worldwide incidence and mortality of gastric cancer is higher than pancreatic cancer.[5] In the United States, however, pancreatic and gastric cancers are the 11th and 16th most common newly presenting cancers. Pancreatic cancer has a high mortality rate and is the third leading cause of cancer death in the United States.[6,7] GOO occurs in approximately 20% of cases of advanced pancreatic cancer, and it is estimated that more than 11,000 pancreatic cancer patients were diagnosed with GOO in 2019.[8-10] The most common benign etiology of GOO is PUD from either nonsteroidal anti-inflammatory drugs (NSAIDs) or *H pylori* infection. Other inflammatory, infectious, and iatrogenic causes of benign GOO are highlighted in Table 1.

AIMS AND SCOPE

The aim of this document is to provide evidence-based recommendations for the endoscopic management of GOO. The committee formulated clinical questions central to the endoscopic management of GOO, comparing clinical outcomes and adverse events with different treatment

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TABLE 1. Etiology of gastric outlet obstruction

Causes of benign gastric outlet obstruction	Causes of malignant gastric outlet obstruction
Peptic ulcer disease	Pancreatic cancer
Nonsteroidal anti-inflammatory drug–induced strictures	Gastric cancer
Caustic ingestions	Duodenal cancer
Chronic pancreatitis	Gastric carcinoids
Pseudocysts	Small intestine carcinoids
Walled-off pancreatic necrosis	Pancreas neuroendocrine tumors
GI polyps	Lymphoma
Lipomas	Sarcomas
Surgical anastomotic strictures	GI stromal tumors
Foreign bodies	Ampulla of Vater cancer
Radiation-induced strictures	Metastatic cancer
Eosinophilic enteritis	Cholangiocarcinoma
Tuberculosis	Gallbladder cancer

options. This document addresses the following clinical questions:

1. In patients with incurable malignant GOO undergoing a palliative intervention, what is the role of gastric and/or duodenal self-expandable metal stent (SEMS) placement compared with surgical gastrojejunostomy (GJ)?
2. In patients with incurable malignant GOO undergoing palliative endoscopic stent placement, what is the role of covered SEMS placement compared with uncovered SEMS placement?
3. In patients with benign GOO, what is the role of endoscopic management (balloon dilation and/or covered SEMS placement) compared with surgical GJ?

The panel also summarized the diagnosis and management considerations pertinent to mechanical GOO in the pediatric population.

METHODS

Overview

This guideline was conceptualized and created using the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) framework,[11,12] beginning with formulation of clinical questions in the Population, Intervention, Comparison, and Outcome (PICO) format. For each PICO question, several outcomes were included and ranked according to their importance. Systematic reviews (SRs) of the available literature were performed for each clinical question. The quality or certainty in the evidence and strengths of recommendations were based on the GRADE framework.[11] When existing SRs were identified, they were used to inform the guideline, when appropriate. If no existing SRs were found, a new SR and meta-analysis (MA) was conducted, when possible, with the assistance of an expert librarian, and evidence profiles were then created with the guidance of a GRADE methodologist. Evidence profiles were presented to a multidisciplinary GRADE panel and members of the American Society for Gastrointestinal Endoscopy (ASGE) Standards of Practice committee. This document was approved by the ASGE Governing Board in May 2020.

Panel composition and conflict of interest management

The panel consisted of content experts (T.J., A.S.), a GRADE methodologist (B.Q.), a patient representative (D.B.), a GI oncologist (A.M.), a GI oncologic surgeon (M.T.), and members of the Standards of Practice committee. All panel members were required to disclose potential financial and intellectual conflicts of interest, which were addressed according to ASGE policies (https://www.asge.org/forms/conflict-of-interest-disclosure and https://www.asge.org/docs/default-source/about-asge/mission-and-governance/asge-conflict-of-interest-and-disclosure-policy.pdf). The panel meeting took place in Chicago on March 6, 2020.

Formulation of clinical questions

Three clinical questions were developed by the authors of the document and members of the ASGE Standards of Practice committee using the PICO format and approved by the ASGE Governing Board. For all clinical questions, potentially relevant patient-centered outcomes were identified and rated from not important to critical through a consensus process. Relevant clinical outcomes included tolerance of an oral diet, reintervention rate, duration of patency (reintervention-free period), major adverse event rate, SEMS migration rate, time to oral intake, and length of hospital stay. A list of the PICO questions is detailed in Table 2.

Literature search and study selection criteria

For each PICO question, a literature search for existing SRs and MAs was performed. Details of the search strategies are reported in Appendix 1 (available online at www.giejournal.org). An expert medical librarian (K.K.) performed all searches. Citations were imported into EndNote (Thompson Reuters, Philadelphia, Pa, USA), and duplicates were removed. The EndNote library was uploaded into Covidence (www.covidence.org), and 2 independent reviewers were assigned to each search. Each study was reviewed based on the title and abstract using explicit criteria for inclusion or exclusion in the GRADE analysis. As necessary, full texts were then reviewed and differences resolved by consensus. If existing SRs and MAs were available, inclusion and exclusion criteria were reviewed, and methodologic quality of the study was assessed using the AMSTAR 2 checklist (A MeaSurement Tool to Assess systematic Reviews; https://amstar.ca/

TABLE 2. Clinical questions addressed in the document using the Population, Intervention, Comparator, and Outcome (Population, Intervention, Comparator, and Outcomes) format

Population	Intervention	Comparator	Outcomes	Rating
1. Patients with incurable malignant GOO requiring palliation	Endoscopically placed SEMS	Surgical gastrojejunostomy	1. Survival	Critical
			2. Postoperative mortality	Critical
			3. Re-establishment of oral intake	Critical
			4. Time to oral intake re-establishment	Critical
			5. Length of hospital stay	Critical
			6. Patency	Critical
			7. Reintervention rate	Critical
			8. Adverse events	Critical
			9. Type of diet	Important
2. Patients with incurable malignant GOO requiring palliation by endoscopically placed SEMS	Covered SEMS	Uncovered SEMS	1. Tolerance of oral diet	Critical
			2. Occlusion rate	Critical
			3. Migration rate	Critical
			4. Reintervention rate	Critical
			5. Adverse events	Critical
3. Patients with benign GOO undergoing intervention	Endoscopic management (balloon dilation, covered SEMS)	Surgery	1. Tolerance of oral diet	Critical
			2. Major adverse events	Critical
			3. Reintervention rate	Critical

GOO, Gastric outlet obstruction; *SEMS*, self-expandable metal stent.

Amstar_Checklist.php).[13] Only SRs and MAs meeting the quality thresholds were used for data synthesis. When applicable, available SRs and MAs were updated based on literature review as described above.

If no existing SR or MA was identified, a full SR and MA (when possible) was conducted using the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-analyses criteria.[14] A medical librarian performed a comprehensive literature search of Ovid Medline (Ovid MEDLINE in-process and other nonindexed citations, Ovid MEDLINE Daily, and Ovid MEDLINE 1946 to September 2018), Embase (via Embase.com 1947 to September 2018), and the Cochrane Database of Systematic Reviews/Cochrane Register of controlled trials (via Wiley Online Library). The searches were limited to human studies published in English and cited through December 2019. Citations were imported into EndNote (Thompson Reuters), and duplicates were removed. The EndNote library was then uploaded into Covidence. Two reviewers (T.J., A.S.) were assigned to each search for each PICO question. Studies were first screened by title and abstract and then by full text, and all conflicts were resolved by consensus. Abstracts and studies with fewer than 10 patients were excluded during screening.

Data extraction and statistical analysis

When necessary, data extraction was accomplished by using Microsoft Excel (Microsoft Corporation, Redmond, Wash, USA). The outcomes varied by PICO question as described below. I^2 statistics were used to assess heterogeneity, and funnel plots were used to assess for publication bias.

Certainty in evidence (quality of evidence)

The certainty of the evidence was determined using the GRADE framework. The GRADE approach to rating the quality or certainty of evidence begins with the study design (randomized controlled trials [RCTs] or observational studies) and then reviews 5 parameters that may reduce quality rating (methodologic limitations, inconsistency, indirectness, imprecision, and publication bias) and 3 parameters that may elevate the rating (large effect, dose–response gradient, plausible confounding). The final quality of evidence scores range from very low to high (Table 3). Guideline developers then formulate the recommendations (guidance statements) and consider the direction (for or against) and grade the strength (strong or weak) of the recommendations based on the criteria outlined in the GRADE approach. Our GRADE evidence profiles, developed using GDTpro application (http://gdt.guidelinedevelopment.org/app), contain detailed information about the quality of evidence assessment and the summary of findings for each of the included outcomes.

Considerations in the development of recommendations

The main factors driving our recommendations included balance between benefits and harms while accounting for the best estimates of the magnitude of effects

TABLE 3. System for rating the quality of evidence

Quality of evidence	Definition	Interpretation
High	We are very confident that the true effect lies close to that of the estimate of effect.	Future research is very unlikely to change our confidence in the estimate of the effect.
Moderate	We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of effect, but there is a possibility that it is substantially different.	Further research is likely to have an impact on our confidence in the estimate of the effect and may change the estimate.
Low	Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of effect.	Further research is very likely to have an impact on our confidence in the estimate of the effect and is likely to change the estimate.
Very low	We have very little confidence in the estimate of the effect: The true effect is likely to be substantially different from the estimate of effect.	Any estimate of the effect is very uncertain.

Adapted from Guyatt et al.[11]

and importance of outcomes, overall quality of evidence, confidence in values and preferences and their variability, and cost/resource implications. The final wording of the recommendations (including direction and strength), remarks, and qualifications were decided by consensus and were approved by all members of the panel. According to the GRADE approach, the recommendations are either "strong" or "conditional" (Table 4). The words "the guideline panel recommends" are used for strong recommendations and "suggests" for conditional recommendations.[15]

RESULTS

Question 1: In patients with incurable malignant GOO undergoing a palliative intervention, what is the role of gastric and/or duodenal SEMS placement compared with surgical GJ?

Recommendation: In patients with incurable malignant GOO undergoing palliative intervention, we suggest either SEMS placement or surgical GJ. The selected approach should be based on patient characteristics, preferences, multidisciplinary input, and local expertise. (Conditional recommendation, low quality of evidence)

Comment: Based on shared decision-making, in patients who are poor surgical candidates with short life expectancy (<6 months) and those who place a high value on resumption of oral diet and being discharged early, we suggest SEMS placement compared with surgical GJ. In patients with a life expectancy of >6 months and good performance status, we suggest surgical GJ compared with SEMS placement.

Summary of the evidence

Our literature search identified 9 SRs,[16-24] of which 3 were rated as moderate quality based on AMSTAR 2 criteria.[20,21,23] Two reviews[20,23] exclusively included the 3 published RCTs comparing surgical GJ with SEMS placement for malignant GOO.[25-27] Of the 3 included RCTs with a total of 84 patients, 2 were single-center trials[25,27] and 1 was a multicenter trial.[26] The panel decided to use 2 SRs[21,23] to guide this PICO question. The study by Upchurch et al[23] is a Cochrane Library SR and MA that included outcomes aligned with our outcomes of interest, as decided a priori. The second SR and MA, by Mintziras et al,[21] included 24 retrospective, comparative studies in addition to the 3 RCTs, for a total of 2354 patients. The Risk Of Bias In Non-randomized Studies of Interventions tool[28] for assessing risk of bias was used in this study (Table 5).

For the outcome of survival, only 1 RCT provided comparative data, which was reported as median number of days for SEMS placement versus surgical GJ.[26] There was no statistically significant difference in survival between SEMS versus surgical GJ (mean difference [MD], 22 days shorter; 95% confidence interval [CI], 53.45 shorter to 9.45 days more). However, review of 9 observational studies reported a survival benefit with surgical GJ (MD, 42.85 days; 95% CI, 12-73.7).[21] The outcome of in-hospital mortality was reported in 1 of 3 RCTs, which reported no difference between the 2 groups (risk ratio [RR], 0.72; 95% CI, 0.14-3.64).[27] Similarly, the SR by Mintziras et al[21] reviewed 15 studies and reported no difference in procedure-related mortality (odds ratio, 0.55; 95% CI, 0.27-1.16).

For the outcome of re-establishment of oral intake, there was no difference between SEMS placement and surgical GJ (RR, 0.98; 95% CI, 0.88-1.09).[23] However, the time to resumption of oral intake was sooner in those undergoing SEMS placement compared with surgery based on 2 RCTs (MD, 3.07 fewer days; 95% CI, 4.76-1.39).[25,26] Similarly, 11 observational studies that included 826 patients demonstrated that patients who underwent endoscopic SEMS placement resumed oral intake nearly 5 days earlier than those who had surgical GJ (MD, 4.9 days fewer; 95% CI, 6.75-3.05).[21]

The 3 RCTs showed a significantly shorter hospital length of stay with SEMS placement versus surgical GJ (MD, 6.7 days shorter; 95% CI, 9.41-3.98). Similar results were noted

TABLE 4. Interpretation of definitions of strength of recommendation using Grading of Recommendations, Assessment, Development and Evaluation framework

Implications for	Strong recommendation	Conditional recommendation
Patients	Most individuals in this situation would want the recommended course of action, and only a small proportion would not.	Most individuals in this situation would want the suggested course of action, but many would not.
Clinicians	Most individuals should receive the intervention. Formal decision aids are not likely to be needed to help individual patients make decisions consistent with their values and preferences.	Recognize that different choices will be appropriate for individual patients and that you must help each patient arrive at a management decision consistent with his or her values and preferences. Decision aids may be useful in helping individuals to make decisions consistent with their values and preferences.
Policymakers	The recommendation can be adopted as policy in most situations. Compliance with this recommendation according to the guideline could be used as a quality criterion or performance indicator.	Policymaking will require substantial debate and involvement of various stakeholders.

Adapted from Andrews et al.[15]

when observational studies were included (MD, 9.75 days shorter; 95% CI, 11.6-7.9 days).[21] When assessing duration of patency, defined as time to recurrence of obstructive symptoms, there was no statistically significant difference between the 2 groups (RR, 5.08; 95% CI, 0.96-26.74).[25,26] However, reintervention rates were higher in SEMS placement versus surgical GJ (odds ratio, 2.95; 95% CI, 1.70-5.14) based on 14 observational studies and 1 RCT.[21] Based on 3 RCTs, there was no significant difference in serious adverse events (Clavien-Dindo classification grade III and above)[29] between the 2 groups for SEMS placement versus surgical GJ (RR, 1.15; 95% CI, 0.33-3.98).[23] Similar results were noted in an analysis that included observational studies (RR, 0.73; 95% CI, 0.50-1.06).[21] The risk of adverse events requiring need for intervention (including endoscopy) was significantly higher with SEMS placement compared with the surgical GJ group (RR, 4.71; 95% CI, 1.36-16.3).[23]

Regarding diet, 2 of 3 RCTS reported pre- and postintervention scores on the Gastric Outlet Obstruction Scoring System (GOOSS). Fiori et al[25] reported that 8 of 9 patients were able to tolerate a soft diet 2 days after SEMS placement and a regular diet 3 days afterward. In comparison, 6 of 9 surgical patients tolerated a soft diet on the sixth postoperative day and a regular diet on the seventh postoperative day. Jeurnink et al[26] reported outcomes as either a GOOSS score $\geq$2 (soft solids to regular diet) or not for both groups. Seven retrospective comparative studies included GOOSS scores, but our review of outcomes did not show a significant difference in type of oral diet tolerated for SEMS placement versus surgery.[30-36]

Certainty in the evidence

The overall certainty for all outcomes results reported by the RCTs was moderate. These outcomes included survival, postoperative mortality, re-establishment of oral intake, time to oral intake resumption, length of hospital stay, patency, reintervention rate, serious adverse events, and serious adverse events with need for reintervention. We downgraded for imprecision because of the small number of events in the outcomes. The overall certainty of the observational review[21] was very low; downgraded for risk of bias and inconsistency as detailed in Table 5.

Considerations

Our literature search did not identify studies citing patient preferences for SEMS placement versus surgical GJ before palliation of unresectable malignant GOO. Patient surveys of quality of life and satisfaction were performed after intervention in each of the 3 RCTs, 2 of which showed no difference in patient satisfaction after SEMS placement versus surgical GJ.[25,26] Mehta et al[27] reported no significant decrease in pain or mental health score 1 month after either intervention; however, there was a significant improvement in the mean physical health score (as measured by the 36-item Short-Form Health Survey)[37] 1 month after SEMS placement compared with after surgery. Models reviewing prognostic factors for survival and performance scores suggest that SEMS placement was preferred over surgical GJ in those with shorter life expectancies.[34,38,39]

The panel considered the evidence on cost-effectiveness comparing the 2 treatment options. Most studies compared initial interventional costs but did not account for total costs after long-term follow-up. Initial costs for SEMS placement were less than for surgical GJ, primarily because of shorter initial hospital length of stay. A decision analysis model comparing cost-effectiveness of enteral SEMS versus surgical GJ concluded that endoscopic stent placement ($8213) was less costly than open ($12,191) and laparoscopic GJ ($10,340) over a 1-month period of follow-up.[40] The success rate and mortality rates used with the model favored SEMS placement over surgery. A retrospective review of a claims database for employer-provided insurance and Medicare supplemental insurance

TABLE 5. Evidence profile for SEMS versus surgical GJ for palliation of incurable malignant GOO

Certainty assessment							No. of patients		Effect			
No. of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	SEMS	Surgical GJ	Relative (95% CI)	Absolute (95% CI)	Certainty	Importance
Survival												
1	Randomized trial [Jeurnick]	Not serious	Not serious	Not serious	Serious*	None	21	18	-	MD **22 days lower** (53.45 lower to 9.45 higher)	⊕⊕⊕◯ MODERATE	CRITICAL
Survival												
9	Observational studies	Serious†	Serious‡	Not serious	Not serious	None	297	216	-	MD **42.85 days fewer** (73.7 fewer to 12 fewer)	⊕◯◯◯ VERY LOW	CRITICAL
Postoperative mortality												
1	Randomized trial [Mehta]	Not serious	Not serious	Not serious	Serious*	None	2/13 (15.4%)	3/14 (21.4%)	**RR 0.72** (0.14 to 3.64)	**50 fewer per 1,000** (from 178 fewer to 284 more)	⊕⊕⊕◯ MODERATE	CRITICAL
Postoperative mortality												
15	14 Observational studies 1 Randomized trial [Mehta]	Serious†	Not serious	Not serious	Not serious	None	27/443 (6.1%)	44/515 (8.5%)	**OR 0.55** (0.27 to 1.16)	**37 fewer per 1,000** (from 61 fewer to 12 more)	⊕◯◯◯ VERY LOW	CRITICAL
Re-establishment of oral intake												
3	Randomized trials [Fiori, Mehta,Jeurnick]	Not serious	Not serious	Not serious	Serious*	None	39/42 (92.9%)	39/40 (97.5%)	**RR 0.98** (0.88 to 1.09)	**20 fewer per 1,000** (from 117 fewer to 88 more)	⊕⊕⊕◯ MODERATE	CRITICAL
Time to oral intake resumption												
2	Randomized trials [Fiori, Jeurnick]	Not serious	Not serious	Not serious	Serious*	None	30	27	-	MD **3.07 days fewer** (4.76 fewer to 1.39 fewer)	⊕⊕⊕◯ MODERATE	CRITICAL
Time to oral intake resumption												
11	Observational studies	Serious†	Serious‡	Not serious	Not serious	None	544	282	-	MD **4.9 days fewer** (6.75 fewer to 3.05 fewer)	⊕◯◯◯ VERY LOW	CRITICAL
Length of hospital stay												
3	Randomized trials [Fiori, Jeurnick, Mehta]	Not serious	Not serious	Not serious	Serious*	None	41	43	-	MD **6.7 days fewer** (9.41 fewer to 3.98 fewer)	⊕⊕⊕◯ MODERATE	CRITICAL
Length of hospital stay												
20	19 Observational studies 1 Randomized trial [Mehta]	Serious†	Serious‡	Not serious	Not serious	None	882	689	-	MD **9.75 days fewer** (11.6 fewer to 7.9 fewer)	⊕◯◯◯ VERY LOW	CRITICAL
Patency												
2	Randomized trials [Fiori, Jeurnick]	Not serious	Not serious	Not serious	Serious*	None	8/30 (26.7%)	1/27 (3.7%)	**RR 5.08** (0.96 to 26.74)	**151 more per 1,000** (from 1 fewer to 953 more)	⊕⊕⊕◯ MODERATE	CRITICAL

(*continued on the next page*)

TABLE 5. Continued

Certainty assessment							No. of patients		Effect			
No. of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	SEMS	Surgical GJ	Relative (95% CI)	Absolute (95% CI)	Certainty	Importance
Reintervention rate												
15	14 Observational studies 1 Randomized trial [Jeurnick]	Serious†	Serious‡	Not serious	Not serious	None	250/955 (26.2%)	84/749 (11.2%)	**OR 2.95** (1.70 to 5.14)	**159 more per 1,000** (from 65 more to 282 more)	⊕◯◯◯ VERY LOW	CRITICAL
Adverse events, serious (Major complications)												
3	Randomized trials	Not serious	Not serious	Not serious	Serious*	None	6/43 (14.0%)	4/41 (9.8%)	**RR 1.15** (0.33 to 3.98)	**15 more per 1,000** (from 65 fewer to 291 more)	⊕⊕⊕◯ MODERATE	CRITICAL
Adverse events, serious (Major complications)												
21	19 Observational studies 2 Randomized trials [Fiori, Jeurnink]	Serious†	Not serious	Not serious	Not serious	None	120/1099 (10.9%)	113/902 (12.5%)	**OR 0.73** (0.50 to 1.06)	**31 fewer per 1,000** (from 58 fewer to 7 more)	⊕◯◯◯ VERY LOW	CRITICAL
Adverse events, serious (Major complications): with need for reintervention												
3	Randomized trials	Not serious	Not serious	Not serious	Serious*	None	13/43 (30.2%)	2/41 (4.9%)	**RR 4.71** (1.36 to 16.30)	**181 more per 1,000** (from 18 more to 746 more)	⊕⊕⊕◯ MODERATE	CRITICAL

CI, Confidence interval; *MD*, mean difference; *OR*, odds ratio; *RR*, risk ratio.
*small number of events
†Bias due to confounding and selection of participants
‡high I squared

plans identified patients who received palliative care for malignant GOO from 2012 to 2015.[41] The median 90-day cost of SEMS placement and associated readmissions was $18,500 (range, $4100-$49,500) compared with $37,200 (range, $12,200-$67,800) for surgery. In the only cost analysis conducted together with an RCT, initial costs were higher for surgical GJ ($9782) than for SEMS placement ($5035) because of the costs associated with longer hospital stay.[42] Comparison of follow-up costs found no significant difference between the 2 groups. However, long-term relief of obstruction was better with surgical GJ, with more patients requiring repeat interventions for obstructive symptoms after SEMS placement. This study suggested that surgical GJ might be beneficial over SEMS placement for patients with life expectancy of ≥2 months, with a calculated incremental cost-effectiveness ratio of $192 per day with a GOOSS score ≥2 (soft solids to regular diet) adjusted for survival.

Discussion

The panel reviewed and discussed the quality of evidence and weighed the benefits and potential harms. It should be highlighted that this clinical question only addresses the application of SEMS compared with surgical GJ in the palliation of unresectable cancer and not as a bridge to surgery. With regard to the outcomes assessed, there was no difference in success rates, major adverse event rates, and postoperative mortality between the 2 interventions. Clinically meaningful differences of shorter time to resumption of oral intake and shorter length of hospital stay were reported with SEMS. These outcomes may be helpful in discussion with patients and other healthcare providers when both surgical GJ and SEMS placement are available options. In addition, shorter time to resumption of oral intake and shorter recovery time with SEMS placement may decrease the time interval before palliative chemotherapy can be administered,[43,44] because maturation of the surgical GJ typically requires several days. This clinical question was not designed to compare outcomes between laparoscopic and open surgical GJ.

It should be noted that reintervention rates for SEMS placement were significantly higher than for surgical GJ. The panel therefore agreed that although stent placement may offer a short-term advantage, patients whose performance status is good and whose life expectancy is longer than 6 months may benefit more from surgical GJ than SEMS placement. Because of the complexity of this

decision-making, the panel recommended that multidisciplinary evaluation of a patient's performance status, projected clinical course, and preferences should guide the decision to palliate by SEMS placement versus surgical GJ. The practice of performing surgical GJ in those with longer life expectancy has not been validated. However, it is a common clinical approach and may be a source of bias in observational studies that report longer survival times in patients undergoing surgical GJ compared with SEMS placement.[21] Similarly, a recent, large, comparative, retrospective, single-center study reported longer survival with surgical GJ than SEMS placement, with poor performance status, ascites, and low albumin being predictors of failure.[45] However, comparison of the 2 groups suggested that patients who underwent surgery had higher albumin and performance status, and like other retrospective studies, selection bias may have affected the outcome favoring surgery.

Although it was not included in the initial PICO question, the panel acknowledged the evolving role of EUS-guided gastroenterostomy (EUS-GE) for the management of malignant GOO. EUS-GE is a relatively new technique that is increasingly used as a therapeutic option for palliation of malignant GOO at high-volume tertiary care centers. EUS is used to identify and access the duodenum or jejunum beyond the area of obstruction from within the stomach, and placement of a lumen-apposing metal stent (LAMS) is performed to create a GE.[46] At the time of drafting this guideline document, the application of LAMS for this purpose was considered an off-label use.

A SR and MA of 5 studies with 199 patients who underwent EUS-GE for both benign and malignant GOO reported a technical success rate of 92.6% (95% CI, 88.26-95.79; I^2 = 0%); serious adverse event rate of 5.61% (95% CI, 2.87-10.67; I^2 = 1.67%), including occurrences of stent maldeployment, peritonitis, surgical intervention, and hemoperitoneum; and reintervention rate of 11.43% (95% CI, 7.29%-17.46%; I^2 = 17.38%).[47] A single-center, retrospective study comparing EUS-GE (n = 22) with endoscopic gastroduodenal SEMs (n = 78) for palliation of malignant GOO reported 100% technical success in both groups and similar length of hospital stay but a higher reintervention rate in the SEMS group (32% vs 8.3%, P = 0.021).[48] Follow-up times for both groups were limited because the authors elected to perform empiric exchange of the LAMS for those patients still alive at 6 months. Another retrospective study comparing EUS-GE performed at multiple centers with SEMS placement at 1 center for malignant GOO found similar results.[49] A retrospective study compared EUS-GE (n = 93) with surgical GJ (n = 63) for palliation of malignant GOO[50] and found the technical success rate of surgical GJ was superior (100% vs 87%, P = 0.009) with no difference in length of hospital stay, serious adverse event rates, rates of recurrent GOO, and mean time to reintervention between the 2 groups.

Relative contraindications to EUS-GE include involvement of the intended transgastric access site with tumor or blood vessels including perigastric varices, large volume ascites, peritoneal carcinomatosis, and bowel obstruction distal to the intended site of GE placement. Prospective RCTs are needed to compare EUS-GE with both surgical GJ and endoscopic SEMS placement.

Question 2: In patients with incurable malignant GOO undergoing palliative endoscopic stent placement, what is the role of covered SEMS placement as compared with uncovered SEMS placement?

Recommendation: In patients with incurable malignant GOO undergoing palliative endoscopic stent placement, there is insufficient evidence to preferentially recommend covered over uncovered SEMS. The final decision should be based on regional stent availability, patient characteristics, and patient preferences. (Conditional recommendation, moderate quality of evidence)

Summary of the evidence

Our literature search identified 4 SRs of which 3 were rated as critically low in quality based on AMSTAR 2 criteria.[20,51-53] The SR with MA conducted by Minata et al[20] was moderate in quality and included 5 RCTs comparing covered with uncovered SEMS. One study was single center,[54] 1 was conducted at 2 centers,[55] and the remaining were multicenter studies.[56-58] Three of the 5 studies only included patients with gastric cancer,[54,56,58] accounting for 247 of 443 cases (55.8%). All 5 studies were conducted in East Asian countries, because covered enteral stents for gastroduodenal obstruction are not available for clinical use in the United States. The evidence profile for this PICO is summarized in Table 6.

Based on 5 RCTs, there was no difference in successful resumption of an oral diet between covered (204/221; 92.3%) and uncovered (201/222; 90.5%) SEMS (risk difference [RD], 0.02; 95% CI, –0.03 to 0.07). However, the RCTs also showed that SEMS occlusion occurred at a significantly lower rate with covered (9/221; 4.1%) compared with uncovered (56/222; 25.2%) SEMS (RD, –0.21; 95% CI, –0.27 to –0.15). This means that the rate of occlusion in covered SEMS was far lower than for uncovered SEMS. In contrast, SEMS migration occurred at a significantly higher rate with covered (26/221; 11.8%) compared with uncovered (6/222; 2.7%) SEMS (RD, 0.09; 95% CI, 0.04 to 0.14).

Reintervention rates were recorded in only 3 studies,[56-58] and no difference was reported between the 2 groups (covered, 26/150 [17.3%]; uncovered, 30/151 [19.9%]; RD, -0.03; 95% CI, –0.11 to 0.06). Covered SEMS had an adverse event rate of 22.3% (42/188) and uncovered SEMS a rate of 30.5% (58/190), with an RD of –0.08 (95% CI, –0.17 to 0.0). One study reported a disproportionately high adverse event rate in the covered SEMS

TABLE 6. Evidence profile for covered versus uncovered SEMS for palliation of incurable malignant GOO

Certainty assessment						No. of patients		Effect			
No. of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Covered SEMS	Uncovered SEMS	Relative (95% CI)	Certainty	Importance
Tolerance of oral diet											
5	Randomized trials	Not serious	Not serious	Not serious	Serious*	None	204/221 (92.3%)	201/222 (90.5%)	**RD 0.02** (-0.03 to 0.07)	⊕⊕⊕◯ MODERATE	CRITICAL
SEMS occlusion											
5	Randomized trials	Not serious	Not serious	Not serious	Serious*	None	9/221 (4.1%)	56/222 (25.2%)	**RD -0.21** (-0.27 to -0.15)	⊕⊕⊕◯ MODERATE	CRITICAL
SEMS migration											
5	Randomized trials	Not serious	Not serious	Not serious	Serious*	None	26/221 (11.8%)	6/222 (2.7%)	**RD 0.09** (0.04 to 0.14)	⊕⊕⊕◯ MODERATE	CRITICAL
Reintervention rate											
3	Randomized trials	Not serious	Not serious	Not serious	Serious*	None	26/150 (17.3%)	30/151 (19.9%)	**RD -0.03** (-0.11 to 0.06)	⊕⊕⊕◯ MODERATE	CRITICAL
Adverse events											
5	Randomized trials	Not serious	Not serious	Not serious	Serious*	None	42/188 (22.3%)	58/190 (30.5%)	**RD -0.08** (-0.17 to 0.00)	⊕⊕⊕◯ MODERATE	CRITICAL

CI, Confidence interval
*small number of events

group of 85% (28/33) versus 34% (11/32) for uncovered SEMS.[58] Abdominal pain accounted for most events (13 covered vs 1 uncovered), followed by bleeding (11 covered vs 2 uncovered). In this study, the covered SEMS were tailored with a large funnel-shaped antimigration flange on the proximal (upstream) ends—which the uncovered SEMS did not feature. Whether this stent design contributed to the higher rate of abdominal pain or bleeding is unclear. The other 4 studies in the analysis compared similarly shaped SEMS. Because of its outlying results, the study with the uniquely tailored covered stents[58] was not included in the adverse event rate comparisons. After exclusion, no statistically significant difference in adverse event rates was noted between covered versus uncovered SEMS.

Certainty in the evidence

The overall certainty for all outcomes results reported by these RCTs was moderate. We downgraded for imprecision because of the small number of events. Although a risk of bias may occur with the inability to blind the study team to the type of SEMS placed, we decided not to downgrade on that basis because the studies had no major methodologic issues. Another potential source of bias was that 3 RCTs only included patients with gastric cancer, and 1 study had over 80%[57] affected by gastric cancer. Therefore, the application of these data to other etiologies of malignant GOO is unclear. In addition, although the adverse event rates were not significantly different between covered and uncovered SEMS, the severity of adverse events was not accounted for in the MA.

Considerations

Available literature demonstrates that both covered and uncovered SEMS had similar success and adverse event rates, with the primary differences in performance being occlusion of uncovered SEMS and migration of covered SEMS. In addition, the panel decided to compare severe adverse event rates between the 2 groups. The selected SR and MA that only included RCTs did not report a significant difference in rates of perforation (covered, 2/221 [0.9%]; uncovered, 0/222 [0%]; RD, 0.01; 95% CI, –0.01 to 0.03).[20] To assess the differences in adverse events, we performed a new SR that included the 5 RCTs and 8 additional observational studies[59-66] with a total of 709 patients who underwent covered and 874 uncovered SEMS placement (Supplementary Table 1, available online at www.giejournal.org). All studies were conducted in East Asia, and most patients underwent SEMS placement for palliation of unresectable gastric cancer, with unresectable pancreatic cancer the second most common malignancy treated. Bleeding rates were no different between uncovered and covered SEMS when excluding for the study with the outlier funnel-shaped covered SEMS.[58] Similarly, there was no difference in rate of pancreatitis: 4 episodes of pancreatitis occurred, with 2 events in each group (covered, 2/155 [1.3%]; uncovered, 2/157 [1.3%]). However, only 2 studies evaluated for pancreatitis as an outcome.[60,64] Only 1 study evaluated for cholangitis as an adverse event, with only 2 events, 1 in each group (covered, 1/126 [0.8%]; uncovered, 1/126 [0.8%]).[60] Although perforations occurred at a higher rate with covered SEMS (10/448, 2.2%) than with uncovered SEMS

(3/496, 0.6%), the studies did not detail whether the perforations occurred in the setting of migration.

No studies comparing costs between covered versus uncovered SEMS were identified. A covered enteral stent designed (and U.S. Food and Drug Administration approved) for palliation of malignant GOO is not available in the United States at this time; thus, all known comparative studies were conducted in East Asia.

Discussion

No difference in technical and clinical success, reintervention rates, or adverse event rates between covered versus uncovered SEMS are evident, but whether there is a significant difference in severe adverse events remains unclear based on our SR of available literature—a critical outcome for this PICO question. Occlusion, which occurred more often in uncovered SEMS, may not be as difficult to address endoscopically, because endoscopic ablation and placement of another SEMS within the occluded SEMS has been described.[67] Conversely, migration, which occurred more often with covered SEMS, may be more difficult to treat and may carry a higher risk for perforation.[68] Repositioning or removing migrated SEMS has been described, with placement of a new SEMS when repositioning fails.[69] The role of anchoring of covered duodenal SEMS by clips or endoscopic suturing to prevent migration has yet to be of proven benefit.[70,71] Another limitation for the reported outcomes was the heterogeneity in the different types of covered and uncovered SEMS included in the SR. These uncertainties in the available literature played a significant role in the panel's decision to not recommend one type of stent over the other. Future large, adequately powered RCTs comparing covered and uncovered SEMS in the United States are needed.

Question 3: In patients with benign GOO, what is the role of endoscopic management compared with surgical management?

Recommendation: There is insufficient evidence to support endoscopic management over surgical management of benign GOO. (Conditional recommendation, low quality of evidence)

Comment: Factors that should be considered in determining appropriate management include the etiology of benign GOO, length of the stricture, response to endoscopic balloon dilation (EBD), and health and comorbidities of the patients.

Summary of the evidence

Our literature search did not identify comparative studies between endoscopic versus surgical management of benign GOO. Rather, endoscopic management is typically attempted first, with the goal of successfully resolving benign GOO, whereas surgery is reserved for "salvage" therapy if endoscopic interventions prove insufficient or if a severe adverse event after endoscopic therapy occurs that requires surgical intervention (ie, perforation). The approach to surgical interventions for the treatment of benign GOO may vary, depending on etiology of the stricture and available expertise. With the introduction of acid suppression therapy and recognition of *H pylori* as a cause of PUD, surgery for benign GOO is uncommon. In the modern era, surgical pyloroplasty and laparoscopic GJ have been reported as acceptable treatments with low morbidity and mortality.[72-78]

We performed an SR of EBD of benign strictures causing GOO. We identified 14 retrospective studies that included 596 patients.[3,79-91] (Supplementary Table 2, available online at www.giejournal.org). The significant heterogeneity in reported studies precluded pooling of data to achieve an estimate of effect. However, the results suggest that patients with benign GOO because of PUD have a high rate of response to endoscopic management without the need for surgery when inflammatory factors such as smoking and NSAIDs are discontinued and *H pylori* infection is treated. Corrosive strictures and strictures caused by chronic pancreatitis appear to be less responsive to endoscopic therapy. Strictures that require multiple dilations were also less likely to respond to endoscopic therapy.[86]

We also identified 2 studies describing the use of covered SEMS for benign GOO strictures.[92,93] A series from Korea with 22 patients who underwent covered SEMS placement for benign GOO (21/22 from PUD) reported an 81.8% rate of early improvement in GOOSS, which was sustained in 67% of those patients.[92] However, a high rate of SEMS migration was reported (62.5%, n = 15). The use of covered SEMS in the United States for benign disease is off-label. All dedicated enteral stents in the United States are uncovered and should not be used for benign disease because they are not removable. Successful management of short, benign peptic strictures by off-label use of covered LAMS has been described in numerous case series and within SRs of LAMS used for therapy of GI tract strictures.[94-98]

Discussion

Given the significant heterogeneity in surgical and endoscopic management of benign GOO, an indirect comparative analysis between these 2 approaches was not feasible. The panel acknowledges the need to assess for and address factors associated with response rates to EBD (*H pylori* infection, use of NSAIDs, and smoking), as highlighted in Supplementary Table 2. Patients with benign GOO secondary to long strictures (>3 cm), caustic ingestion, and chronic pancreatitis are less likely to respond to EBD. The need for multiple EBD procedures is predictive for treatment failure and need for surgery. Future prospective trials are needed to compare endoscopic and surgical approaches for management of patients with benign GOO. Similarly, comparative studies between EBD versus covered SEMS

(including the placement of LAMS) for benign GOO are required.

CONSIDERATIONS FOR THE PEDIATRIC POPULATION

GOO in pediatric patients is usually from benign etiologies. The most common cause is infantile hypertrophic pyloric stenosis, typically presenting with nonbilious emesis. Standard endoscopy is only used to exclude other diagnoses outside of infancy, and EUS has been used in some cases.[99] Surgery is considered to be the standard management for infantile hypertrophic pyloric stenosis. Beyond infancy, peptic and caustic ulceration are the most common causes of GOO. Anatomic malformations including antral webs and duplication cysts[100] as well as bezoars have been reported, and GOO as a manifestation of malignancy is rare in children. EBD has been used for therapy in pediatric GOO, and there are limited reports of needle-knife incisional therapy and SEMS placement.[101-105]

SUMMARY AND CONCLUSIONS

Mechanical GOO occurs frequently with advanced malignancies and commonly affects those with progressive pancreatic and gastric cancer. SEMS placement and surgical GJ are acceptable treatment options, and multidisciplinary care, patient characteristics and preferences, and available local expertise should guide current treatment. Further investigation of outcomes from covered SEMS and EUS-GE would likely guide future management of malignant GOO. Ideal management of benign GOO remains uncertain, because prior studies focused on endoscopic management to avoid surgery rather than prospective comparison. Retrospective studies suggest higher rates of success with EBD when *H pylori* is treated and when NSAIDs and smoking are stopped and lower success rates with corrosive strictures and strictures requiring multiple dilations.

RECOMMENDATIONS

1. In patients with incurable malignant GOO undergoing palliative intervention, we suggest either SEMS placement or surgical GJ. The selected approach should be based on patient characteristics and preferences, multidisciplinary input, and local expertise. (Conditional recommendation, low quality of evidence)

   Comment: Based on shared decision-making, in patients who are poor surgical candidates with short life expectancy (<6 months) and those who place a high value on resumption of oral diet and being discharged early, we suggest SEMS placement compared with surgical GJ. In patients with a life expectancy of >6 months and good performance status, we suggest surgical GJ compared with SEMS placement.
2. In patients with incurable malignant GOO undergoing palliative endoscopic stent placement there is insufficient evidence to preferentially recommend either covered or uncovered SEMS. The final decision should be based on regional stent availability, patient characteristics, and patient preference. (Conditional recommendation, moderate quality of evidence)
3. There is insufficient evidence to uniformly support either endoscopic or surgical management for mixed varieties of benign GOO. (Conditional recommendation, low quality of evidence)

   Comment: Factors that should be considered in determining appropriate management include etiology of benign GOO, length of stricture, and response to initial EBD.

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Abbreviations: AMSTAR, A MeaSurement Tool to Assess systematic Reviews; ASGE, American Society for Gastrointestinal Endoscopy; CI, confidence interval; EBD, endoscopic balloon dilation; GE, gastroenterostomy; GJ, gastrojejunostomy; GOO, gastric outlet obstruction; GOOSS, Gastric Outlet Obstruction Scoring System; GRADE, Grading of Recommendations, Assessment, Development and Evaluation; LAMS, lumen-apposing metal stent; MD, mean difference; MA, meta-analysis; NSAID, nonsteroidal anti-inflammatory drug; PICO, Population, Intervention, Comparator, and Outcome; PUD, peptic ulcer disease; RCT, randomized controlled trial; RD, risk difference; RR, risk ratio; SEMS, self-expandable metal stent; SR, systematic review.

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SUPPLEMENTARY TABLE 1. Systematic review of covered versus uncovered SEMS adverse events

Reference	Type of study	Covered	Un-covered	Bleeding covered	Bleeding uncovered	Perforation covered	Perforation uncovered	Cholangitis covered	Cholangitis uncovered	Pancreatitis covered	Pancreatitis uncovered
Shi et al, 2014[58]	RCT	33	32	11*	2	0	0	N	N	N	N
Lim et al, 2014[57]	RCT	66	68	0	0	0	0	N	N	N	N
Kim et al, 2010[54]	RCT	40	40	0	0	1	0	N	N	N	N
Maetani et al, 2014[55]	RCT	31	31	0	1	1	0	N	N	N	N
Lee et al, 2015[56]	RCT	51	51	N	N	N	N	N	N	N	N
Hori et al, 2017[60]	Retrospective	126	126	1	0	3	0	1	1	1	1
Jung et al, 2016[61]	Retrospective	93†	120	N	N	N	N	N	N	N	N
Kim et al, 2015[62]	Retrospective	29	38	N	N	3	0	N	N	N	N
Park et al, 2013[65]	Retrospective	64	128	N	N	N	N	N	N	N	N
Woo et al, 2013[66]	Retrospective	24	46	1	1	2	2	N	N	N	N
Maetani et al, 2009[64]	Retrospective	29	31	0	1	0	1	N	N	1	1
Bang et al, 2008[59]	Retrospective	53	79	N	N	N	N	N	N	N	N
Lee et al, 2009[63]	Prospective	70	84	0	0	0	0	N	N	N	N
Totals		709	874	2	5	10	3	1	1	2	2
				2/386	5/458	10/448	3/496	1/126	1/126	2/155	2/157
Event rate, %				0.5	1.1	2.2	0.6	0.8	0.8	1.3	1.3

SEMS, Self-expandable metal stent; *RCT*, randomized controlled trial; *N*, not available.
*Funnel-shaped covered SEMS and outlier omitted from bleeding calculation.
†Seventy-seven partially covered, 16 fully covered.

SUPPLEMENTARY TABLE 2. Systematic review of successful endoscopic balloon dilation treatment of benign gastric outlet obstruction caused by NSAIDs, *Helicobacter pylori*, and pancreatitis

Reference	No. of patients	NSAIDs	*Helicobacter pylori*	Pancreatitis
Boylan & Gradzka, 1999[79]	40	19/24 (79.1)		
Cherian et al, 2007[80]	23	8/8 (100)	17/17 (100)	
Chiu et al, 2013[81]	7			
DiSario et al, 1994[82]	30	12/15 (80)		
Misra et al, 1998[3]	14			
Hamzaoui et al, 2015[83]	45			
Hewitt et al, 1999[84]	41			
Kochhar et al, 2009[85]	41*			
Kochhar et al, 2018[86]	264	97.8†		
Kochhar et al, 2004[87]	23			0/4 (0)
Lam et al, 2004[88]	33		11/14 (79)	
Lau et al, 1996[89]	41			
Noor et al, 2011[90]	10	9/10 (90)		
Rana et al, 2011[91]	25		10/11 (91)‡	3/5 (60)

Values are n/N (%).
NSAID, Nonsteroidal anti-inflammatory drug.
*Data overlaps with 2018 study by same author.
†Patients on opioids (n = 10) and on opioids plus NSAIDs (n = 12) were grouped together.
‡*Helicobacter pylori* patients were grouped together with 2 patients who took NSAIDs.

APPENDIX 1

Search strategy

Search date: September 6, 2018

Databases searched: Ovid MEDLINE: Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE Daily, and Ovid MEDLINE 1946 to Present, Embase Classic+Embase 1947 to 2018 September 6; Wiley Cochrane

Population, Intervention, Comparator, and Outcomes 1 and 2

Ovid MEDLINE(R), Embase

Number	Searches	Results
1	exp Gastric Outlet Obstruction/ use ppez	5550
2	exp stomach obstruction/ use emczd	3981
3	((gastric or GI or gastrointestinal or gastroduodenal) adj4 obstruction).ti,ab.	9462
4	goo.ti,ab.	734
5	or/1-4	15,535
6	exp Stents/ use ppez	69,495
7	exp stent/ use emczd	153,959
8	(stent* or sems).ti,ab.	237,684
9	(EUS-GJ or (endoscop* adj3 gastrojejunostomy)).ti,ab.	330
10	(EUS-GE or (endoscop* adj3 gastroenterostomy)).ti,ab.	72
11	or/6-10	286,140
12	5 and 11	1921
13	limit 12 to english language	1738
14	animals/ not (humans/ and animals/)	5,782,738
15	13 not 14	1729
16	remove duplicates from 15	1231
17	Meta - Analysis/ use ppez or Meta - Analysis as Topic/ use ppez or exp Technology Assessment, Biomedical/ use ppez	117,957
18	Meta Analysis/ use emczd or "Meta Analysis (Topic)"/ use emczd or Biomedical Technology Assessment/ use emczd	194,284
19	Meta Analysis.pt.	92,260
20	(meta analy* or metaanaly* or health technolog* assess*).mp.	410,060
21	(((systematic* or methodologic*) adj3 (review* or overview*)) or pooled analysis or published studies or published literature or hand search* or handsearch* or medline or pub med or pubmed or embase or cochrane or cinahl or data synthes* or data extraction* or HTA or HTAs or (technolog* adj (assessment* or overview* or appraisal*))).ti,ab.	641,188
22	or/17-21	847,523
23	16 and 22	51
24	remove duplicates from 23	51

Wiley Cochrane

ID	Search	hits
#1	MeSH descriptor: [Gastric Outlet Obstruction] explode all trees	65
#2	((gastric or GI or gastrointestinal or gastroduodenal) near/4 obstruction):ti,ab	175
#3	goo:ti,ab	39
#4	#1 or #2 or #3	226
#5	MeSH descriptor: [Stents] explode all trees	3806
#6	(stent* or SEMS):ti,ab	10,644
#7	(EUS-GJ or (endoscop* NEAR/3 gastrojejunostomy)):ti,ab	13
#8	(EUS-GE or (endoscop* NEAR/3 gastroenterostomy)):ti,ab	4
#9	#5 or #6 or #7 or #8	10,951
#10	#4 and #9	49

Population, Intervention, Comparator, and Outcome 3

Ovid MEDLINE(R), Embase

Number	Searches	Results
1	exp Gastric Outlet Obstruction/ use ppez	5550
2	exp stomach obstruction/ use emczd	3981
3	((gastric or GI or gastrointestinal or gastroduodenal) adj4 obstruction).ti,ab.	9462
4	goo.ti,ab.	734
5	or/1-4	15,535
6	exp Dilatation/ use ppez	10,560
7	exp balloon dilatation/ use emczd	17,270
8	(dilatation or dilation).ti,ab.	213,935
9	or/6-8	227,722
10	5 and 9	1010
11	limit 10 to english language	910
12	animals/ not (humans/ and animals/)	5,782,738
13	11 not 12	891

(*continued on the next page*)

. Continued

Number	Searches	Results
14	remove duplicates from 13	703
15	Meta - Analysis/ use ppez or Meta - Analysis as Topic/ use ppez or exp Technology Assessment, Biomedical/ use ppez	117,957
16	Meta Analysis/ use emczd or "Meta Analysis (Topic)"/ use emczd or Biomedical Technology Assessment/ use emczd	194,284
17	Meta Analysis.pt.	92,260
18	(meta analy* or metaanaly* or health technolog* assess*).mp.	410,060
19	(((systematic* or methodologic*) adj3 (review* or overview*)) or pooled analysis or published studies or published literature or hand search* or handsearch* or medline or pub med or pubmed or embase or cochrane or cinahl or data synthes* or data extraction* or HTA or HTAs or (technolog* adj (assessment* or overview* or appraisal*))).ti,ab.	641,188
20	or/15-19	847,523
21	14 and 20	12
22	remove duplicates from 21	12

Wiley Cochrane

ID	Search	hits
#1	MeSH descriptor: [Gastric Outlet Obstruction] explode all trees	65
#2	((gastric or GI or gastrointestinal or gastroduodenal) near/4 obstruction):ti,ab	175
#3	goo:ti,ab	39
#4	#1 or #2 or #3	226
#5	MeSH descriptor: [Dilatation] explode all trees	389
#6	(dilatation or dilation):ti,ab	6818
#7	#5 or #6	6958
#8	#4 and #7	5