Gastric Electrical Stimulation

NOTE: This policy only applies to the initial placement of the device. This policy does not apply to revision(s) or replacement(s) after the device has been placed.

I Gastric electrical stimulation may be considered medically necessary in the treatment of chronic intractable nausea and vomiting secondary to gastroparesis of diabetic, idiopathic or post-surgical etiology when all of the following criteria are met:

A Significantly delayed gastric emptying as documented by standard scintigraphic imaging of solid food; and

B Patient is refractory or intolerant of 2 out of 3 classes of prokinetic medications and 2 out of 3 antiemetic medications. (see Appendices for classes); and
C Patient's nutritional status is sufficiently low that weight has decreased to 90% or less of normal body weight for a patient’s height and age in comparison with pre-illness weight.

II Gastric electrical stimulation is investigational for all other indications including but not limited to the treatment of obesity.

NOTE: A summary of the supporting rationale for the policy criteria is at the end of the policy.

BACKGROUND

A subcutaneously implanted pulse generator delivers electrical stimulation to the stomach via intramuscular leads that are implanted on the outer surface of the greater curvature of the stomach either laparoscopically or during a laparotomy. Stimulation parameters are typically programmed at an “on time” (ON) (e.g., 0.1 second) alternating with an “off time” (OFF) (e.g., 5.0 seconds).

GASTRIC STIMULATION FOR THE TREATMENT OF INTRACTABLE NAUSEA AND VOMITING DUE TO GASTROPARESIS

Gastroparesis is a chronic disorder of gastric motility characterized by delayed emptying of a solid meal. Symptoms include bloating, distension, nausea, and vomiting. When severe and chronic, gastroparesis can be associated with dehydration, poor nutritional status, and poor glycemic control in diabetics. While most commonly associated with diabetes, gastroparesis is also found in chronic pseudo-obstruction, connective tissue disorders, Parkinson disease, and psychological pathology. Idiopathic gastroparesis refers to symptoms of gastroparesis which are not associated with an identifiable cause. Treatment of gastroparesis includes prokinetic agents such as metoclopramide, and antiemetic agents such as metoclopramide, granisetron, or ondansetron. Severe cases may require enteral or total parenteral nutrition.

GASTRIC STIMULATION FOR THE TREATMENT OF OBESITY

GES has also been investigated as a treatment of obesity as a technique to increase a feeling of satiety with subsequent reduced food intake and weight loss. The exact mechanisms resulting in changes in eating behavior are uncertain but may be related to neurohormonal modulation and/or stomach muscle stimulation.

REGULATORY STATUS

The Enterra™ Therapy System (formerly named Gastric Electrical Stimulation [GES] System; manufactured by Medtronic) is the only device approved for treatment of chronic refractory gastroparesis. It received approval for marketing from the U.S. Food and Drug Administration (FDA) in 2000 through the humanitarian device exemption (HDE) process.[1] This process requires the manufacturer to provide adequate information for the FDA to determine that the device has “probable” benefit but does not pose an unreasonable or significant risk; it does not
require data confirming the efficacy of the device. The HDE process is available for devices treating conditions that affect fewer than 4,000 Americans per year.

**EVIDENCE SUMMARY**

**GASTRIC STIMULATION FOR THE TREATMENT OF INTRACTABLE NAUSEA AND VOMITING DUE TO GASTROPARESIS**

**Systematic Reviews**

Several systematic reviews of studies of gastric electrical stimulation (GES) for gastroparesis have been published, the most recent of which was conducted by Levinthal et al in 2017.[2-4]

To be included in the Levinthal review, studies had to include adults with established gastroparesis, report patient symptom scores and administer treatment for at least 1 week. Five randomized controlled trials (RCTs) and 13 non-RCTs meeting criteria were identified. Pooled analysis of data from the 5 RCTs (n=185 patients) did not find a statistically significant difference in symptom severity when the GES was turned on versus off (standardized mean difference [SMD], 0.17; 95% confidence interval [CI], -0.06 to 0.40; p=0.15). Another pooled analysis did not find a statistically significant difference in nausea severity scores when the GES was on or off (SMD = -0.143; 95% CI, -0.50 to 0.22; p=0.45). In a pooled analysis of 13 open-label single-arm studies and data from open-label extensions of 3 RCTs, mean total symptom severity score decreased 2.68 (95% CI, 2.04 to 3.32) at follow-up from a mean of 6.85 (95% CI, 6.28 to 7.42) at baseline. The rate of adverse events in the immediate postoperative period (reported in 7 studies) was 8.7% (95% CI, 4.3% to 17.1%). The in-hospital mortality rate within 30 days of surgery was 1.4% (95% CI, 0.8% to 2.5%), the rate of reoperations (up to 10 years of follow-up) was 11.1% (95% CI, 8.7% to 14.1%), and the rate of device removal was 8.4% (95% CI, 5.7% to 12.2%).

**Randomized Controlled Trials**

The data presented to the FDA documenting the “probable benefit” of the GES (Enterra™) system was based on a multicenter double-blind cross-over study referred to as the Worldwide Anti-Vomiting Electrical Stimulation Study (WAVESS).[1] The study included 33 patients with intractable idiopathic or diabetic gastroparesis. The primary endpoint of the study was a reduction in vomiting frequency, as measured by patient diaries. In the initial phase of the study, all patients underwent implantation of the stimulator and were randomly and blindly assigned to stimulation ON or stimulation OFF for the first month, with crossover to OFF and ON during the second month. The baseline vomiting frequency was 47 episodes per month, which significantly declined in both ON and OFF groups to 23 and 29 episodes, respectively. However, there were no significant differences in the number of vomiting episodes between the 2 groups, suggesting a placebo effect.

After the first 2 months of therapy, patients were asked which month of the cross-over stimulation they preferred. Twenty-one of the 33 patients selected the ON mode as their preferred month, compared to 7 who preferred the OFF mode, and 5 who had no preference. The greater preference for ON stimulation suggested some short-term effect that was not placebo.

In a continuing open phase of the trial, the patients then received the stimulation consistent with their preference. However, by 4 months all patients had the device turned ON (it was not
clear whether this phase was by preference or design). At 6 and 12 months’ follow-up, the mean number of vomiting episodes continued to decline, although only 15 patients were followed for a period of 12 months. Data regarding quality of life were also obtained at 6 and 12 months and showed improvement. At 6 months, there was a significant improvement in 2-hour gastric retention (from 80% retention to 60% retention), but not in 4-hour gastric retention. (Fifty percent gastric retention at 2 hours was considered the upper limits of normal.)

The results of the randomized portion of the study suggest a placebo effect. Therefore, long-term results of GES must be validated in a longer-term randomized trial. It is interesting to note that GES did not return gastric emptying to normal in the majority of the patients tested. In as much as the device is intended to improve gastric emptying, as a proof of principle, it would be interesting to investigate the correlation between the degree of gastric emptying and symptom improvement.

In an update to WAVESS, Abell and colleagues reported 12-month outcomes for all of the patients. Statistically significant improvements were found for weekly vomiting frequency, total abdominal symptom score, and scintigraphic solid food emptying. At baseline the median vomiting frequency was 17.3 episodes per week with gastroparetic symptoms over a mean of 6.2 years. All patients had scintigraphic evidence of delayed gastric emptying at 2 and 4 hours, all patients were refractory to prokinetic and antiemetic medications, and 14 required some form of parenteral or enteral feedings. Results at the end of phase 1 (the blinded phase) showed a 50% decreased vomiting frequency for patients whose devices were ON compared to patients whose devices were OFF (p=0.05).

Symptom severity trended toward improvement in the ON versus OFF period, although these changes did not reach statistical significance in phase 1. In a second phase of the study all patients were switched to the ON position with 6- and 12-months follow-up. Vomiting at 12 months was compared to baseline; 72% for the combined group, 63% for diabetics with gastroparesis, and 83% for patients with idiopathic gastroparesis. Total symptom score improved significantly (p<0.05) at 6 and 12 months. Physical and mental quality of life scores improved significantly compared to baseline (p= less than 0.025). Baseline gastric retention was 78% at 2 hours. This decreased significantly with electrical stimulation to 65% at 6 months and 56% at 12 months for the combined group. The changes in 2-hour gastric emptying were not significant for the diabetic and idiopathic groups separately. Four-hour gastric emptying improved from 34% retention at baseline to 22% retention at 12 months. The difference was statistically significant for the combined group as well as the diabetic and idiopathic groups separately.

McCallum and colleagues performed a multicenter prospective study to evaluate Enterra™ therapy in patients with chronic intractable nausea and vomiting from diabetic gastroparesis (DGP). In this study, 55 patients with refractory DGP (5.9 years of DGP) were implanted with the Enterra™ system. After surgery, all patients had the stimulator turned ON for 6 weeks and then were randomly assigned to groups that had consecutive 3-month cross-over periods with the device ON or OFF. After this period, the device was turned ON in all patients and they were followed up unblinded for 4.5 months. During the initial 6-week phase with the stimulator turned ON, the median reduction in weekly vomiting frequency (WVF) compared with baseline was 57%. There was no difference in WVF between patients who had the device turned ON or OFF during the 3-month cross-over period. At 1 year, the WVF of all patients was significantly lower than baseline values (median reduction, 68%; P < 0.001). One of the patients had the
device removed due to infection; 2 patients required surgical intervention due to lead-related problems.

In a later study, McCallum and colleagues evaluated GES (Enterra™ system) in patients with chronic vomiting due to idiopathic gastroparesis in a randomized, double-blind crossover trial.[7] In this study, 32 patients with nausea and vomiting associated with idiopathic gastroparesis, which was unresponsive or intolerant to prokinetic and antiemetic drugs, received Enterra™ implants and had the device turned on for 6 weeks. Subsequently, 27 of these patients were randomized to have the device turned on or off for 2 consecutive 3 month periods. Twenty five of these subjects completed the randomized phase; of note, 2 subjects had the device turned on early, 2 subjects had randomization assignment errors, and 1 subject had missing diaries. During the initial 6-week on period, all subjects demonstrated improvements in their WVF, demonstrating a median reduction of 61.2% compared with baseline (17.3 episodes/week at baseline vs 5.5 episodes/week at 6 week postimplant, p<0.001). During the on-off crossover phase, subjects demonstrated no significant differences between the on and off phase in the study’s primary end point, median WVF (median 6.4 in the on phase vs 9.8 in the off phase; p=1.0). Among the 19 subjects who completed 12 months of follow up, there was an 87.1% reduction in median WVF compared with baseline (17.3 episodes/week at baseline vs 2 episodes/week at 12-month follow-up, p<0.001). Two subjects required surgical intervention for lead migration/dislodgement or neurostimulator migration.

Nonrandomized Studies

In 2016, Heckert and colleagues reported on GES as a treatment for refractory symptoms of gastroparesis in 138 patients (65 diabetic, 68 idiopathic, and 5 other) with delayed gastric emptying at one-year follow-up (1.4 ± 1.0 years).[8] Patients reported their response to GES using the Clinical Patient Grading Assessment Scale (CPGAS), of which, 75% of patients felt their symptoms had improved, and 25% felt their symptoms were the same or worsened (diabetics had a greater response than idiopathic patients). Symptom severity was assessed by analyzing Patient Assessment of GI Symptoms (PAGI-SYM) questionnaires, before insertion of GES and at the last follow-up visit. PAGI-SYM scores were improved for all symptoms, though the authors report nausea, early satiety and loss of appetite to have been most improved; and constipation, diarrhea, and abdominal distension to have been least improved. In this selected group of patients, the authors concluded GES to be beneficial in the majority of patients.

In 2013, Keller and colleagues reported complication rates and need for a second surgery in 233 patients who had GES implantation surgery over a ten year period at a single institution.[9] Additional surgery was required in 58% of patients. The majority of reoperations were due to the following complications: nutritional access (45 patients, requiring 77 procedures), subcutaneous pocket issues (n = 21), gastroparetic symptoms (n = 11), mechanical issues (n = 9) and infection (n = 4). The study reported that patient BMI was predictive of additional surgeries, with 4.45 overall increased risk of pocket revision surgery. Although 70% of patients reported improved symptoms of pain, bloating and nausea, GES had a significantly high reoperation rate due to complications associated with the initial procedure.

In 2007, Anand et al. reported on a study of 214 consecutive drug-refractory patients with the symptoms of gastroparesis (146 idiopathic, 45 diabetic, 23 after surgery).[10] A GES device was implanted in 156 patients. The remaining 58 patients, designated as the control group, were either on the waiting list for permanent implantation or consented to not receive a permanent
implant. At last follow-up (median 4 years), most patients who received implants (135 of 156) were alive with intact devices, significantly reduced gastrointestinal symptoms, and improved health-related quality of life, with evidence of improved gastric emptying. Also, 90% of the patients had a response in at least 1 of 3 main symptoms. Most patients that explanted, usually for pocket infections, were later successfully reimplanted.

GES placement using minimally invasive surgical approaches has also been evaluated in several publications. Laparoscopy has been reported in at least two studies as a feasible approach in placement of GES for patients with medically refractory diabetic or idiopathic gastroparesis[11,12].

Several small case series and retrospective reviews have been reported, some with long-term outcomes up to 5 years.[11,13-29] The data indicate that GES may be associated with improvements in gastrointestinal symptom scores, nutrition and quality-of-life for patients; these improvements were sustained over time. However, gastric emptying rates were mixed.

Adverse Events

Bielefeldt analyzed the number, severity and type of voluntarily reported adverse events related to Enterra™ in the Manufacturer and User Device Experience (MAUDE) databank of the FDA.[30] Data were retrieved for 2001 through October 31, 2015, of which 1472 reports were abstracted. Thirty-six perioperative complication reports were reviewed; 6 were serious events, including three deaths (1 due to cardiac arrest, 2 due to septic complications with resulting multi organ failure), one stroke, and one myocardial infarction complicated further by a pulmonary embolism. Overall, most of the reports were regarding patient concerns, local complications, or system failure. Limitations of these findings include reporting bias (the MAUDE data are voluntarily submitted), and report misclassification bias (MAUDE data sources vary from patient reports to published articles and inconsistencies in reporting have been found). Risk-benefit could not directly be assessed given the nature of the MAUDE database, though the author cites other studies for outcomes measurement, most of which are included in the other sections of this evidence review. Overall, 35% of the reported adverse events prompted an additional surgery.

Section Summary

The evidence regarding the clinical utility of GES for gastroparesis due to intractable nausea and vomiting is limited to 3 small crossover RCTs. However, long-term, 12-month data suggest improvements in gastrointestinal symptom scores, nutrition, and quality-of-life scores, suggesting some benefit with GES treatment. Given the lack of alternative treatment options in this specific patient population, GES may be considered reasonable treatment of symptoms of gastroparesis.

GASTRIC STIMULATION FOR THE TREATMENT OF OBESITY

Systematic Review

In 2014, Cha and colleagues published a review of 33 studies evaluating various methods of gastric stimulation as a treatment of obesity, including implantable GES.[31] The majority of included studies were small in nature with 24 studies evaluating 30 or fewer patients. In addition, many of the studies reported high dropout rates of more than 50% of patients at the end of the study follow-up period. A major limitation of the review was the inclusion of studies which did not include the treatment of obesity (i.e., BMI or weight loss) as a primary outcome measure. Furthermore, there were methodological difference in the patient inclusion criteria
and most of the studies included in the review were limited by short-term follow-up of less than 1 year. The authors concluded that the level of evidence regarding GES as a treatment of obesity was low. Long-term RCTs which compare GES to other treatments of obesity and sham are needed in order to assess the safety and efficacy of GES in this population.

**Randomized Controlled Trials**

There is 1 published RCT on GES for the treatment of obesity. In 2009, Shikora et al. reported on a randomized controlled, double-blind study (SHAPE trial) to evaluate GES for the treatment of obesity.[32] All 190 patients participating in the study received an implantable gastric stimulator and were randomized to have the stimulator turned on or off. All patients were evaluated monthly, participated in support groups and reduced their diet by 500-kcal/day. At 12 month follow-up, there was no difference in excess weight loss between the treatment group (weight loss of 11.8% +/- 17.6%) and the control group (weight loss of 11.7% +/- 16.9%) using intention-to-treat analysis (p=0.717).

**Nonrandomized Studies**

Additional, small studies – including one patient population with comorbidities of gastroparesis and morbid obesity – have reported positive outcomes in weight loss and maintenance of weight loss along with minimal complications.[33-38] However, due to lack of long-term outcomes from well-designed randomized clinical trials, conclusions cannot be made concerning the safety and efficacy of chronic gastric stimulation as a treatment for morbid obesity.

**PRACTICE GUIDELINE SUMMARY**

**AMERICAN COLLEGE OF GASTROENTEROLOGY**[39]

The American College of Gastroenterology (ACG) published a clinical practice guideline on management of gastroparesis in 2013. The recommendations for this guideline were based on review of the evidence-base through 2011. The ACG concluded that GES treatment does not adequately address the clinical needs of these patients, but that, “GES may be considered for compassionate treatment in patients with refractory symptoms, particularly nausea and vomiting. Symptom severity and gastric emptying have been shown to improve in patients with diabetic gastroparesis (DG), but not in patients with idiopathic gastroparesis (IG) or postsurgical gastroparesis (PSG). (Conditional recommendation, moderate level of evidence.).”

**SUMMARY**

It appears that gastric electrical stimulation (GES) may improve intractable nausea and vomiting for patients with gastroparesis. Clinical guidelines based on research state GES may be considered for compassionate treatment in patients with refractory symptoms, particularly nausea and vomiting. Therefore, given the lack of treatment options in this very specific patient population, GES may be medically necessary in carefully selected patients with gastroparesis when policy criteria are met.

Due to limited evidence on the efficacy and safety GES, when policy criteria are not met, all other indications including treatment for obesity are considered investigational.
REFERENCES


2. Levinthal, DJ, Bielefeldt, K. Systematic review and meta-analysis: Gastric electrical stimulation for gastroparesis. *Autonomic neuroscience : basic & clinical*. 2017 Jan;202:45-55. PMID: 27085627


15. van der Voort, IR, Becker, JC, Dietl, KH, Konturek, JW, Domschke, W, Pohle, T. Gastric electrical stimulation results in improved metabolic control in diabetic patients suffering


40. BlueCross BlueShield Association Medical Policy Reference Manual "Gastric Electrical Stimulation." Policy No. 7.01.73

**CODES**

The CPT code book instructs that, after January 1, 2012, procedures related to gastric stimulation electrodes for morbid obesity should be reported using code unlisted procedure codes 43659 for laparoscopic approach and 43999 for open laparotomy approach.

<table>
<thead>
<tr>
<th>Codes</th>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPT</td>
<td>43647</td>
<td>Laparoscopy, surgical; implantation or replacement of gastric neurostimulator electrodes, antrum</td>
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<tr>
<td></td>
<td>43648</td>
<td>Laparoscopy, surgical; revision or removal of gastric neurostimulator electrodes, antrum</td>
</tr>
<tr>
<td></td>
<td>43659</td>
<td>Unlisted laparoscopy procedure, stomach</td>
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<tr>
<td></td>
<td>43881</td>
<td>Implantation or replacement of gastric neurostimulator electrodes, antrum, open</td>
</tr>
<tr>
<td></td>
<td>43882</td>
<td>Revision or removal of gastric neurostimulator electrodes, antrum, open</td>
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<tr>
<td></td>
<td>43999</td>
<td>Unlisted procedure, stomach</td>
</tr>
<tr>
<td></td>
<td>64590</td>
<td>Insertion or replacement of peripheral or gastric neurostimulator pulse generator or receiver, direct or inductive coupling.</td>
</tr>
<tr>
<td></td>
<td>64595</td>
<td>Revision or removal of peripheral or gastric neurostimulator pulse generator or receiver</td>
</tr>
</tbody>
</table>
Codes | Number | Description
--- | --- | ---
 | 95980 | Electronic analysis of implanted neurostimulator pulse generator system (eg, rate, pulse amplitude and duration, configuration of wave form, battery status, electrode selectability, output modulation, cycling, impedance and patient measurements) gastric neurostimulator pulse generator/transmitter; intraoperative, with programming
 | 95981 | ; subsequent, without programming
 | 95982 | ; subsequent, with reprogramming

HCPCS

C1767 | Generator, neurostimulator (implantable), nonrechargeable
C1778 | Lead neurostimulator
C1883 | Adaptor/Extension, pacing lead or neurostimular lead (implantable)
C1897 | Lead neurostimulator test kit (implantable)
E0765 | FDA approved nerve stimulator, with replaceable batteries, for treatment of nausea and vomiting
L8679 | Implantable neurostimulator, pulse generator, any type
L8680 | Implantable neurostimulator electrode, each
L8685 | Implantable neurostimulator pulse generator, single array, rechargeable, includes extension
 | L8686 | ; non-rechargeable, includes extension
L8687 | Implantable neurostimulator pulse generator, dual array, rechargeable, includes extension
 | L8688 | ; non-rechargeable, includes extension

Appendix 1: Prokinetic Medications

<table>
<thead>
<tr>
<th>Class</th>
<th>Common Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cholinergic Agonists</td>
<td>dextroprenaline (Ilopan®), bethanechol (Urecholine®)</td>
</tr>
<tr>
<td>Motolin receptor agonists</td>
<td>erythromycin</td>
</tr>
<tr>
<td>Dopamine receptor antagonists</td>
<td>metoclopramide (Reglan®)</td>
</tr>
</tbody>
</table>

Appendix 2: Antiemetic Medications

<table>
<thead>
<tr>
<th>Class</th>
<th>Common Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antihistamines</td>
<td>diphenhydramine (Benadryl®), dimenhydrinate (Dramamine®), meclizine (Antivert®), hydroxyzine (Vistaril®), trimethobenzamide (Tigan®)</td>
</tr>
<tr>
<td>Serotonin (5HT₃) receptor antagonists</td>
<td>ondansetron (Zofran®), granisetron (Kytril®), dolasetron (Anzemet®)</td>
</tr>
<tr>
<td>Dopamine receptor antagonists</td>
<td>Metoclopramide (Reglan®), perphenazine (Trilafon®), prochlorperazine (Compazine®), promethazine (Phenergan®), thiethylperazine (Torecan®), cyclizine (Marezine®)</td>
</tr>
</tbody>
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Date of Origin: February 2001