Communication from the ASGE Technology Committee

REPORT ON EMERGING TECHNOLOGY

Endoluminal bariatric techniques

The American Society for Gastrointestinal Endoscopy (ASGE) Technology Committee provides reviews of new or emerging endoscopic technologies that have the potential to have an impact on the practice of GI endoscopy. Evidence-based methodology is used, with a MEDLINE literature search to identify pertinent preclinical and clinical studies on the topic and a MAUDE (U.S. Food and Drug Administration Center for Devices and Radiological Health) database search to identify the reported complications of a given technology. Both are supplemented by accessing the "related articles" feature of PubMed and by scrutinizing pertinent references cited by the identified studies. Controlled clinical trials are emphasized, but in many cases, data from randomized, controlled trials are lacking. In such cases, large case series, preliminary clinical studies, and expert opinions are used. Technical data are gathered from traditional and Web-based publications, proprietary publications, and informal communications with pertinent vendors. For this review, the MEDLINE database was searched through January 2011 using the keywords "bariatric," "endoscopic," "intragastric balloon," "duodenojejunal bypass sleeve," and "transoral gastroplasty." Reports on Emerging Technologies are drafted by 1 or 2 members of the ASGE Technology Committee, reviewed and edited by the committee as a whole, and approved by the Governing Board of the ASGE. These reports are scientific reviews provided solely for educational and informational purposes. Reports on Emerging Technologies are not rules and should not be construed as establishing a legal standard of care or as encouraging, advocating, requiring, or discouraging any particular treatment or payment for such treatment.

Obesity is a worldwide epidemic associated with multiple comorbidities.[1] Behavioral and pharmacological treatment approaches are only modestly effective and are not durable.[2] Bariatric surgical procedures are effective but are associated with major complications in as many as 25% of patients and a mortality rate as high as 7.6%.[3-6] There is a need for less-invasive weight-loss procedures. This document reviews endoluminal devices and techniques. These devices are not yet approved for use in the United States.

0016-5107/$36.00
doi:10.1016/j.gie.2012.02.020

INTRAGASTRIC BALLOON

The intragastric balloon (IGB) is thought to induce early satiety by partially filling the stomach. Previously available balloons, such as Garren-Edwards and Ballobes, failed to induce significant weight loss and were associated with significant complications.[7-9] The newer balloons have a larger capacity and may be filled with either saline solution or air (Fig. 1).

BIOENTERICS INTRAGASTRIC BALLOON

The BioEnterics Intragastric Balloon (BIB) (Allergan Inc, Irvine, Calif) is a spherical, large-capacity (600-800 mL) silicone polymer balloon. The deflated balloon comes preloaded on a catheter, which is blindly passed transorally into the esophagus. Once the balloon has been passed, an endoscope is passed along side it to ensure accurate placement of the balloon in the fundus. Under direct visualization, the balloon is then inflated by injecting saline solution mixed with methylene blue through the external portion of the catheter. The BIB should be removed after a maximum of 6 months because beyond this period, there is a higher risk of spontaneous balloon deflation. If inadvertent balloon rupture occurs, the methylene blue is systemically absorbed, causing a change in urine color, which serves as an alert that the balloon has deflated.

Uncontrolled studies have mostly shown positive results with the BIB, with mean body mass index (BMI) decrease of 4.9 to 6.5 kg/m^2,[10-12] although 1 small Asian study failed to show a benefit.[13] Compared with structured diet therapy in a retrospective study, BIB placement resulted in a significantly greater decrease in BMI at 6 months (35.4 kg/m^2 vs 38.9 kg/m^2).[14] The BIB has been compared with surgical treatment (sleeve gastrectomy) in 2 nonrandomized studies. At 6 months, 1 study showed no difference in mean weight loss, although the surgical procedure was superior at 12-month followup.[15] The other study of superobese patients (BMI >50) found that sleeve gastrectomy patients lost significantly more weight at 6 months (45.5 kg vs 22.3 kg).[16] Studies that evaluated the effect of BIB placement on comorbidities showed a decreased incidence of metabolic syndrome,[17,18] decreased insulin resistance,[19] im-

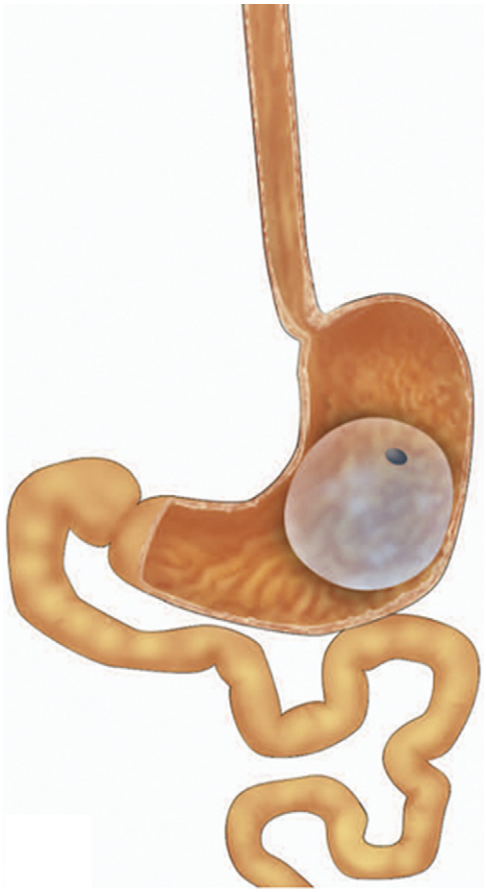

Figure 1. Large-capacity intragastric balloon after deployment. Balloon is filled with a mixture of saline solution and methylene blue.

provement in hepatic steatosis[20] and obstructive sleep apnea,[21] and a significant reduction in hemoglobin A1c levels in those who lost weight.[18,22] Finally, a small uncontrolled study found that weight loss caused by preoperative BIB therapy may reduce the rate of conversion of laparoscopic gastric banding to open surgery and decreased intraoperative complications.[23]

There are 2 published randomized, clinical trials of the BIB, and they are limited by small sample size and short follow-up. One study randomized 23 patients to sham treatment and 20 patients to a balloon treatment group for 3 months. There was no difference in weight loss between the groups.[24] No major complications were noted in this study. A subsequent double-blind, randomized, sham-controlled study allocated 32 patients to a BIB or sham procedure followed by crossover after 3 months.[25] Patients receiving active treatment during the first 3 months had greater decrease in mean BMI (5.8 kg/m^2 vs 4 kg/m^2, $P <$ .001). After crossover, the balloon group again had a greater decrease in mean BMI (5.1 kg/m^2 vs 1.1 kg/m^2, $P <$ .001). No complications were reported. A meta-analysis including 30 studies (18 prospective and 12 retrospective) and a total of 4877 patients found that the overall short-term (after 6 months) weight loss was 17.8 kg (mean 4.9-28.5 kg) after BIB placement.[26]

There are 2 case series that include follow-up beyond 1 year. In 1 series, 100 consecutive patients were followed for a mean of 4.8 years; the BIB was removed at 1 year. Weight loss that was 10% or greater that baseline and sustained at 2.5 years was achieved in 24% of individuals.[27] A prospective, nonrandomized study of 118 patients reported 5-year follow-up after single versus repeated BIB placement. The single treatment group had balloon in place for 6 months, and the repeat treatment group had the balloon placed immediately after the first balloon removal (n = 8) or after IGB-free interval (n = 11, median IGB-free interval of 16.3 months). Compared with subjects with a single treatment (n = 99), those with repeat treatment (n = 19) had greater weight loss in kilograms at 1 year (12.0 kg vs 6.0 kg) and excess weight loss (percentage of EWL calculated by dividing actual weight loss by ideal weight loss) (40.9% vs 20.8% EWL; P = .008), but the difference became less than 2 kg starting at 3 years.[28]

Taken together, these studies suggest that BIB placement can result in short-term weight loss in the range of 14 to 18 kg in 6 months, but the weight loss does not appear to last, and 20% to 40% of patients fail to achieve significant weight loss.

OTHER IGBs

Other available IGBs include the Heliosphere (IHB) (Helioscopie, Vienne, France), Silimed (Silimed, Rio de Janeiro, Brazil), and Semstationary Antral Balloon (JP Industria Farmaceutica, Ribeirao Preto, Brazil). The placement of the IHB is similar to that of the BIB except that the balloon is inflated with air. Data regarding the efficacy and safety of IHB are limited.[29-31] In the largest published study, which included 82 consecutive patients and a median follow-up of 182 days, 70% achieved more than 10% body weight loss. There are very few data on the other 2 IGBs to date.[32]

Comparison of IGBs

There is a single study comparing the BIB and IHB. In this prospective, double-blind study, 18 patients were randomized to IHB and 15 to BIB. Weight loss was similar in both groups at 6 months.[33]

Complications of IGBs

Complications of IGBs reported in a large case series and a meta-analysis include esophagitis (1.27%), gastric perforation (≤0.21%), gastric outlet obstruction (0.76%), gastric ulcer (0.2%), balloon rupture (0.36%), and death (0.07%).[10,26]

Other reported complications of the BIB include esophageal perforation,[34] small-bowel obstruction requiring surgery,[35-37] and 1 case report of cardiac arrest after BIB

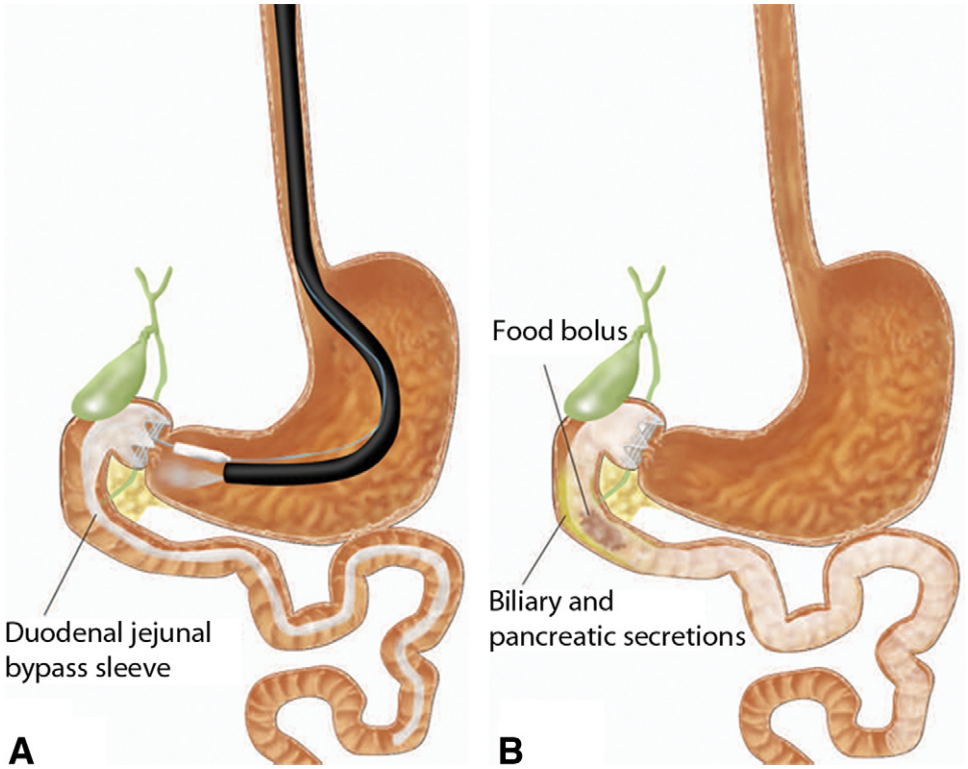

Figure 2. A, Duodenojejunal bypass sleeve is deployed over a guidewire and anchored in the duodenum under direct visualization. **B,** The sleeve creates a barrier to absorption and also delays mixing of food with biliary and pancreatic secretions.

placement, which was thought to be secondary to vagal nerve activation caused by stretching of the gastric wall.[38] Among 82 patients who underwent IHB placement, nausea and vomiting during the first week of insertion occurred in 7.4% of patients. Two (3%) spontaneous deflations without migration were noted, but only 1 early surgical removal (1.2%) was required.[32]

DUODENOJEJUNAL BYPASS SLEEVE

The first strictly endoluminal implant that effectively bypasses the proximal small intestine is the duodenojejunal bypass sleeve (DJBS), also known as Endobarrier Gastrointestinal Liner (GI Dynamics Inc, Lexington, Mass). The device is a 60-cm long, impermeable plastic sleeve that is anchored in the duodenal bulb and extends into the proximal jejunum. Because the sleeve covers the duodenum and a portion of the jejunum, it creates a barrier to absorption and delays the mixing of food with pancreaticobiliary secretions (Fig. 2). The sleeve system is passed over a guidewire, and then, under direct visualization, it is fully deployed in the duodenal bulb to anchor the device. It may be removed by grasping the polypropylene drawstring with a custom device. It is withdrawn with the aid of a foreign-body retrieval hood to avoid trauma to the stomach or esophagus.

A multicenter study randomized 30 patients to DJBS and 11 to low-calorie diet alone. In a per-protocol analysis, the mean percentage of EWL after 3 months was 19.0% for device patients compared with 6.9% for control patients ($P < .002$).[39] In a prospective, sham-controlled, single-blind trial randomizing 13 patients to DJBS and 24 to a sham procedure, weight loss at 12 weeks was significantly greater in the treatment group (8.2 kg vs 2.1 kg, $P < .05$).[40] Eight of 13 DJBS subjects were terminated early because of side effects including GI bleeding, abdominal pain, nausea, and vomiting.

In a small study of 10 patients who underwent placement of DJBS modified with a proximal flow restrictor of a 4-mm diameter, the percentage of EWL was 40% at 24 weeks. Episodes of nausea, vomiting, and abdominal pain required endoscopic dilation of the restrictor orifice in 8 patients, with no clinically significant adverse events.[41]

These small studies suggest that DJBS may be effective in achieving weight loss but appears to be poorly tolerated in its current design. Larger trials with longer follow-up are needed.

ENDOLUMINAL RESTRICTIVE PROCEDURES

Gastroplasty decreases gastric volume to induce weight loss. The available devices for endoluminal gastroplasty are the EndoCinch Suturing System (C.R. Bard, Murray Hill, NJ) and the Transoral Gastroplasty System (TOGA) (Satiety, Inc, Palo Alto, Calif). The Trans-oral Endoscopic Restrictive Implant System (TERIS; BaroSense,

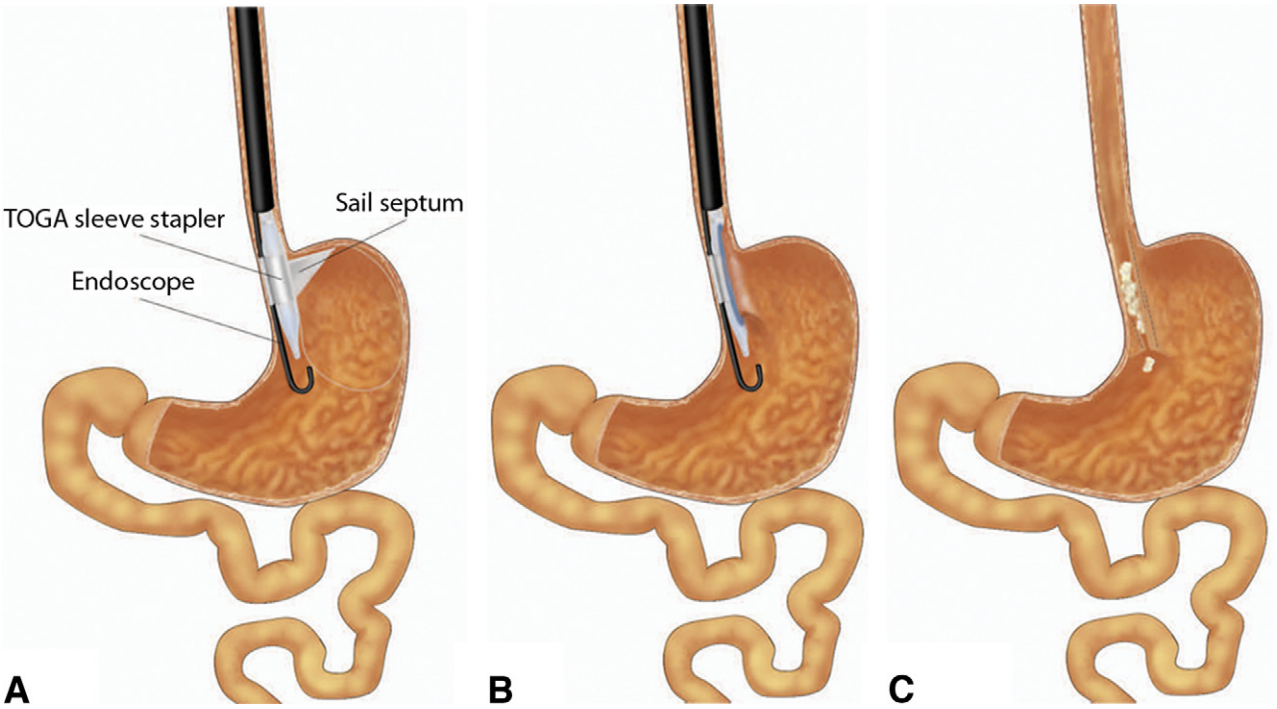

Figure 3. A, The TOGA device. A "sail septum" is used to keep the stomach in the desired position for the procedure. **B,** Gastric mucosa being suctioned into the TOGA device to create restrictive pouch. **C,** restrictive pouch.

Redwood City, CA) restricts oral intake via an implantable diaphragm.

EndoCinch, originally developed as an endoscopic treatment for GERD, is a suturing device that is mounted on the tip of the endoscope. This overtube-based device uses a suction chamber to capture the gastric wall and creates pleats using tagged sutures to reduce gastric volume. A mean EWL of 21% at 1 month and 58% at 12 months was achieved in 64 patients who underwent the procedure.[42] Eleven of 14 patients who underwent follow-up endoscopy had intact plication sutures.

The TOGA system is an endoscopic full-thickness stapling device that allows exclusion of much of the stomach by creating a narrow gastric sleeve (Fig. 3). It is composed of a flexible 18-mm shaft device that is introduced into the proximal stomach over a guidewire. The endoscope is passed thorough a special channel within the shaft. Once its position is confirmed endoscopically, a "sail septum" is deployed to stabilize the anterior and posterior walls of the body and greater curvature and prevent their incorporation into the sleeve. Suction pods located within the stapling device are activated, bringing lesser curvature tissue within the jaws of the device. The stapler is then fired, creating the narrow sleeve, and the maneuvers are repeated to create an 80– to 90-mm sleeve, approximately 19 mm in diameter extending from the esophagus along the lesser curvature. The sleeve is then narrowed at the outlet using the TOGA restrictor.

In a series of 21 patients who underwent gastroplasty with the TOGA system, the mean EWL was 24.4% at 6 months. The most commonly reported adverse events were vomiting, pain, nausea, and transient dysphagia.[43] Because gaps in the staple line were evident in 13 patients, the technique was subsequently improved by the development of an adjustable septum, allowing closer apposition of the 2 staple lines. Eleven patients who underwent the modified technique had a mean of 46.0% EWL at 6 months.[44] Laparoscopic Roux-en-Y gastric bypass was technically feasible in all 4 patients who previously underwent the TOGA procedure and did not interfere with the short-term results of the laparoscopic RYGB.[45]

The Trans-oral Endoscopic Restrictive Implant System creates a restriction analogous to gastric banding. The technique involves stapling plications into the gastric cardia with anchor placement and subsequent attachment of a restrictor diaphragm. This results in a restrictive pouch with a 10-mm orifice (Fig. 4). It is designed to be a permanent implant, which may be removed or modified as needed. In a preliminary study of 12 patients, the EWL was 12.3% and 22.2% at 1 and 3 months, respectively.[46] In 1 patient, gastric perforation developed that required surgery, and in 2 patients, pneumoperitoneum developed that was treated conservatively. Weight loss was reported to be comparable to that with laparoscopic gastric band placement.

OTHER TECHNIQUES

The use of botulinum toxin (Botox; Allergan Inc) in obesity is based on animal studies that showed weight loss

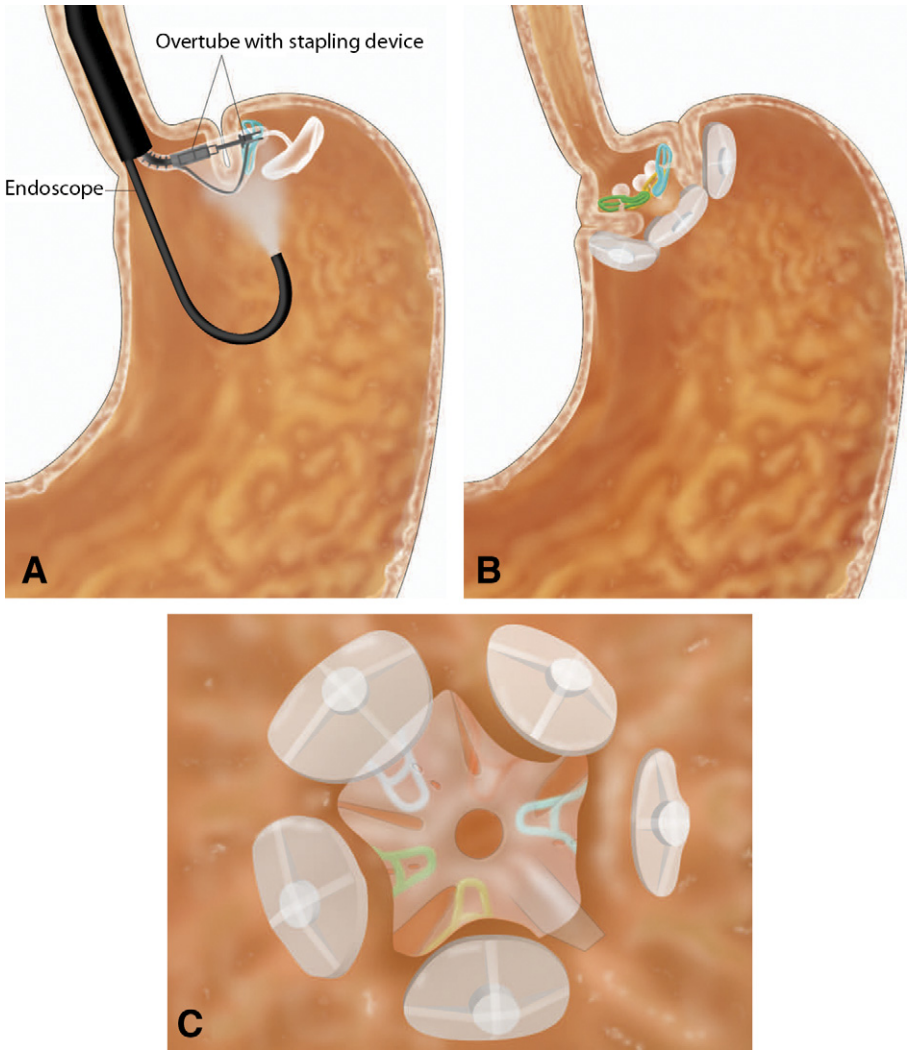

Figure 4. A, The Trans-oral Endoscopic Restrictive Implant System (TERIS) device creates a small gastric pouch by means of multiple gastric plications using a specialized stapling device. **B,** Completed TERIS procedure with small restrictive gastric pouch. **C,** Inner view of the TERIS procedure showing restrictive diaphragm with 10-mm orifice.

by decreasing gastric emptying as a result of cholinergic denervation.[47] Injection in the prepyloric antral gastric wall in 12 patients failed to induce weight loss.[48] However, injection of Botox into the fundus as well as the antrum resulted in significantly higher BMI reduction (4.0 ± 0.36 kg/m^2 vs 2 ± 0.58 kg/m^2, $P < .001$) at 8 weeks in a randomized, sham-controlled study of 24 obese patients. No significant side effects were reported.

There are several other endoluminal bariatric devices at various stages of development, including an endoscopically placed removable sleeve (ValenTx bypass sleeve; ValenTx, Inc, Carpinteria, Calif) and a device for radiofrequency antralplasty (Silhouette Medical, Mountain View, Calif). Intragastric balloon placement using an ingestible capsule has been reported. The volume of the capsule can be adjusted wirelessly after being swallowed by the patient.[49]

AREAS FOR FUTURE RESEARCH

Long-term data on the safety, efficacy, and durability of endoluminal bariatric techniques are needed. Further studies comparing different endoluminal techniques and their proper role in treating obesity are required.

SUMMARY

Less-invasive weight loss methods are needed to address the growing obesity epidemic. Endoluminal bariatric techniques are a promising area of research with the potential to have an impact on this growing health issue. Further study on their role is required before incorporation into clinical practice.

DISCLOSURE

All authors disclosed no financial relationships relevant to this publication.

Abbreviations: BIB, BioEnterics intragastric balloon; BMI, body mass index; IGB, intragastric balloon; IHB, intragastric heliosphere balloon; DJBS, duodenojejunal bypass sleeve; EWL, excess weight loss; TOGA, Transoral Gastroplasty System.

REFERENCES

1. The World Health Organization 2005 data. Available at: http://www.who.int/mediacentre/factsheets/fs311/en/index.html. Accessed January 6, 2011.
2. Sjöström L, Lindroos AK, Peltonen M, et al. Lifestyle, diabetes, and cardiovascular risk factors 10 years after bariatric surgery. N Engl J Med 2004;351:2683-93.
3. Paiva D, Bernardes L, Suretti L. Laparoscopic biliopancreatic diversion: technique and initial results. Obes Surg 2002;12:358-61.
4. Kim WW, Gagner M, Kini S, et al. Laparoscopic vs. open biliopancreatic diversion with duodenal switch: a comparative study. J Gastrointest Surg 2003;7:552-7.
5. Gracia J, Martínez M, Elia M, et al. Obesity surgery results depending on technique performed: long-term outcome. Obes Surg 2009;19:432-8.
6. SAGES Guidelines Committee. SAGES guideline for clinical application of laparoscopic bariatric surgery. Surg Obes Relat Dis 2009;5:387-405.
7. Hogan R, Johnston J, Long B, et al. A double-blind, randomized, sham-controlled trial of the gastric bubble for obesity. Gastrointest Endosc 1989;35:381-5.
8. Benjamin S, Maher K, Cattau E Jr, et al. Double-blind controlled trial of the Garren-Edwards gastric bubble: an adjunctive treatment for exogenous obesity. Gastroenterology 1988;95:581-8.
9. Mathus-Vliegen E, Tytgat G, Veldhuyzen-Offermans E. Intragastric balloon in the treatment of super-morbid obesity. Double-blind, sham-controlled, crossover evaluation of 500-milliliter balloon. Gastroenterology 1990;99:362-9.
10. Genco A, Bruni T, Doldi S, et al. BioEnterics Intragastric Balloon: the Italian experience with 2,515 patients. Obes Surg 2005;15:1161-4.
11. Lopez-Nava G, Rubio M, Prados S, et al. BioEnterics® intragastric balloon (BIB®). Single ambulatory center Spanish experience with 714 consecutive patients treated with one or two consecutive balloons. Obes Surg 2011;21:5-9.
12. Sallet J, Marchesini J, Paiva D, et al. Brazilian multicenter study of the intragastric balloon. Obes Surg 2004;14:991-8.
13. Ganesh R, Rao AD, Baladas HG, et al. The Bioenteric Intragastric Balloon (BIB) as a treatment for obesity: poor results in Asian patients. Singapore Med J 2007;48:227-31.
14. Genco A, Balducci S, Bacci V, et al. Intragastric balloon or diet alone? A retrospective evaluation. Obes Surg 2008;18:989-92.
15. Genco A, Cipriano M, Materia A, et al. Laparoscopic sleeve gastrectomy versus intragastric balloon: a case-control study. Surg Endosc 2009;23:1849-53.
16. Milone L, Strong V, Gagner M. Laparoscopic sleeve gastrectomy is superior to endoscopic intragastric balloon as a first stage procedure for super-obese patients (BMI $>$ or $=$ 50). Obes Surg 2005;15:612-7.
17. Crea N, Pata G, Della Casa D, et al. Improvement of metabolic syndrome following intragastric balloon: 1 year follow-up analysis. Obes Surg 2009;19:1084-8.
18. Mui WL, Ng EK, Tsung BY, et al. Impact on obesity-related illnesses and quality of life following intragastric balloon. Obes Surg 2010;20:1128-32.
19. Ricci G, Bersani G, Rossi A, et al. Bariatric therapy with intragastric balloon improves liver dysfunction and insulin resistance in obese patients. Obes Surg 2008;18:1438-42.
20. Forlano R, Ippolito AM, Iacobellis A, et al. Effect of the BioEnterics intragastric balloon on weight, insulin resistance, and liver steatosis in obese patients. Gastrointest Endosc 2010;71:927-33.
21. Busetto L, Enzi G, Inelmen EM, et al. Obstructive sleep apnea syndrome in morbid obesity: effects of intragastric balloon. Chest 2005;128:618-23.
22. Chan AO, Chow WS, Lam KF, et al. The effect of intragastric balloon placement on weight loss and type 2 diabetes control. Aliment Pharmacol Ther 2008;28:162-4.
23. Busetto L, Segato G, De Luca M, et al. Preoperative weight loss by intragastric balloon in super-obese patients treated with laparoscopic gastric banding: a case-control study. Obes Surg 2004;14:671-6.
24. Mathus-Vliegen EM, Tytgat GN. Intragastric balloon for treatment-resistant obesity: safety, tolerance, and efficacy of 1-year balloon treatment followed by a 1-year balloon-free follow-up. Gastrointest Endosc 2005;61:19-27.
25. Genco A, Cipriano M, Bacci V, et al. BioEnterics Intragastric Balloon (BIB): a short-term, double-blind, randomised, controlled, crossover study on weight reduction in morbidly obese patients. Int J Obes 2006;30:129-33.
26. Dumonceau JM. Evidence-based review of the Bioenterics intragastric balloon for weight loss. Obes Surg 2008;18:1611-7.
27. Dastis NS, François E, Deviere J, et al. Intragastric balloon for weight loss: results in 100 individuals followed for at least 2.5 years. Endoscopy 2009;41:575-80.
28. Dumonceau JM, François E, Hittelet A, et al. Single vs repeated treatment with the intragastric balloon: a 5-year weight loss study. Obes Surg 2010;20:692-7.
29. Forestieri P, De Palma GD, Formato A, et al. Heliosphere Bag in the treatment of severe obesity: preliminary experience. Obes Surg 2006;16:635-7.
30. Trande P, Mussetto A, Mirante VG, et al. Efficacy, tolerance and safety of new intragastric air-filled balloon (Heliosphere BAG) for obesity: the experience of 17 cases. Obes Surg 2010;20:1227-30.
31. Mion F, Gincul R, Roman S, et al. Tolerance and efficacy of an air-filled balloon in non-morbidly obese patients: results of a prospective multicenter study. Obes Surg 2007;17:764-9. Erratum in: Obes Surg 2007;17:996.
32. Lecumberri E, Krekshi W, Matía P, et al. Effectiveness and safety of air-filled balloon heliosphere BAG® in 82 consecutive obese patients. Obes Surg 2011;21:1508-12.
33. De Castro ML, Morales MJ, Del Campo V, et al. Efficacy, safety, and tolerance of two types of intragastric balloons placed in obese subjects: a double-blind comparative study. Obes Surg 2010;20:1642-6.
34. Nijhof HW, Steenvoorde P, Tollenaar RA. Perforation of the esophagus caused by the insertion of an intragastric balloon for the treatment of obesity. Obes Surg 2006;16:667-70.
35. Zdichavsky M, Beckert S, Kueper M, et al. Mechanical ileus induces surgical intervention due to gastric balloon: a case report and review of the literature. Obes Surg 2010;20:1743-6.
36. Oztürk A, Akinci OF, Kurt M. Small intestinal obstruction due to self-deflated free intragastric balloon. Surg Obes Relat Dis 2010;6:569-71.
37. Vanden Eynden F, Urbain P. Small intestine gastric balloon impaction treated by laparoscopic surgery. Obes Surg 2001;11:646-8.
38. Cubattoli L, Barneschi C, Mastrocinque E, et al. Cardiac arrest after intragastric balloon insertion in a super-obese patient. Obes Surg 2009;19:253-6. Epub 2008 Jul 10.
39. Schouten R, Rijs CS, Bouvy ND, et al. A multicenter, randomized efficacy study of the EndoBarrier Gastrointestinal Liner for presurgical weight loss prior to bariatric surgery. Ann Surg 2010;251:236-43.
40. Gersin KS, Rothstein RI, Rosenthal RJ, et al. Open-label, sham-controlled trial of an endoscopic duodenojejunal bypass liner for preoperative weight loss in bariatric surgery candidates. Gastrointest Endosc 2010;71:976-82.
41. Escalona A, Yáñez R, Pimentel F, et al. Initial human experience with restrictive duodenal-jejunal bypass liner for treatment of morbid obesity. Surg Obes Relat Dis 2010;6:126-31.

42. Fogel R, De Fogel J, Bonilla Y, et al. Clinical experience of transoral suturing for an endoluminal vertical gastroplasty: 1-year follow-up in 64 patients. Gastrointest Endosc 2008;68:51-8.
43. Devière J, Ojeda Valdes G, Cuevas Herrera L, et al. Safety, feasibility and weight loss after transoral gastroplasty: first human multicenter study. Surg Endosc 2008;22:589-98. Epub 2007 Nov 1. Erratum in: Surg Endosc 2008;22:599.
44. Moreno C, Closset J, Dugardeyn S, et al. Transoral gastroplasty is safe, feasible, and induces significant weight loss in morbidly obese patients: results of the second human pilot study. Endoscopy 2008;40:406-13. Erratum in: Endoscopy 2008;40:537.
45. Closset J, Germanova D, Loi P, et al. Laparoscopic gastric bypass as a revision procedure after transoral gastroplasty. Obes Surg 2011;21:1-4.
46. de Jong K, Mathus-Vliegen EM, Veldhuyzen EA, et al. Short-term safety and efficacy of the Trans-oral Endoscopic Restrictive Implant System for the treatment of obesity. Gastrointest Endosc 2010;72:497-504.
47. Coskun H, Duran Y, Dilege E, et al. Effect on gastric emptying and weight reduction of botulinum toxin-A injection into the gastric antral layer: an experimental study in the obese rat model. Obes Surg 2005;15:1137-43.
48. García-Compean D, Mendoza-Fuerte E, Martínez JA, et al. Endoscopic injection of botulinum toxin in the gastric antrum for the treatment of obesity. Results of a pilot study. Gastroenterol Clin Biol 2005;29:789-91.
49. Kencana AP, Rasouli M, Huynh VA, et al. An ingestible wireless capsule for treatment of obesity. Conf Proc IEEE Eng Med Biol Soc 2010;1:963-6.

Prepared by:
ASGE TECHNOLOGY COMMITTEE
Sripathi R. Kethu, MD
Subbhas Banerjee, MD
Bradley A. Barth, MD
David J. Desilets, MD
Vivek Kaul, MD
Marcos C. Pedrosa, MD
Patrick R. Pfau, MD
Douglas K. Pleskow, MD
Jeffery L. Tokar, MD
Amy Wang, MD
Louis-Michel Wong Kee Song, MD
Sarah A. Rodriguez, MD, Committee Chair
This document is a product of the ASGE Technology Assessment Committee. This document was reviewed and approved by the Governing Board of the ASGE.