DOI: https://doi.org/10.25121/PNM.2018.31.3.158 Post N Med 2018; XXXI(3): 158-164





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# The current place of intragastric balloon in the treatment of obesity – what should clinicians know?

## Aktualne miejsce balonu dożołądkowego w leczeniu otyłości – co powinni wiedzieć lekarze?

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**Keywords**
obesity, weight loss, endoscopy, intragastric balloon

**Słowa kluczowe**
otyłość, redukcja masy ciała, endoskopia, balon dożołądkowy

**Conflict of interest**
**Konflikt interesów**
None
Brak konfliktu interesów

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Summary

Endoscopic bariatric therapy (EBT), including intragastric balloon (IGB), seem to fill the gap between medical and surgical options of obesity treatment. Currently, there are three IGB systems approved by the FDA: Orbera™ Intragastric Balloon System, ReShape Integrated Dual Balloon System, and the Obalon system. Despite the advantages of IGB such as anatomy preservation, potentially lower risk of serious complications, and costing than bariatric surgery, the achieved weight loss is smaller and often only temporary. The maximum efficacy of IGB therapy is achieved with a comprehensive weight management program including patient education and lifestyle modification. Careful selection of patients for IGB, frequent control visits after balloon placement, and its removal at 6 months on time after insertion are recommended to reduce complications and increase the safety profile of IGB therapy. We discuss the current place of IGBs in the treatment of obesity with particular focus on their efficacy and safety, recent FDA updates, and published data in order to facilitate future decisions on implementing EBT for individual patients.

Streszczenie

Istniejącą lukę w leczeniu otyłości, pomiędzy standardowym postępowaniem zachowawczym a chirurgią bariatryczną, wypełniają metody endoskopowe, w tym balon dożołądkowy (ang. *intragastric balloon* – IGB). Aktualnie zatwierdzone przez FDA są trzy balony dożołądkowe: Orbera™ Intragastric Balloon System, ReShape Integrated Dual Balloon System oraz Obalon. Pomimo korzyści wynikających z terapii IGB, takich jak: zachowanie anatomii, potencjalnie mniejsze ryzyko poważnych powikłań i niższe koszty w porównaniu z leczeniem chirurgicznym, osiągany spadek masy ciała jest mniejszy i często tymczasowy. Maksymalną skuteczność z terapii IGB może zapewnić jedynie kompleksowe leczenie obejmujące również edukację pacjenta i zmianę stylu życia. Aby zmniejszyć częstość powikłań i poprawić bezpieczeństwo procedury należy ostrożnie selekcjonować chorych do IGB, przeprowadzać częste kontrole po założeniu balonu i usunąć go we właściwym czasie. W artykule przedstawiamy aktualne dane o zastosowaniu IGB w leczeniu otyłości ze szczególnym uwzględnieniem korzyści i bezpieczeństwa ich stosowania, ostatnich doniesień FDA oraz najnowszych badań.

## INTRODUCTION

Considering the increasing worldwide number of obese and overweight patients as well as obesity-related complications, there is a need for therapies that will provide long-term weight loss. To date, standard treatments of obesity that include diets, physical activity, and pharmacology have had limited efficacy. Currently, bariatric and metabolic surgery remains the most effective method to achieve and maintain weight loss. Bariatric surgery is mainly reserved for patients with a body mass index (BMI) $\geq 40$ or $\geq 30$ kg/m$^2$ with comorbidities. Overall, the rate of serious complications associated with bariatric surgery is 4% and mortality rate is around 0.1% (1). However, less than 2% of eligible obese patients receive bariatric surgery. There are patients who do not want to undergo surgery or patients who are at higher surgical risk, with contraindications to surgery and/or anesthesia. In addition, some

patients with obesity-related comorbidities have a BMI just below the established criteria for bariatric surgery. Moreover, certain patients such as younger people would prefer to lose weight by using non-invasive options. Thus, endoscopic bariatric therapies (EBT), especially intragastric balloons (IGBs), seem to fill the gap between medical and surgical options. Despite the advantages of IGB, such as anatomy preservation, a potentially lower risk of serious complications, and costing less than bariatric surgery, the achieved weight loss is smaller and rather temporary (2, 3). Therefore, other behavioral and pharmacological interventions are important to maintain weight loss. In this paper, we will discuss the current place of IGBs in the treatment of obesity with a particular focus on their efficacy and safety, recent US Food and Drug Administration (FDA) updates, in order to facilitate future decisions on implementing EBT for the individual patient. Other EBTs will not be discussed in this review.

## THE USE OF ENDOSCOPIC BARIATRIC THERAPIES

Endoscopic bariatric devices are generally divided into gastric and small bowel endoscopic therapies. Gastric EBT includes devices that occupy space in the stomach (IGB), devices that remove a portion of the consumed meal (aspiration therapy), and devices that alter gastric anatomy to reduce volume and accommodation (plication, suturing) (tab. 1). Some devices have already been approved by the FDA and several more are currently under investigation (4). All health care providers should be particularly familiar with IGBs which are available worldwide. Weight loss due to IGBs mostly results from increased satiety and delayed gastric emptying.

**Tab. 1.** Endoscopic bariatric therapies

| **Gastric endoscopic bariatric therapies** |
|---|
| Devices occupying stomach space with the device: Intragastric balloons<br>Orbera Intragastric Balloon System (Apollo Endosurgery, Austin, TX)<br>ReShape Integrated Dual Balloon System (ReShape Medical, San Clemente, CA)<br>Obalon Balloon System (Obalon Therapeutics, Carlsbad, CA)<br>Spatz Adjustable Balloon System (Spatz FGIA, Great Neck, NY)<br>Elipse Balloon (Allurion Technologies, Wellesley, MA)<br>Devices occupying space by delaying gastric emptying:<br>Transpyloric Shuttle, TPS (BARONova Inc, San Carlos, CA)<br>Devices removing excess calories<br>Aspiration therapy (Aspire Assist System, Aspire Bariatrics, King of Prussia, PA), FDA approved<br>Devices altering anatomy<br>Primary Surgery Obesity Endoluminal, POSE Procedure (Incisionless Operating Platform, USGI<br>Medical, San Clemente, CA)<br>Endoscopic Sleeve Gastroplasty, ESG (The Overtstitch, Apollo Endosurgery, Austin, TX) |
| **Small bowel endoscopic bariatric therapies** |
| Duodenal-Jejunal Bypass Liner, EndoBarrier (GI Dynamics, Boston, MA)<br>Duodenal Mucosal Resurfacing, Revita DMR (Frctyl, Lexington, MA)<br>Gastroduodenojejunal bypass sleeve, ValentTX Endoluminal Bypass (ValentTX Inc, Hopkins, MN)<br>Self-assembling magnets for dual-path enternal bypass, Incisionless Magnetic Anastomosis System,<br>IMAS (GI Windows, Boston, MA) |

The American Society for Metabolic and Bariatric Surgery (ASMBS) has added IGB therapy to the list of approved procedures and devices for the treatment of obesity with discussing potential situations where this therapy may be offered. In general, an IGB is indicated for patients with a BMI between 30 and 40 kg/m$^2$ who were not able to lose weight or maintain weight loss with standard noninvasive methods or who refuse to undergo permanent bariatric surgery. IGB can be considered as a bridge therapy for patients who need to lose weight before non-bariatric procedures (e.g. knee or hip replacement) (2, 5).

Currently, there are three types of IGBs having been approved by the FDA from 2015 to 2016: Orbera™ (Orbera™ Intragastric Balloon System, Apollo Endosurgery Inc., Austin, TX), ReShape Integrated Dual Balloon System (ReShape Medical, Inc., San Clemente, CA), and the Obalon System (Obalon Therapeutics, Inc.) (tab. 2) (6-8). In addition, the FDA approved in 2016 the AsspireAssist (Aspire Bariatric Inc., King of Prussia, PA) which removes a portion of the stomach content after eating (tab. 1) (4). The Orbera™ and ReShape balloons were the first IGBs that received approval after the removal of the Garren-Edwards Gastric Bubble (GEB, American Edwards) in 1988 due to several reports that showed a low efficacy and high complications rate including balloon deflation causing bowel obstruction, bleeding gastric ulcers, and gastric perforation (4). The ASMBS estimated that 5,000 IGBs have been implemented since FDA approval, which represents less than 3 percent of the 216,000 bariatric surgeries performed in the United States in 2016 (6). The Orbera™ and ReShape IGBs are placed for

**Tab. 2.** Intragastric balloons characteristics

| |
|---|
| **Orbera Intragastric Balloon System**<br>FDA approved. Implantation time: 6 months.<br>Saline-filled single silicone balloon system, fill volume: 400-700 mL.<br>Placement: endoscopic. Removal: endoscopic after aspiration of balloon fluid. |
| **ReShape Integrated Dual Balloon System**<br>FDA approved. Implantation time: 6 months.<br>Saline-filled double silicone balloon system. Fill volume: 375-450 mL/balloon.<br>Placement: endoscopic. Removal: endoscopic after deflation. |
| **Obalon Balloon System**<br>FDA approved. Implantation time: 6 months (from the first balloon administration).<br>Nitrogen mix gas filled, up to 3 thin polymer balloons Fill volume: 250 mL.<br>Placement: balloon swallowed in a capsule, confirmation with fluoroscopy.<br>Removal: endoscopic after deflation. |
| **Spatz Adjustable Balloon System**<br>Not FDA approved. Implantation time: 12 months.<br>Saline-filled silicone balloon system with volume adjustment.<br>Placement: endoscopic. Removal: endoscopic. |
| **Elipse Balloon**<br>Not FDA approved. Implantation time: 4 months.<br>Saline-filled balloon made of film. Fill volume: 550 mL.<br>Placement: balloon swallowed in a capsule, confirmation with fluoroscopy.<br>Removal: catastrophic valve release to allow complete balloon deflation and passage through<br>gastrointestinal tract. |

a maximum period of 6 months. The Obalon System is intended to remain in the stomach for 6 months from the time of placement of the first balloon. After that time, all balloons must be removed. The indication for IGB according to the instruction of the individual companies are as follows. The Orbera™ Intragastric Balloon System is indicated for patients with a BMI of ≥ 30 and ≤ 40 kg/m$^2$ in conjunction with a long-term supervised diet and behavior modification program designed to increase the possibility of significant long-term weight loss and maintenance of that weight loss. The Orbera™ IGB is indicated for adult patients who have failed to achieve weight reduction with more conservative alternatives such as a supervised diet, exercise, and behavior modification programs (10). The ReShape Dual Balloon System is indicated in conjunction with diet and exercise for adult patients with a BMI of 30 to 40 kg/m$^2$ and 1 or more obesity-related comorbid conditions and who have failed to achieve weight reduction with diet and exercise alone. The maximum placement period for the ReShape balloon is 6 months (11). The Obalon Balloon System is indicated for temporary use to facilitate weight loss in adults with obesity (BMI of 30 to 40 kg/m$^2$) who have failed to lose weight through diet and exercise. The system is intended to be used as an adjunct to a moderate intensity diet and behavior modification program (12).

## INTRAGASTRIC BALLOONS IN CLINICAL PRACTICE

The ASMBS and American Society for Gastrointestinal Endoscopy (ASGE) recommend multidisciplinary care of patients treated with an IGB to support weight loss and subsequent maintenance (2, 3). There are several important issues that should be taken into account when performing EBT in clinical practice in order to achieve maximum benefits with the lowest risks. The institutions offering EBT must have access to several services that will provide proper management of obese patients such as: gastroenterologists trained in bariatric procedures, gastrointestinal endoscopy nurses, bariatric surgeons, anaesthetists, dieticians, and mental health providers. Appropriate patient selection is critical for procedure success itself and weight loss maintenance. The clinical history should be analyzed to assess contraindications and risk of potential complications. Contraindications to an IGB include: prior gastric or bariatric surgery, large hiatal hernia (≥ 5 cm), esophageal motility disorders, esophageal strictures, inflammatory bowel diseases affecting the upper gastrointestinal tract, pregnancy and breastfeeding, potential upper gastrointestinal bleeding conditions (e.g. varices), severe liver disease, gastric mass, concurrent use of anticoagulation therapy or aspirin, coagulopathy, uncontrolled psychiatric disorders, alcoholism or drug addiction, and suspicion of allergy to IGB materials (2, 3, 10-13). In addition, patients should be informed about the necessity of diet and behavior modification not only at the time of balloon therapy but as well as before and after the procedure. Patients should be motivated to lose weight before and after the procedure to achieve long-term benefits. Therefore, IGB therapy should not be offered for patients who are unwilling to participate in an established supervised diet and behavior modification program. The AMBS underlines the importance of informed patient consent. Patients should be informed that IGB therapy is a non-surgical, but invasive procedure, and should receive detailed information about potential adverse events such as: intestinal/gastric outlet/esophageal obstruction, death, nausea, vomiting, abdominal pain, gastroesophageal reflux, injury to the digestive tract during placement or removal of the balloon (ulcers, bleeding, perforation), balloon deflation and its subsequent removal, insufficient or no weight loss, and complications associated with endoscopy or anaesthesia. Particular attention with consultations should be paid to avoid misinterpretation of the procedure. Patients who lack a general understanding of the procedure and its risks and benefits should not be considered for IGB therapy (2, 13). Currently, the FDA recommends patients to participate in a lifestyle program for 6 months when the balloon is placed in the stomach and for 6 months after its removal. All patients should have regular sessions with a dietician before and after the endoscopic procedure. General patient management recommendations are summarized in table 3 (2, 3, 13).

## PIVOTAL INTRAGASTRIC BALLOON STUDIES

The Orbera™ IGB was approved based on the results of the Orbera FDA pivotal trial and two trials performed in France and Australia. The study of Abu Dayyeh et al. included in the Appolo Endosurgery "Direction for Use" was a 12-month multicenter, prospective, non-blinded randomized study in which a 6-month therapy with Orbera with a behavioral program over 12 months was compared to 12 months of a behavioral program alone (control) in adult patients with a BMI of 30-40 kg/m$^2$ (10). The mean weight loss was higher in the IGB treated group compared to the control group (%TBWL: 10.2 vs 3.3) (tab. 3). However, the weight loss difference between these two interventions diminished at 9 months (%TBWL: 9.1 for IGB vs 3.4 for controls) and 12 months (%TBWL: 7.6 for IGB vs 3.1 for controls) (Orbera instruction). The severity of comorbidities such as diabetes, hypertension, and dyslipidemia has been reduced but not significantly when compared to controls and was likely the result of a lifestyle intervention program. Both study groups reported improvement in the quality of life. However, the Orbera™ IGB resulted in significantly better improvement in all domains of Short Form 36 (SF-36) compared to controls. There were no unanticipated or deaths during the study and the rate of procedure or device-related serious adverse events was 10%. Early IGB retrieval occurred in 18.8% of patients. The most common adverse events were nausea, vomiting, and abdominal pain, with the majority being mild to moderate and resolving within 2 weeks after balloon placement (tab. 4) (7, 10).

**Tab. 3.** Intragastric balloon in clinical practice – patient management

| | |
|---|---|
| Pre-procedural patient evaluation | Careful selection of patient: medical history, physical examination, screening for obesity-related diseases, commitment to lifestyle change Nutrition assessment: diet history, eating patterns.<br>Education for postoperative diet.<br>Routine laboratory tests: complete blood count, fasting blood glucose, lipid panel, liver profile, kidney function, prothrombin time, urinalysis.<br>Consider nutritional screening: 25-hydroxy vitamin D, iron, vitamin $B_{12}$, and folic acid.<br>Consider psychological evaluation: psychosocial behavioral evaluation by a psychiatrist or psychologist.<br>Consider if necessary: endocrine and cardiopulmonary evaluation. |
| Procedure issues | Post-procedural symptoms (usually first days) management:<br>vomiting and nausea: ondansetron (8 mg po tid), metoclopramide (10 mg)<br>dehydration: ensure adequate fluid intake, intravenous fluid<br>reflux symptoms: proton pump inhibitor po<br>Early post-procedural diet recommendation:<br>Day 1 to 2: clear liquids only (e.g. water weak coffee, tea)<br>Day 3 to 14: full liquid diet (1000-1200 kcal/d, e.g. low fat yogurt drinks, skim milk, protein shakes)<br>Day 15 to 21: soft food (1200-1500 kcal/d)<br>After 21 days: normal textured food<br>Solid food should be introduce gradually<br>Recommend 1/2 glass of water 30 minutes before and 30 minutes after eating<br>Balloon removal at 6 months:<br>Day 3 to 4 before: full liquid diet<br>24 to 36 hours before: clear liquid diet<br>12 hours before: fasting<br>Concern for spontaneous deflation: patients education, methylene blue in balloon, abdominal radiograph (if necessary) |
| Post-procedural patient evaluation | Consider evaluation of laboratory tests and micronutrient status<br>Lifestyle intervention (for one year, frequency based on trials: 6 to 13 visits, face-to-face session preferred) including:<br>diet (dietitian/physician) to reduce calorie intake<br>exercise (moderate-intensity exercise, ≥ 150 minutes per week for weight loss and 200-300 minutes per week for weight maintenance)<br>behavioral modification (self-monitoring, slowing the rate of eating, social support, cognitive restructuring, problem solving, relapse intervention) |

**Tab. 4.** The results of IGB pivotal trials

| | **The Orbera** | **ReShape** | **Obalon** |
|---|---|---|---|
| Study design | Randomized, open-label | Randomized, sham-controlled, double--blinded | Randomized, sham-controlled, double-blinded |
| Active/control group (n) | 125/130 | 187/139 | 198/189 |
| Visits (lifestyle intervention) | 12 | 6 | 7 |
| %TBWL[1] (balloon vs control) | 10.2 ± 6.6 vs 3.3 ± 5.0 | 6.8 vs 3.3 | 6.6 ± 5.1 vs 3.4 ± 5.0 |
| Responder rate[2] | 79.2% | 48.8% | 62.1% |
| Serious adverse events | gastric outlet obstruction with gastritis (n = 1),<br>gastric perforation with sepsis (n = 1), aspiration pneumonia (n = 1), infected balloon (n = 1),<br>dehydration (n = 2),<br>device intolerance (n = 8),<br>esophageal mucosal injury (n = 2),<br>laryngospasm (n = 1) | esophageal mucosal tear (n = 1), contained esophageal perforation (n = 1), bleeding gastric ulcer (n = 1), aspiration pneumonia (n = 1), dehydration (n = 2) | bleeding gastric ulcer (n = 1) |
| Early retrieval | 18.8% | 15% | 9.6% |
| Non-serious adverse events | vomiting (86.8%),<br>nausea (75.6%),<br>abdominal pain (57.5%), GERD (30%),<br>dyspepsia (21.3%),<br>erosive esophagitis (0.6%), erosive gastritis (0.6%) | vomiting (86.7%),<br>nausea (61.0%),<br>abdominal pain (54.5%), gastric ulcer (35.2%, 10.3%), dyspepsia (17.8),<br>GERD (6.8%),<br>erosive esophagitis (0.4%), erosive gastritis (0.6%) | abdominal pain (72.6%), nausea (56.0%),<br>vomiting (17.3%), dyspepsia (16.9%),<br>erosive gastritis (7.1%),<br>erosive esophagitis (1.8%),<br>gastric ulcer (0.9%) |

[1] %TBWL – % total body weight loss; [2] Responder rate: % of subjects or ≥ 5% TBWL or ≥ 25% EWL

In the Reshape and Obalon IGBs pivotal trials, the mean %TBWL was smaller than in in the Orbera™ IGB study (tab. 4). However, the number of lifestyle intervention visits in these trials was different. In the REDUCE pivotal study of ReShape IGB, 7.5% patients who received a balloon had a device or procedure-related serious adverse events. Most of the adverse events were vomiting, nausea, and abdominal pain. There were no deaths, device migration, nor intestinal obstruction (tab. 4). The high number of reported gastric ulcers was reduced by 74% after a device modification. The device was removed in 8 patients due to serious adverse events. Early device deflation occurred in 6% of patients without any adverse events noted (8, 11).

In the SMART pivotal study of the Obalon System, a serious adverse event (gastric ulcer bleeding) occurred in 1 patient (0.3%). There were no deaths, migration, nor intestinal obstruction. Only one balloon deflation occurred. There were 16 patients (4.8%) who did not receive all three balloons due to pain or nausea (n = 6), unwillingness to have another balloon (n = 5), or balloon swallowing problems (tab. 4) (9, 12).

## FDA UPDATES ON SAFETY OF IGB

In 2017, the FDA issued two letters to healthcare provides about the potential risks associated with liquid-filled IGBs (14, 15). On February 9th 2017, the FDA informed about spontaneous hyperinflation and acute pancreatitis cases that led to balloon removal (14). Over-inflation occurred as soon as nine days after balloon insertion and presented with symptoms including abdominal pain, abdominal distention with or without discomfort, difficult breathing, and/or vomiting. Pancreatitis can occur as soon as three days after implantation and presents with severe abdominal and back pain. Companies have revised their product labelling in order to address the risks of these adverse events. On August 10th, the FDA warned that since 2016, five patients treated with IGBs have died within a month or less after balloon placement (four reports involved the Orbera™ IGB and one report involved the ReShape Integrated Dual Balloon System). Three deaths occurred within the first 3 days. In addition, the agency stated that the root cause or incidence rate of the patient deaths is not known and they were not able to definitely attribute the deaths to the devices or the insertion procedures for these devices (15). Two additional deaths were reported in the same time: one gastric perforation with the Orbera™ IGB and one esophageal perforation with the ReShape IGB. As a result of the second statement, Apollo Endosurgery noted that the Orbera™ IGB is the only system in accordance with the standards of the ASGE and company self-reported deaths to the FDA, and the death rate among patients treated with the Orbera™ IGB since August 2015 was less than 0.01%, being lower than the rate observed with surgical procedures (14-16). The FDA recommended close monitoring of patients treated with these devices, assessing the symptoms reported by patients in order to detect possible spontaneous over-inflation and/or pancreatitis, following the manufacturer's instructions during device removal, and reporting all complications and adverse events through MedWatch, the FDA Safety Information and Adverse Event Reporting Program which will help identify and understand the risks connected with IGBs. The FDA informed that it is working with both companies and FDA-mandated post-approval studies are ongoing to better understand causes of complications, as well as safety and effectiveness of these devices (14, 15).

The ASGE and Association for Bariatric Endoscopy (ABE), a Division of ASGE, has also responded to the FDA letters and stated that any weight loss procedure, whether endoscopic or surgical, must be evaluated for its risks and benefits and underlined that patients be carefully selected for each procedure. The ASGE/ABE will be monitoring all information regarding safety and complications of IGB (17). In addition, the ASMBS proposed an addendum to the Position Statement on Intragastric Balloon Therapy in January 2018 (18). The ASMBS noted that the reported rate for acute pancreatitis was 0.1%, and 0.04% for hyperinflation, and mortality rate was 0.037%. Furthermore, other complications such as gastritis, ulceration, reflux, nausea, vomiting, bowel obstruction, dehydration, renal insufficiency, arrhythmia, and early removal have all been documented at a level below 1% (18).

## EFFICACY AND SAFETY OF IGB IN OTHER PUBLISHED STUDIES

There are several studies assessing the differences in the efficacy and safety of IGBs that differ in design, outcomes, and therapy duration.

In 2015, the ASGE published a meta-analysis of studies with IGB therapy that showed a pooled estimate of 13.2% TBWL at 6 months and 11.3% at 12 months. The most common adverse events included abdominal pain (33.7%) and nausea (29%). Balloon intolerance was estimated to be 7.5%. Rarely observed complications were balloon migration (1.4%) and perforation (0.1%) with the half of the perforations occurring in patients with prior bariatric surgery (19).

IGB therapy provides better weight loss benefits compared to medication. Weight loss usually stops with the cessation of medications and indeed is regained within 6 months. Conversely, 66 to 90% of the weight loss due to IGB therapy is maintained 6 months after balloon removal (7-12). An average of 52% of the weight loss is sustained at 12 months after balloon removal (20). In one study, 83% of patients achieved > 20% excess weight loss (EWL) with IGB therapy, at 1 year after balloon removal the %EWL was 27.7%, at a 2-year follow-up %EWL was 17.1%, and 5-year %EWL was estimated to be 12.97%. It was noted that 68% of weight loss during therapy was maintained a year after IGB removal (21).

The weight loss is associated with prevention and improvement of obesity-related comorbidities such as hypertension and obesity. It has been demonstrated that Orbera™ IGB can improve obesity-related comorbidities such as hypertension (from 29 to 16%), hyperlipidemia (from 32 to 21%), and diabetes (from 15 to 10%) (23). In a recent systemic review and meta-analysis of 10 randomized controlled trials and 30 observational studies including 5,668 patients, IGB therapy was more effective than diet in improving obesity-related metabolic risk factors with low rate of serious adverse events (1.3%). However, the authors concluded that the strength of the evidence is limited by the small number of patients and lack of a long-term follow-up (24).

Vargas et all, performed a post-regulatory approval study of the efficacy and safety of Orbera™ IGB and

found that IGB therapy is safe, provides weight loss, and reduces obesity-related comorbidities in a real-world clinical setting. They analyzed 321 patients treated with an IGB from the Mayo Clinic's database. The rate of early balloon removal was 16.7% with a median of 8 months after its placement and was observed more often in patients taking selective serotonin or serotonin-norepinephrine re-uptake inhibitors. At 6 months, the %TBLW was 11.8% ± 7.5% and %TBWL > 10% was achieved by 62% patients (25).

A retrospective analysis of 202 real-world patients treated with the ReShape IGB (2 academic centers and 5 private practices) found that it is a safe and effective weight loss therapy. The %TBWL at 6 months greater than 10% was achieved by 60.4% patients. The balloon was removed before the end of the 6th month in 6.4% of patients. Only one patient has balloon migration causing intestinal obstruction that needed surgery and 8.4% of patients had esophageal tears during insertion of the balloon (26).

Another recent systemic review and meta-analysis investigated the association between balloon filling volume and weight loss outcomes. The authors found that there was no association between balloon filling volume and the %TBWL at 6 months, early balloon removal, gastroesophageal reflux symptoms, and ulcer rate. However, higher balloon filling volumes appeared to be associated with a lower rate of migration and esophagitis. The authors recommended a balloon filling volume of 600-650 mL (27).

The use of an IGB before bariatric surgery was also analyzed (28-30). Zerrweck et al. found that an IGB prior to laparoscopic gastric bypass in super obese patients significantly reduced excess BMI and was associated with a lower risk of significant outcomes and shorter operative time (28). In contrast, recent studies do not support beneficial effects of IGB therapy before bariatric surgery (29, 30). In a prospective randomized multicenter study, insertion of an IGB before laparoscopic gastric bypass did not improve the perioperative outcomes or affect postoperative weight loss compared to standard medical care (29). In another prospective, case control study, IGB therapy performed before laparoscopic sleeve gastrectomy and gastric bypass in morbid obesity was ineffective in reducing postsurgical morbidity. However, it resulted in a greater weight reduction compared to diet and exercise (30).

A Brazilian group recently published practical guidelines based on experience with over 40,000 cases and stated that IGB leads to satisfactory weight loss with a low rate of complications. Early removal rate due to intolerance was 2.2% and the adverse events rate after an adaptation period was 2.5%. The most common adverse events were hyperinflation (0.9%) and spontaneous deflation (0.8%) (31).

In contrast, in another recently published review of eight randomized control trials, the weighted reported incidence of serious adverse events in patients treated with an IGB was 10.5-28.2% (32). The safety update on IGB published by the same authors noted that the Orbera™ and ReShape IGBs had been implicated in 33 deaths between January 1st 2006 and October 5th 2017. In addition, they recommended the FDA to reconsider its approval and withdrawal of these two IGBs (16).

Doubt still exists about the efficacy and safety of intragastric balloons resulting in difficult assessments of real benefits and risks associated with IGB therapy. New interpretation of clinical studies published so far and the proper design of future clinical trials using new tools such as the FDA benefit-risk paradigm, a Preference Calculator for Weight-Loss Devices will give us more definitive answers (33).

## CONCLUSIONS

Overall, the data suggest that IGB therapy is an effective and safe tool for weight loss filling the gap in the current options for obesity treatment. However, the maximum success of IGB therapy can only be achieved in a comprehensive weight management program including patient education and lifestyle intervention. Careful selection of patients for IGB, frequent control visits after balloon placement, and its removal by 6 months after insertion are recommended to reduce complications and increase the safety of IGB therapy.

BIBLIOGRAPHY


1. American Society for Metabolic and Bariatric Surgery: Metabolic and bariatric surgery: fact sheet. 2013; https://asmbs.org/wp/uploads/2014/05/Metabolic+Bariatric-Surgery.pdf.
2. Ali MR, Moustarah F, Kim JJ et al.: American Society for Metabolic and Bariatric Surgery position statement on intragastric balloon therapy endorsed by the Society of American Gastrointestinal and Endoscopic Surgeon. Surg Obes Relat Dis 2016; 12: 462-467.
3. Sullivan S, Kumar N, Edmundowicz SA et al.: ASGE position statement on endoscopic bariatric therapies in clinical practice. Gastrointest Endosc 2015; 82: 767-772.
4. Sullivan S, Edmundowicz SA, Thompson CC: Endoscopic Bariatric and Metabolic Therapies: New and Emerging Technologies. Gastroenterology 2017; 152: 1791-1801.
5. American Society for Metabolic and Bariatric Surgery: Approved procedures and devices; https://asmbs.org/resources/approved-procedures.
6. US Food and Drug Administration: Summary of safety and effectiveness data (SSED) ORBERA Intragastric Balloon System; https://www.accessdata.fda.gov/cdrh_docs/pdf14/P140008b.pdf. 2015:1-32.
7. US Food and Drug Administration: Summary of safety and effectiveness data (SSED) ReShape Integrated Dual Balloon System; https://www.accessdata.fda.gov/cdrh_docs/pdf14/P140012b.pdf. 2015:1-43.
8. US Food and Drug Administration: Summary of safety and effectiveness data (SSED) Obalon Balloon System; https://www.accessdata.fda.gov/cdrh_docs/pdf16/P160001b.pdf. 2016:1-46.
9. ASMBS adds intragastric balloon to approved procedures and devices. Connect Official News Magazine of ASMS; http://connect.asmbs.org/february-2018-asmbs-balloon-approval.html.
10. Orbera Intragastric Balloon System. Direction for Use; http://apolloendo.com/wp-content/uploads/2017/06/GRF-00346-00R02.pdf.
11. ReShape Medical: ReShape Integrated Dual Balloon System Instruction for use; https://reshapeready.com/wp-content/uploads/2015/07/ReShape_Instructions_For_Use.pdf.
12. Obalon Balloon System Instruction for Use; http://www.obalon.com/wp-content/uploads/2016/12/P160001.ObalonBalloonIFU.PhysicianLabeling.IR-10_Response_clean_0908201612.pdf.
13. Papademetriou M, Popov V: Intragastric Balloons in Clinical Practice. Gastrointest Endoscopy Clin N Am 2017; 27: 245-256.

14. US Food and Drug Administration: The FDA alerts health care providers about potential risks with liquid-filled intragastric balloons. February 9, 2017; https://www.fda.gov/MedicalDevices/Safety/LetterstoHealthCareProviders/ucm540655.htm.
15. US Food and Drug Administration: UPDATE: Potential risks with liquid-filled intragastric balloons – Letter to Health Care Providers. August 10, 2017; https://www.fda.gov/MedicalDevices/Safety/LetterstoHealthCareProviders/ucm570707.htm.
16. Tate CM, Geliebter A: Intragastric Ballon Treatment for Obesity: FDA Safety Updates. Adv Ther 2018; 35: 1-4.
17. ASGE/ABE issue response to FDA intragastric balloons warning. August 18, 2017; http://www.bariatricnews.net/?q=news/112798/asgeabe-issue-response-fda-intragastric-balloons-warning.
18. Moore R, Rosenthal R, American Society for Metabolic and Bariatric Surgery: Proposed Addendum to Position Statement on Intragastric Ballon Therapy. January 2018; https://asmbs.org/wp/uploads/2018/02/Balloon-Addemdum-Moore-Rosenthal.pdf.
19. ASGE Bariatric Endoscopy Task Force and ASGE Technology Committee, Abu Dayyeh BK, Kumar N et al.: ASGE Bariatric Endoscopy Task Force systematic review and meta-analysis assessing the ASGE PIVI thresholds for adopting endoscopic bariatric therapies. Gastrointest Endosc 2015; 82: 425-38.e5.
20. Gaur S, Levy S, Mathus-Vliegen L et al.: Balancing risk and reward: a critical review of the intragastric balloon for weight loss. Gastrointest Endosc 2015; 81: 1330-1336.
21. Kotzampassi K, Grosomanidis V, Papakostas P et al.: 500 intragastric balloons: what happens 5 years thereafter? Obes Surg 2012; 22: 896-903.
22. Vagas EJ, Rizk M, Bazerbachi F et al.: Medical Devices for Obesity Treatment. Med Clin N Am 2018; 102: 149-163.
23. Genco A, López-Nava G, Wahlen C et al.: Multi-centre European experience with intragastric balloon in overweight populations: 13 years of experience. Obes Surg 2013; 23: 515-521.
24. Popov VB, Ou A, Schulman AR et al.: The impact of Intragastric Balloons on Obesity-Related Co-Morbidities: A Systemic Review and Meta-Analysis. Am J Gastroenterol 2017; 112: 429-439.
25. Vargas EJ, Pesta CM, Bali A et al.: Single Fluid-Filled Intragastric Balloon Safe and Effective for Inducing Weight Loss in a Real-World Population. Clin Gastroenterol Hepatol 2018 Feb 7. pii: S1542-3565(18)30117-4 [Epub ahead of print].
26. Agnihotri A, Xie A, Bartalos C et al.: Real-world safety and efficacy of fluid-filled dual intra-gastric balloon for weight loss. Clin Gastroenterol Hepatol 2018 Feb 23. pii: S1542-3565(18)30171-X [Epub ahead of print].
27. Kumar N, Bazerbachi F, Rustagi T et al.: The influence of the Orbera Intragastric Balloon Filling Volumes on Weight Loss, Tolerability, and Adverse Events: a Systemic Review and Meta-Analysis. Obes Surg 2017; 27: 2272-2278.
28. Zerrweck C, Maunoury V, Caiazzo R et al.: Preoperative weight loss with intragastric balloon decreases the risk of significant adverse outcomes of laparoscopic gastric bypass in super-super obese patients. Obes Surg 2012; 22: 777-782.
29. Coffin B, Maunoury V, Pattou F et al.: Impact of Intragastric Balloon Before Laparoscopic Gastric Bypass on Patients with Super Obesity: a Randomized Multicenter Study. Obes Surg 2017; 27: 902-909.
30. Vicente C, Rábago LR, Ortega A et al.: Usefulness of an intra-gastric balloon before bariatric surgery. Rev Esp Enferm Dig 2017; 109: 256-264.
31. Neto MG, Silva LB, Grecco E et al.: Brazilian Intragastric Balloon Consensus Statement (BIBC): practical guidelines based on experience of over 40,000 cases. Surg Obes Relat Dis 2018; 14: 151-159.
32. Tate CM, Geliebter A: Intragastric Balloon Treatment for Obesity: Review of Recent Studies. Adv Ther 2017; 34: 1859-1875.
33. Marrone AK, Antonino MJ, Silverstein JS et al.: The Regulatory Perspectives on Endoscopic Devices for Obesity. Gastrointest Endosc Clin N Am 2017; 27: 327-341.

received/otrzymano: 14.05.2018
accepted/zaakceptowano: 4.06.2018