OBES SURG (2018) 28:405–409
DOI 10.1007/s11695-017-2877-1

ORIGINAL CONTRIBUTIONS

Safety and Efficacy of a New Swallowable Intragastric Balloon Not Needing Endoscopy: Early Italian Experience

A. Genco[1] · I. Ernesti[2] · R. Ienca[2] · G. Casella[1] · S. Mariani[2] · D. Francomano[2] · E. Soricelli[1] · M. Lorenzo[3] · M. Monti[1]

Published online: 4 September 2017

Abstract
Purpose The aim of this study was to evaluate the safety and efficacy of a new intragastric balloon (Elipse™ Balloon, Allurion Technologies, Natick, MA USA) not needing endoscopy.
Materials and Methods The balloon was swallowed under fluoroscopy in 38 consecutive patients (F/M 28/10, mean age 46.4 ± 10.6 years, mean weight 109.7 ± 21.9 kg, and mean body mass index (BMI) 38.6 ± 6.7 kg/m^2). After 4 months, the balloon spontaneously emptied and it was excreted through the digestive tract without upper endoscopy.
Results There were no complications during balloon passage. After 16 weeks, the mean weight loss was 12.7 kg, mean percent excess weight loss was 26%, and mean BMI reduction was 4.2 kg/m^2. Total body weight loss was 11.6%. There was a significant reduction in major co-morbidities related to metabolic syndrome: blood pressure ($p < 0.02$), waist circumference ($p < 0.002$), triglycerides ($p < 0.0001$), blood glucose ($p < 0.001$), and HOMA-IR index ($p < 0.001$). At the end of the treatment, 37 balloons were naturally excreted in the stool, and one balloon was endoscopically removed.
Conclusions The results of this study on 38 consecutive patients demonstrate that the Elipse™ Balloon is safe, effective, and very well accepted by patients.

Keywords Overweight/obese treatment · Intragastric balloon · Weight loss · Elipse™

Introduction

Intragastric balloons have been used for several years to reduce weight in obese patients before bariatric surgery or in combination with lifestyle intervention in overweight patients to prevent obesity [1, 2]. Balloons can also be used for the treatment of obesity or even morbid obesity for patients that do not accept the idea of more invasive interventions as reg-

✉ A. Genco
alfredo.genco@uniroma1.it

I. Ernesti
ilaria.ernesti@uniroma1.it

R. Ienca
roberta.ienca@libero.it

G. Casella
giovanni.casella@uniroma1.it

S. Mariani
stefaniamariani@yahoo.com

D. Francomano
davide.francomano@gmail.com

E. Soricelli
emanuele.soricelli@gmail.com

M. Lorenzo
michele.lorenzo@gmail.com

M. Monti
massimo.monti@uniroma1.it

[1] Department of Surgical Sciences, Surgical Endoscopy Unit, Sapienza University of Rome, Rome, Italy

[2] Department of Experimental Medicine-Medical Physiopathology, Food Science and Endocrinology Section, Sapienza University of Rome, Rome, Italy

[3] National Health Service, Naples, Italy

ular laparoscopic bariatric surgery. Moreover, in overweight and moderately obese patients, endoscopic therapies, such as intragastric balloons, produce more weight loss when compared to behavioral and pharmacological treatment [3–5]. Balloon placement and removal usually require conscious or unconscious sedation and an upper endoscopy (UE) [6]. These procedures add costs and risks to the therapy and may lead to complications and higher procedure cost. In addition, UE can be uncomfortable, decreasing the general acceptance of the treatment.

In this study, a new liquid-filled, swallowable intragastric balloon was used. The device is placed under fluoroscopy without anesthesia or UE and it is conceived to open spontaneously in the stomach and be excreted through the digestive tract after 4 months [7, 8]. The aim of this study was to evaluate the safety and efficacy of this new balloon.

Material and Methods

The Elipse™ System

The Elipse balloon (Allurion Technologies, Natick, MA USA) is a gastric balloon that does not require UE for placement and removal. The balloon is enclosed in a small capsule attached to a thin catheter about 75 cm long and 1.3 mm in diameter. The capsule is easily swollen with a glass of water. In case swallowing is difficult, a stylet can be fed through the catheter to stiffen it, allowing the physician to gently push the capsule during swallowing. The balloon contains a small radiopaque ring that can be used to confirm its correct position inside the stomach through an abdominal x-ray. Finally, the balloon is filled with 550 mL of liquid consisting of distilled water with potassium sorbate preservative, and then the catheter is removed. This device is designed to spontaneously empty through a release valve after approximately 16 weeks of treatment and be excreted.

Study Design and Patients

This was a prospective study conducted in overweight and/or obese patients during the period between January and June 2016.

Inclusion criteria were age between 18 and 65 years and body mass index (BMI) greater than or equal to 27 kg/m^2 and less than 45 kg/m^2.

Patients were excluded from the study if they presented with any of the following: previous bariatric or gastric surgery or more than one other abdominal/gynecological operation, history of bowel obstructions, hiatal hernia (>5 cm), heart failure, eating disorders (bulimia, night eating syndrome or binge eating disorder), blood coagulation disorders, and certified pregnancy.

Following approval by the ethics committee, informed consent was obtained from all participants.

Screening

A detailed medical and obesity history was obtained in order to establish if the patient was an appropriate candidate. At the time of enrollment, all patients underwent clinical and anthropometric evaluation (height, weight, waist circumference, BMI, blood pressure, electrocardiogram). Moreover, blood tests including fasting insulin and glucose, complete blood count, coagulation profile, liver profile, and lipid panel were conducted. UE was performed in case of concerning digestive symptoms. Finally, a psychiatric and alimentary behavior evaluation was performed in all patients.

Elipse Balloon Deployment

Patients fasted for at least 8 h prior to the procedure and received a single 125 mg per os (PO) dose of the anti-emetic Aprepitant (Emend®) 4 h before the deployment of the balloon. Right after balloon placement, they received 4 mg intravenous (IV) ondansetron, 10 mg IV butylscopolamine, and IV hydration. Patients were discharged 2–4 h after the procedure with dietary recommendations, unless concerning symptoms and/or clinical signs were observed. A 2-day course of antiemetics (80 mg aprepitant PO on days 2 and 3 and 4 mg ondansetron TID as needed) and anti-spasmodic (10 mg butylscopolamine TID as needed) were prescribed as reported previously [8]. Omeprazole 40 mg daily was started 2 weeks prior to placement and was continued until the end of treatment. With regard to the dietary recommendations, only fluid hydration was permitted for the first 24 h. During the first week, a gradual progression to a semi-liquid diet (yogurt, mashed potatoes, thin soup, puréed vegetables) was recommended. Generally, at the beginning of the second week, the patient proceeded with caution to a hypocaloric, textured diet plan. The dietary program was administered by a nutritionist and was based on a daily intake of about 1000–1200 kcal (including at least 1 g of protein/kg of ideal weight consumed over three main meals and two small snacks). Regular physical activity was suggested to all patients.

Follow-Up

Close follow-up was conducted to prevent and identify possible adverse events. The patients were made aware of the importance of adequate hydration (at least 1.5 L water/day sipped slowly) and the importance of reporting symptoms early. In addition, they were contacted by phone every day for the first week after placement. Patients underwent a clinical and nutritional evaluation, as well as physical and anthropometric exam (weight, waist circumference, and BMI

measurement) every week in the first month, then twice a month until the end of the treatment. Moreover, the patients received a diary to record all medication intake. The presence and the severity of balloon's intolerance symptoms (nausea, vomiting, cramping, abdominal pain, satiety, regurgitation, difficulty in swallowing liquid or solid foods) were measured by means of a visual analog scale (VAS) (0 to 10 points, with 10 being most severe) the day of deployment (T0), 1-week (T1), 2-week (T2), 1-month (T3), 2-months (T4) follow-up, and at the end of treatment (T5).

Statistical Analysis

All results are reported as mean ± standard error (SE). Statistical differences for single comparisons were studied using *t* tests for non-paired data. Multiple regression analysis was performed to assess values for the VAS scale, BMI, weight, and waist circumference between the time points. A p value of 0.05 ± SD was considered statistically significant. Statistical analysis was carried out using SPSS/19.0 (SPSS, Chicago, IL, USA) and GraphPad Prism Version 5 (GraphPad Software Inc., San Diego, CA).

Results

Baseline Characteristics

A total of 38 patients were enrolled. At baseline, there were 28 females (73%) and 10 males (27%). The mean age was 46.4 ± 10.6 years, mean weight was 109.7 ± 21.9 kg, and mean BMI was 38.6 ± 6.7 kg/m^2 (Table 1). All patients demonstrated good compliance on nutritional recommendations and underwent all clinical and anthropometric evaluation every 2 weeks.

In the majority of cases, an UE was not performed during screening. We performed an UE in 7 patients who reported upper gastrointestinal symptoms during screening. Eight other patients had a history of unremarkable UE within the last 12 months due to previous intragastric balloon removal.

One patient was withdrawn from the study after 22 days. The patient was found to have a binge eating disorder, not previously diagnosed because this information was omitted by patient during enrollment. After two binge eating episodes, the patient presented with symptoms of balloon intolerance including nausea and recurrent vomiting. The balloon was punctured with a needle aspiration device, suctioned until empty, and removed endoscopically using a grasper for foreign body under conscious sedation.

Table 1 Demographics, mean ± SD

	Female (*n* 28)	Male (*n* 10)
Age (years)	45.1 ± 10.6	47.5 ± 11.5
Weight	128.7 ± 24.0	101.5 ± 14.7
BMI kg/m^2	42.0 ± 8.6	37.7 ± 5.4
Waist (cm)	134.1 ± 16.7	118.1 ± 15.1
Caucasian (%)	100	100

Performance

Thirty-six out of 38 patients (94.8%) were able to swallow the capsule with a glass of water. Two patients (5.2%) required assistance with a stylet. An abdominal x-ray was performed to confirm that the capsule had reached the stomach. All devices were filled with 550 mL of the provided filling fluid consisting of distilled water with potassium sorbate preservative. No complications as a result of balloon deployment were recorded. At approximately 16 weeks, all balloons were emptied through the release valve and were uneventfully excreted.

Safety

No serious adverse events were observed during the treatment. In particular, there were no gastric perforations, symptoms of ulceration, intestinal obstructions, and gastrointestinal hemorrhage.

All symptoms—including nausea, vomiting, cramping, abdominal pain, regurgitation, satiety, difficulty in swallowing liquid, and solid foods—were self-limiting or resolved with medications during the treatment. Among common side effects, nausea and regurgitation resulted in the highest VAS scores. With regards to other symptoms, a significant difference was evident between the first week after placement (T1) and at the end of treatment (T5) (Table 2).

One patient was seen after 10 weeks of treatment for nausea and vomiting which resolved after 6 h of outpatient observation with IV fluid hydration, anti-spasmodics, and antiemetics. This patient continued the treatment without any further complications.

Weight Loss

All patients lost weight during the treatment. We found a statistically significant difference in weight loss after 16 weeks: the mean weight loss was 12.7 kg, mean BMI reduction was 4.2 points kg/m^2, mean percent excess weight loss was 26%, and mean total body weight loss was 11.6% (Fig. 1a and b). Also, the treatment produced a significant reduction in the factors related to clinical diagnosis of metabolic syndrome: blood pressure ($p < 0.02$), waist circumference ($p < 0.002$), triglycerides ($p < 0.0001$), blood glucose ($p < 0.001$), and HOMA-IR index ($p < 0.001$) (Table 3) (Fig. 2).

Table 2 Symptoms assessment score by visual analog scale (VAS), mean ± SD

	T0	T1	T2	T3	T4	T5
Nausea	6 ± 3.1	2.2 ± 2.9*	0.4 ± 1.7*	0.2 ± 0.8*	0.2 ± 0.8*	0 ± 0*
Vomiting	2.6 ± 3.8	0.8 ± 1.9*	0.3 ± 1.8*	0.1 ± 0.2*	0.0 ± 0.2*	0 ± 0*
Regurgitation	3.8 ± 3.6	1.7 ± 2.6*	0.6 ± 1.4*	0.9 ± 2.5*	0.5 ± 1.5*	0.3 ± 1.2*
Satiety	9.3 ± 1.4	8.7 ± 1.6*	7.9 ± 1.7*	6.5 ± 3*	5.7 ± 2.7*	4.5 ± 2.3*
Cramping	6.7 ± 2.6	2.9 ± 2.7*	1.2 ± 1.7*	0.9 ± 1.8*	0.1 ± 0.6	0 ± 0
Abdominal pain	4.2 ± 3.4	2.6 ± 3.1*	1.2 ± 2*	1.5 ± 2.6*	0.2 ± 0.8	0 ± 0
Difficulty of liquid consumption	3.2 ± 3.6	1.3 ± 2.4*	0.1 ± 0.4*	0 ± 0*	0 ± 0*	0 ± 0*
Difficulty of solid consumption	–	2.2 ± 3.4	1.4 ± 3.3*	0.7 ± 2.1*	0.0 ± 0.2*	0 ± 0*

T0 day of deployment; *T1*, *T2*, *T3*, and *T4* 1-week, 2-week, 1-month, and 2-month follow-up; *T5* end of treatment

*: p <0.001 (data of T1, T2, T3, T4, T5 have been compared to T0)

Moreover, we observed increases in satiety and fullness initially as measured by VAS (Table 2).

Discussion

Intragastric balloons for temporary weight loss in overweight, obese, and morbidly obese patients have now been used all around the world [9]. Different kinds of intragastric balloons are commercially available and have been shown to have similar effects on weight loss [10]. While the mortality rate is very low, patient adoption may be limited due to the cost of procedure and the risk or discomfort associated with anesthesia and the endoscopies required for insertion and removal.

Our preliminary results with the Elipse balloon indicate that it is a safe and effective device.

It is the first balloon that does not require UE or sedation for both placement and removal, and hence offers an option to overweight and obese patients who feel uncomfortable with endoscopy and anesthesia.

This is a swallowable balloon which is conceived to self-empty after 4 months and to be excreted through the gastrointestinal tract. The deployment is quick, easy, and non-invasive. Moreover, the presence of the radiopaque catheter and ring inside the balloon allows it to be visualized through a simple abdominal x-ray or on fluoroscopy.

Fig. 1 Elipse balloon inside its capsule (left) and filled with 550 ml of the proper solution (right)

In this study, we also assessed aprepitant and ondansetron together as anti-emetics after balloon placement. Based on previous experiences with liquid-filled balloons, the combination therapy appears to improve the nausea and vomiting and decrease the rate of voluntary removal associated with balloon therapy [8, 11].

Moreover, only 1 patient withdrew early from the study. The patient experienced nausea and vomiting after binge eating episodes. The balloon was endoscopically punctured and removed after 22 days of balloon therapy. No other patients in this series requested early removal of the balloon.

The Elipse balloon remains in the stomach for 4 months instead of 6 months. However, our results demonstrate similar weight loss to other liquid-filled intragastric balloons and confirm previous reports that 80–90% of the weight that is lost during balloon therapy happens during the first 3–4 months [12]. The weight loss curve also appears to be correlated to a higher sense of satiety. Furthermore, we observed important improvements in obesity-related co-morbidities (Table 3). In addition, the Elipse balloon appears to be a safe device that can be swallowed and excreted without serious adverse events. The absence of UE avoids the complications reported

Table 3 Changes in BMI, blood pressure, and metabolic factors before and after treatment with the Elipse balloon; mean ± SD

	T0	T5	*p* value
Systolic BP (mmHg)	132.5 ± 12.1	125.5 ± 12.3	0.042
Diastolic BP (mmHg)	85.5 ± 8.5	80.5 ± 9.5	0.023
Waist (cm)	123.5 ± 16.9	111 ± 16.2	0.0024
Triglycerides (mg/dl)	152 ± 22	118 ± 29	< 0.0001
Blood glucose (mmol/L)	108 ± 11.5	98 ± 13.5	< 0.001
HDL (mmol/L)	38 ± 6.5	41 ± 7.5	NS
HOMA-IR	3.55 ± 1.2	2.65 ± 1.6	< 0.001
BMI (kg/m^2)	38.6 ± 6.7	34.4 ± 5.4	< 0.001

T0 day of deployment, *T5* end of treatment, *NS* not significant

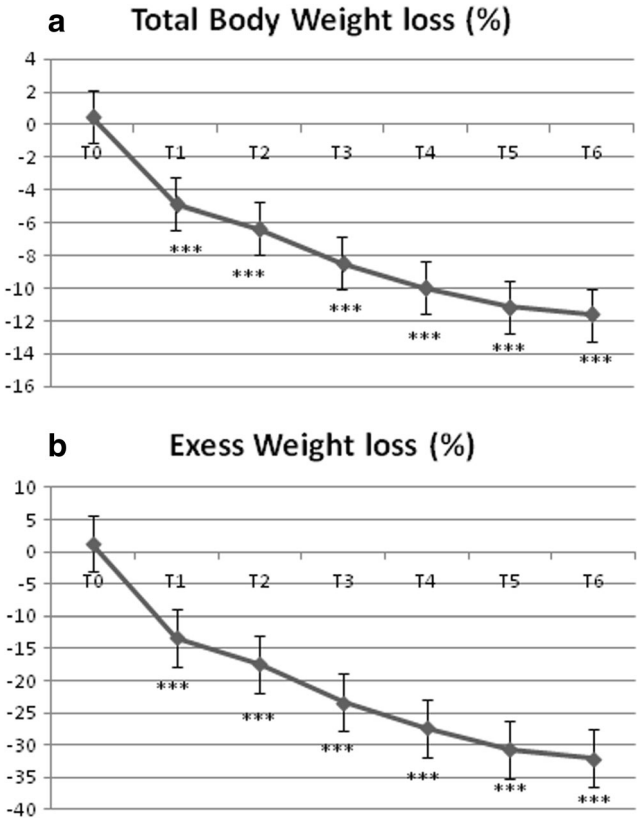

Fig. 2 Changes in **a** total body weight loss percent and **b** excess weight loss percent during the treatment compared to baseline ***$p < 0.0001$

previously with other intragastric balloons, including esophageal tear, gastrointestinal bleeding, or aspiration pneumonia [11]. Moreover, the absence of UE and anesthesia is appreciated by patients, allowing us to treat those who fear the complications associated with more invasive procedures.

Some limitations to our study should be considered. First, the sample of the study was small and non-randomized. Second, we do not yet have data on how patients will perform long after the Elipse balloon is excreted, although the weight loss achieved here indicates that the post-balloon performance should resemble other balloons. Finally, these results reflect the experience of a single center.

Conclusion

The results of this study on 38 consecutive patients show that the Elipse balloon is safe, effective, and well accepted. The lack of endoscopy and sedation represents a remarkable progress in the field of intragastric balloons and it might improve the compliance of the patients to this device. However, further studies involving a larger number of patients are needed to confirm the preliminary results of our experience and to assess the possible role of Elipse balloon as tool to prevent obesity in overweight patients.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflicts of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

References

1. Genco A, Bruni T, Doldi SB, et al. BioEnterics intragastric balloon: the Italian experience with 2,515 patients. Obes Surg. 2005;15(8):1161–4.
2. Imaz I, Martínez-Cervell C, García-Alvarez EE, et al. Safety and effectiveness of the intragastric balloon for obesity. A meta-analysis. Obes Surg. 2008;18(7):841–6.
3. 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(1):129–33.
4. Martins Fernandes FA Jr, Carvalho GL, Lima DL, et al. Intragastric balloon for overweight patients. JSLS. 2016;20(1). https://doi.org/10.4293/JSLS.2015.00107
5. Sullivan S, Edmundowicz SA, Thompson CC. Endoscopic bariatric and metabolic therapies: New and emerging technologies. Gastroenterology. 2017;152(7):1791–801.
6. Messina T, Genco A, Favaro R, et al. Intragastric balloon positioning and removal: sedation or general anesthesia? Surg Endosc. 2011;25(12):3811–4.
7. Machytka E, Chuttani R, Bojkova M, et al. Elipse, a procedureless gastric balloon for weight loss: a proof-of-concept pilot study. Obes Surg. 2016;26(3):512–6.
8. Machytka E, Gaur S, Chuttani R, et al. Elipse, the first procedureless gastric balloon for weight loss: a prospective, observational, open-label, multicenter study. Endoscopy 2017;49(2):154–60.
9. Dumonceau JM. Evidence-based review of the Bioenterics intragastric balloon for weight loss. Obes Surg. 2008;18(12):1611–7.
10. Fanelli RD, Andrew BD. Is endoluminal bariatric therapy a new paradigm of treatment for obesity? Clin Gastroenterol Hepatol : Off Clin Pract J Am Gastroenterol Assoc. 2016;14(4):507–15.
11. Ponce J, Woodman G, Swain J, et al. The REDUCE pivotal trial: a prospective, randomized controlled pivotal trial of a dual intragastric balloon for the treatment of obesity. Surg Obes Relat Dis. 2015;11(4):874–81.
12. 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(6):1330–6.