OBES SURG (2012) 22:565–571
DOI 10.1007/s11695-011-0514-y

CLINICAL RESEARCH

Intragastric Balloon in Association with Lifestyle and/or Pharmacotherapy in the Long-Term Management of Obesity

Maria Grazia Farina · Roberto Baratta · Angela Nigro · Federica Vinciguerra · Concetta Puglisi · Roberto Schembri · Clara Virgilio · Riccardo Vigneri · Lucia Frittitta

Published online: 7 September 2011

Abstract
Background Intragastric balloon (BioEnterics Intragastric Balloon, BIB®) or pharmacotherapy are possible options for the treatment of obese patients when traditional approaches have failed. The aim of our study was to compare in obese patients the effect on weight loss and metabolic changes of lifestyle modifications associated with either BIB or pharmacotherapy or the two treatments in sequence as a maintenance strategy for weight loss.
Methods Fifty obese patients were recruited and randomly assigned to lifestyle modifications combined with either BIB for 6 months (n=30) or sibutramine (pharmacotherapy group) for 1 year (n=20). After BIB removal, patients were randomly assigned to either correct lifestyle (BIB/lifestyle) or lifestyle plus pharmacotherapy (BIB/pharmacotherapy).
Results At 6 months, patients treated with BIB lost significantly (P<0.05) more weight (percent of initial weight lost, %IWL=14.5±1.2; percent of excess BMI lost, %EBL=37.7±3.2) than patients who received pharmacological treatment (%IWL=9.1±1.5, %EBL=25.3±4.1). At 1 year, the weight lost was significantly (P<0.05) greater in patients treated with either BIB/pharmacotherapy (%IWL=15.8±2.3%, %EBL=41.3±6.7%) or BIB/lifestyle (%IWL=14.3±2.7, %EBL=34.9±6.5%) in respect to pharmacotherapy group (%IWL=8.0±1.4%, %EBL=22.1±3.9%). Moreover, patients treated sequentially with BIB/lifestyle or BIB/pharmacotherapy showed a significant (P<0.05) improvement in insulin sensitivity and triglycerides levels.
Conclusions BIB represents an efficacious long-term obesity treatment when supplemental strategies, as lifestyle modifications or pharmacotherapy, are established for weight maintenance after its removal.

Keywords Obesity therapy · Intragastric balloon · BIB · Sibutramine · Lifestyle intervention

M. G. Farina · R. Baratta · A. Nigro · F. Vinciguerra · C. Puglisi · R. Schembri · R. Vigneri · L. Frittitta
Endocrinology Unit, Department of Clinical and Molecular Biomedicine, University of Catania Medical School, Catania, Italy

C. Virgilio
Gastroenterology Unit, Garibaldi Hospital, Catania, Italy

L. Frittitta (✉)
Endocrinology, University of Catania, Garibaldi Hospital, Via Palermo 636, 95122 Catania, Italy
e-mail: lfritti@unict.it

Introduction

Obesity is a chronic disease and a risk factor for major causes of morbidity and mortality, including cardiovascular diseases, type 2 diabetes mellitus, and cancer [1, 2]. Quality of life is also reduced in obese subjects [3, 4]. A weight loss of approximately 10% reduces the risk of developing diabetes, improves lipid profile and blood pressure, and decreases insulin resistance [5–8]. Although lifestyle modifications, including diet and exercise, are the cornerstones of therapy in overweight and obese individuals, these approaches often fail in the medium–long term [9].

When lifestyle changes and pharmacological treatment fails, an alternative therapy for obese patients is the use of an intragastric balloon (BIB®, Bioenterics Intragastric Balloon). Intragastric balloon insertion is a minimally invasive procedure inducing weight loss by partially filling the stomach, slowing down gastric emptying and, therefore,

inducing satiety [10–19]. Intragastric balloon represents a temporary non-pharmacological and non-surgical obesity treatment that is totally reversible and can be repeated several times [20, 21]. It has been used also to prepare morbid obese patients to subsequent bariatric surgery [14–16]. Several studies indicate that a 6-month treatment with BIB induces an average 12–13 kg weight loss [11–13, 19], with a minimal risk of major complications. Unfortunately, this treatment is temporary, and in almost all patients, weight loss is followed by subsequent weight regain [11–13, 18, 21–26]. Several authors have reported a successful weight loss in the short time (i.e., 6 months) but only a few studies have investigated the long-term results after BIB removal [18, 20–26].

Pharmacological therapy can be considered in obese (BMI ≥30 kg/m^2) or overweight (BMI ≥27 kg/m^2) patients with comorbidites, such as type 2 diabetes or hypertension. However, only a few drugs for the treatment of obesity are now available, as sibutramine has been withdrawn from USA and Europe markets in October 2010, for the potential cardiovascular risks reported in obese patients [27].

Long-term strategies are needed for weight maintenance in obese patients and intragastric balloon can be part of that when accompanied by some other interventions. For this purpose, we evaluated in a comparative prospective study weight loss and metabolic improvements in obese patients treated for 1 year with BIB and subsequent treatment with lifestyle modifications and/or pharmacological treatment.

Materials and Methods

Subjects

Fifty obese subjects [male/female, 11/39; age, 35.0±1.2 (mean±SEM) years, median 36.0, range 18–53; BMI, 41.8±0.8 kg/m^2, median 41.1, range 31.2–53.2] were recruited among 303 screened individuals because they met the criteria and volunteered to enter the study (Fig. 1). The sample size was selected to provide a statistical power of 80% to detect a 4-kg difference in weight loss at the end of the trial among the different treatment groups.

Exclusion criteria were diabetes mellitus, systemic, neurological or psychiatric disorders, including history of bulimia or anorexia and drug or alcohol abuse, presence of gastric or duodenal ulcer or *Helicobacter pylori* infection, uncontrolled hypertension (i.e., blood pressure >145/95 mmHg) or tachycardia (pulse rate >90 beats per minute), glaucoma, cancer, other cardiovascular, endocrine, renal or hepatic diseases. Pregnancy, lactation, or also childbearing potential because not taking adequate contraceptive precautions were exclusion criteria.

Subjects were recruited from our outpatient Obesity Clinic gave informed consent and entered the study, which was approved by the local ethics committee, according to the Declaration of Helsinki.

Study Design and Randomization

Standard diet was given to all 50 recruited patients. After 2 weeks, patients were randomly assigned (randomization 2:3) to either pharmacotherapy (sibutramine 10 mg/day, still permitted by regulatory agencies and commercially available when this study was carried out) for 1 year (n=20, pharmacotherapy group) or intragastric balloon (BIB®, BioEnterics Intragastric Balloon, Inamed Health, CA, USA) for 6 months (n=30). The BIB was inserted and removed under endoscopic control, inflated with 500 ml of saline and methylene blue (10 ml) and endoscopically removed, following complete deflation, 6 months later. The 30 BIB-treated patients, after BIB removal, were randomly assigned (randomization 1:1) to either lifestyle (n=15, BIB/lifestyle) or lifestyle plus sibutramine 10 mg/die (n=15, BIB/pharmacotherapy) for additional 6 months. All patients received a balanced (50% carbohydrates, 30% fats, 20% proteins) hypocaloric diet, calculated to achieve a caloric deficit of 1,000 kcal/day in respect to the basal energy expenditure assessed according to Harris–Benedict formula. The caloric range permitted was between 900 and 1,500 kcal.

All patients were assigned to a lifestyle change program and detailed instructions were given to achieve specific goals. The lifestyle change program consisted in food and physical activity records and in the individual guidance to achieve the target of physical activity (at least 30 min/day of moderate exercise for 5 days/week, such as walking, jogging, swimming, aerobic ball games, or bicycle). Each patient had sessions with the same physician and nutritionist every 4 weeks to test and to schedule the goals achieved.

At each visit, all patients underwent complete clinical examination with weight measurement in light clothing and without shoes, waist circumference measurement at the level of iliac crest edge (according to NHANES III), and two systolic and diastolic blood pressure recordings at 5-min interval.

In all patients, we considered the following weight loss measures: kilograms, BMI, percent of initial weight lost (%IWL), percent of excess BMI lost (%EBL) [28].

Metabolic and Biochemical Assessments

Metabolic and biochemical measurements were carried out after an overnight fast before beginning and at the end of the study (1 year). Thyrotropin (TSH) and 24 h urinary free

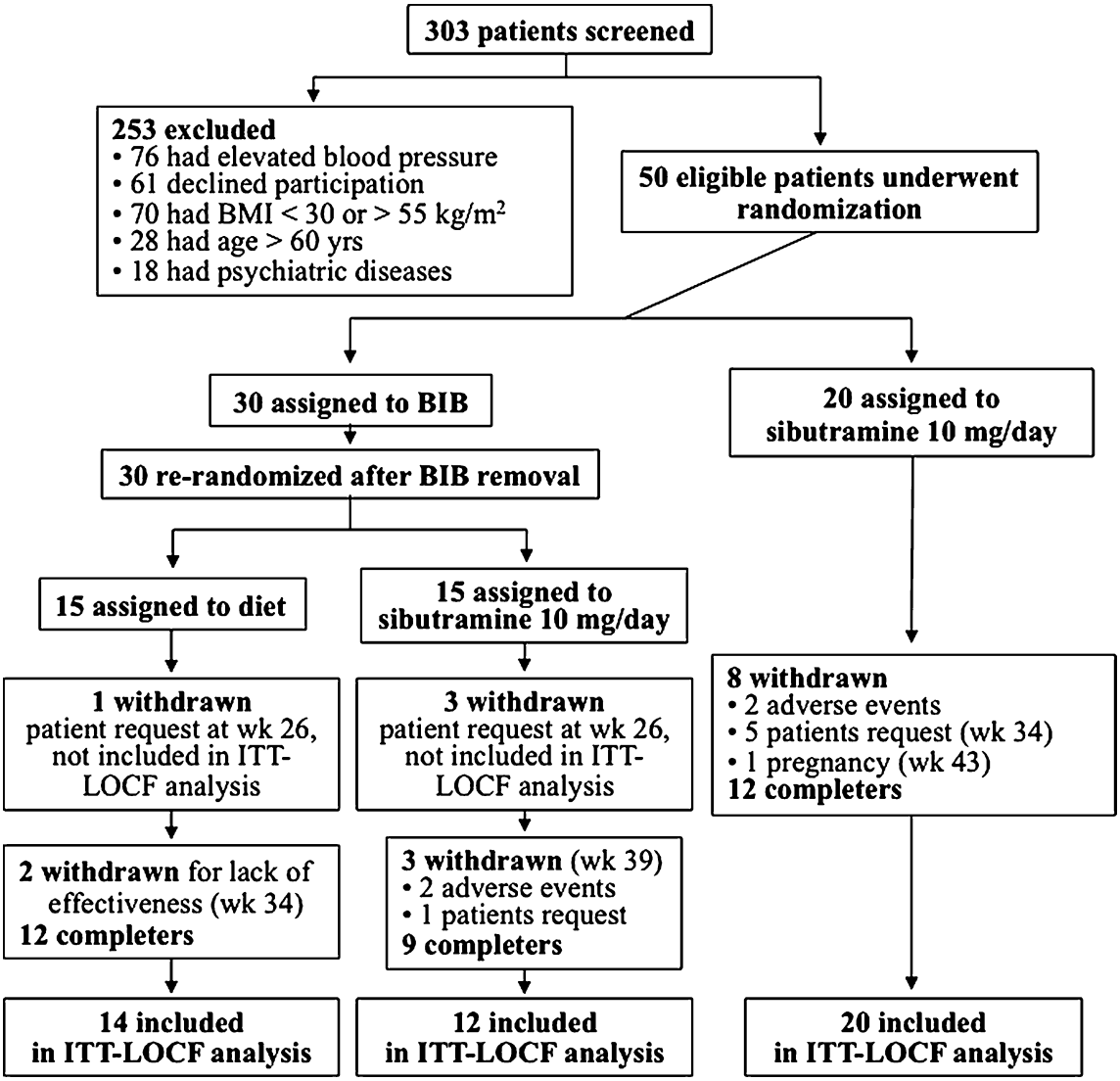

Fig. 1 Trial profile

cortisol were measured to exclude thyroid or adrenal dysfunction (Abbott Laboratories, Abbott Park, IL, USA). Plasma glucose was measured by the glucose oxidase method on a Beckman Glucose Analyzer two (Beckman Coulter, Inc., Fullerton, CA, USA) and plasma insulin by microparticle enzyme immunoassay (Abbott Laboratories, Abbott Park, IL, USA). Total cholesterol and triglycerides were evaluated by enzymatic methods (Instrumentation Laboratory, Milan, Italy). High-density lipoprotein cholesterol fraction was separated by use of Mg^{++} and dextran sulfate method (Sclavo Diagnostics, Siena, Italy). Plasma glucose and insulin levels were also measured before, 30, 60, 90, and 120 min after a 75-g oral glucose tolerance test and the Insulin Sensitivity Index (ISI) was calculated, according to the formula: $10{,}000/\sqrt{(\text{glucose}_0 \times \text{insulin}_0 \times \text{glucose}_{\text{mean}} \times \text{insulin}_{\text{mean}})}$ [29].

Statistical Analyses

Values are given as mean±SEM. Differences in clinical characteristics and metabolic parameters before and after weight loss were compared by paired Student's *t* test. Mean value differences (anthropometric and metabolic parameters as continuous variables) within or between groups (as categorical variables), after adjusting for several covariates (age, gender, baseline values), were evaluated using one-way analysis of variance (ANOVA) or ANOVA repeated measurements. Variables that were not normally distributed were log-transformed for analysis (plasma insulin, serum triglycerides, and ISI). Chi-square test was used to test for differences between categorical variables (treatment groups and percent of patients who lost ≥10% of body weight). All analyses were performed by Statistical

Table 1 Clinical characteristics of obese patients in the randomized groups

	Pharmacotherapy group	BIB group
Males/females	4/16	7/23
Age (years)	32.7±1.8	36.6±1.5
Weight (kg)	108.7±2.9	115.1±3.3
BMI (kg/m^2)	41.0±1.3	42.3±1.0
Waist (cm)	123.1±3.2	125.8±2.4
SBP (mmHg)	123.2±2.2	126.2±2.1
DBP (mmHg)	82.7±1.9	80.8±1.7
FPG (mg/dl)	93.9±2.0	100.4±2.3
IRI (mU/l)	17.8±1.6	15.3±1.4
ISI	2.61±0.26	2.87±0.22
TC (mg/dl)	177.8±8.3	198.1±7.4
HDL-C (mg/dl)	42.2±2.6	45.9±2.2
Tg (mg/dl)	110.0±12.3	131.7±12.0

Data are mean±SEM

BMI body mass index, *SBP* systolic blood pressure, *DBP* diastolic blood pressure, *FPG* fasting plasma glucose, *IRI* immunoreactive insulin, *ISI* insulin sensitivity index, *TC* total cholesterol, *HDL-C* high-density lipoprotein cholesterol, *Tg* triglycerides

package, SPSS version 16 (Chicago, IL, USA) and the StatView software (version 5.01; SAS Institute, Cary, NC, USA). A P value <0.05 was considered statistically significant.

The intention to treat (ITT) analysis by the lost observation carried forward (LOCF) was applied for missing data (Fig. 1). After BIB-treated patients were re-randomized at 6 months, 4 out of 30 (3 in BIB/pharmacotherapy group and 1 in BIB/lifestyle group) dropped out from the study. These patients were not considered for the ITT-LOCF analysis because no observation was available until the end of the study (from 6 to 12 months).

Results

Anthropometric Parameters and Blood Pressure

No significant difference was present at baseline between patients assigned to either BIB or pharmacotherapy (Table 1).

Patients treated with BIB obtained a significant (P range <0.0001–≤0.005 vs. previous month) and progressive weight loss for all the 6 months of treatment (%IWL=14.5±1.2%; %EBL=37.7±3.2% at 6 months, Fig. 2). In this group, weight loss at 6 months was significantly (P<0.05) greater than in pharmacotherapy group (Fig. 2). After BIB removal, patients treated with lifestyle modifications (BIB/lifestyle) maintained their body weight for the following 3 months and then showed a slight trend to weight regain, that became significant at the end of follow-up (11 vs. 12 month, P<0.005). However, at the end of the study, the overall weight loss in this group remained significantly (P<0.05) greater than in pharmacotherapy group (Fig. 2). In patients treated with pharmacological therapy after BIB removal (BIB/pharmacotherapy), a small but significant (P<0.005) additional weight loss was observed at 7 months of treatment and then was maintained throughout the rest of the study (%IWL=15.8±2.3% and %EBL=41.3±6.7% at 1 year). In this group, moreover, at the end of the study, the overall weight loss was significantly (P<0.05) higher than in pharmacotherapy group (Fig. 2). In contrast, no difference in the overall weight loss was detected between BIB/lifestyle and BIB/pharmacotherapy groups.

The proportion of patients that achieved a weight loss ≥10% at 1 year was 75% in BIB/pharmacotherapy (9/12), 50% in BIB/lifestyle (7/14), and 35% in pharmacotherapy group (7/20) (Fig. 3).

After 1 year, waist circumference significantly (P≤0.001) decreased in all three treatment groups in respect to baseline (Table 2).

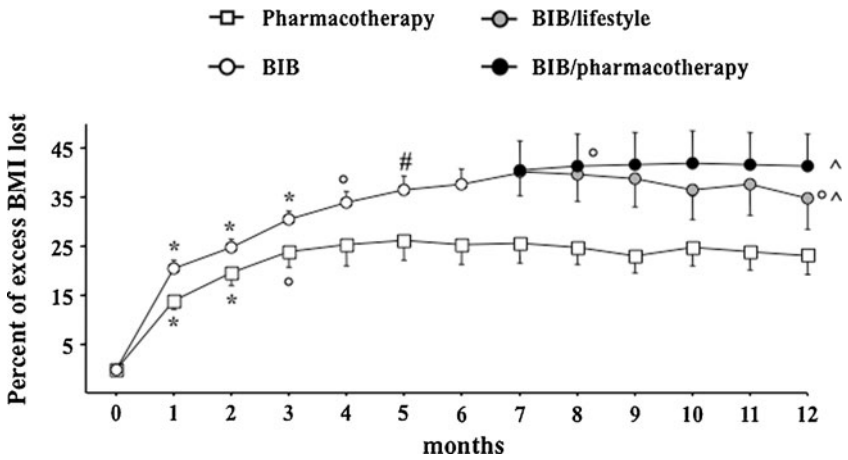

Fig. 2 Percent of excess BMI lost. *P<0.0001; °P<0.005; #P<0.05 vs. previous month in the same group of treatment (paired t test); ^P<0.05 vs. pharmacotherapy group (ANOVA repeated measurements) at 0–6 and 6–12 months

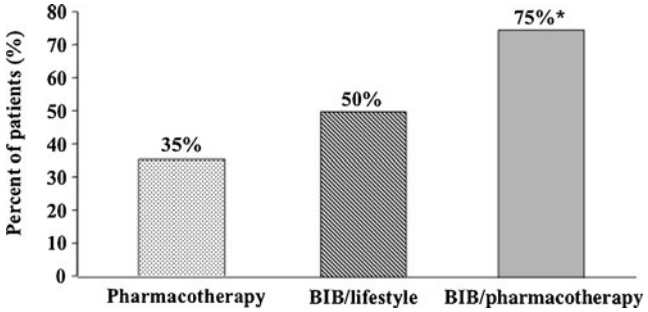

Fig. 3 Percent of patients who lost ≥10% of body weight from baseline according to treatment groups. *$P<0.05$ vs. pharmacotherapy group

A significant systolic blood pressure reduction was observed in patients treated with BIB/lifestyle in respect to those treated with pharmacotherapy ($P<0.05$, data adjusted for age, gender, and baseline values). In addition, also diastolic blood pressure was significantly lower in patients treated with BIB/lifestyle than in BIB/pharmacotherapy group ($P<0.05$, data adjusted for age, gender, and baseline values).

Metabolic Parameters

All metabolic parameters improved in respect to baseline values after 1 year with all three treatment protocols (Table 2). Patients treated with BIB/lifestyle had a significant ($P<0.05$) improvement in ISI and serum triglycerides. Patients treated sequentially with BIB/pharmacotherapy had the most pronounced metabolic improvement: fasting plasma glucose, ISI, and serum triglycerides levels significantly (P range <0.05–0.001) improved in respect to baseline. Moreover, fasting glucose improvement was significantly ($P<0.05$) greater than in pharmacotherapy group, and serum triglycerides decreased significantly ($P<0.05$) more in respect to both pharmacotherapy group and BIB/lifestyle-treated patients (data adjusted for age, gender, and baseline values). The more marked metabolic improvements observed in patients treated sequentially with BIB/pharmacotherapy in respect to the other groups were mediated by weight loss, because statistical significance was lost when data were adjusted for this parameter.

Adverse Events

No serious adverse event was observed during the study. Among BIB-treated patients, two developed belching and eight had heartburn, requiring pharmacological therapy in two of them. In the group of patients treated sequentially with BIB/pharmacotherapy, two developed borderline hypertension, other two tachycardia, and one constipation. Among pharmacotherapy group, three patients developed insomnia, one tachycardia, and one tachycardia plus hypertension requiring anti-hypertensive treatment. Two patients withdrew from the study because of these complications. Other mild adverse events in this group were constipation and dry mouth, observed in six and ten patients, respectively.

Table 2 Clinical and biochemical changes after 1 year in respect to baseline

	Pharmacotherapy	BIB/pharmacotherapy	BIB/lifestyle
Males/females	4/16	2/10	4/10
Weight loss (kg)	−8.9±1.7*	−17.6±2.3*·**	−17.4±3.4*·**
BMI (kg/m^2)	−3.3±0.6*	−6.6±1.0*·**	−6.3±1.2*·**
Waist (cm)	−9.3±1.9*	−12.4±2.0*	−11.5±2.6*
SBP (mmHg)	+1.5±2.5	+1.2±3.1	−6.0±3.7**
DBP (mmHg)	+1.5±2.2	+4.2±2.9	−2.5±3.8***
FPG (mg/dl)	+2.4±3.3	−9.8±3.4****·**	−5.1±3.7
IRI (mU/l)	−1.1±2.1	−1.2±1.2	−2.4±3.7
ISI	+0.6±0.3	+2.0±0.7****	+1.7±0.7*****
TC (mg/dl)	+1.9±6.6	−6.8±10.2	−0.9±11.6
HDL-C (mg/dl)	+6.2±2.4*****	+3.0±3.1	+5.1±3.1
Tg (mg/dl)	−14.6±12.2	−49.8±20.7*****·******	−21.5±10.5*****

Data are mean±SEM

BMI body mass index, *SBP* systolic blood pressure, *DBP* diastolic blood pressure, *FPG* fasting plasma glucose, *IRI* immunoreactive insulin, *ISI* insulin sensitivity index, *TC* total cholesterol, *HDL-C* high-density lipoprotein cholesterol, *Tg* triglycerides

*$P\leq0.001$ vs. baseline values within the same group of treatment; **$P<0.05$ vs. pharmacotherapy group; ***$P<0.05$ vs. BIB/pharmacotherapy; ****$P\leq0.01$ vs. baseline values within the same group of treatment; *****$P<0.05$ vs. baseline values within the same group of treatment; ******$P<0.05$ vs. pharmacotherapy and BIB/lifestyle. Differences between groups were evaluated after adjusting data for age, gender, and baseline values

Discussion

Several studies on the treatment of obesity have underlined that a 5–10% weight loss is an effective therapeutic target for improving several metabolic parameters and to reducing the cardiovascular risk in obese patients [6, 7]. This target, however, is difficult to obtain with only diet and lifestyle changes. Therefore, pharmacotherapy or BIB represent valid therapeutic options in obese patients when the conventional lifestyle and diet approach has failed [9, 11, 30].

Both BIB and sibutramine (permitted by regulatory agencies and commercially available when this study was designed and carried out) affect satiety, but with different mechanisms. The intragastric balloon is active at gastrointestinal level, while sibutramine acts on the central nervous system.

The intragastric balloon has been demonstrated effective in inducing a significant (>10%) weight loss, but its effect is short-lasting and most patients regain weight after its removal [11–13, 15, 18, 22–25]. The study with the longest follow-up (2.5 years) [26] shows that after BIB removal and in the absence of adequate accompanying measures, most patients regain weight. The intragastric balloon, however, may be part of a sequential long-term weight-loss strategy, being efficacious in causing an important weight loss that needs to be maintained with accompanying strategies. Treatments following BIB removal have been poorly investigated [11, 13, 20, 21]. Our study, aimed at evaluating the efficacy of a sequential treatment involving intragastric balloon, intensive lifestyle modifications, and pharmacological treatment, indicates that this therapeutic strategy is effective in inducing metabolic improvements and in long-term weight maintenance in obese patients.

Weight loss obtained by BIB is approximately the double than that obtained with pharmacological therapy (i.e., sibutramine). A major issue is how to deal with patients following BIB treatment to avoid weight regain. After BIB removal, when two different treatments (lifestyle or lifestyle plus pharmacotherapy) were used, both stabilized weight loss for the following 6 months. This sequential treatment, at 1 year, determined a weight decrease greater than 10% in 50% of patients treated sequentially with BIB/lifestyle and in 75% of patients with BIB/pharmacotherapy. These data indicate that, although sibutramine is not longer available for the treatment of obesity, the use of other drugs still available for the management of obesity (i.e., orlistat or phentermine) can better support the patient weight loss in a long-term strategy for body weight maintenance after BIB removal.

In conclusion, both patients and physicians must be aware that BIB is an effective but temporary treatment of obesity. Intensive lifestyle, alone or in association with pharmacological therapy, should be recommended to all patients after BIB removal as maintenance strategies to avoid weight regain and stabilize the metabolic improvements.

Conflict of Interest The authors (MGF, RB, AN, FV, CP, RS, CV, RV, and LF) declare no conflict of interest with any institution or product mentioned in the manuscript.

References

1. Despres JP, Pascot A, Lemieux I. Risk factors associated with obesity: a metabolic perspective. Ann Endocrinol (Paris). 2000;61 Suppl 6:31–8.
2. Vigneri P, Frasca F, Sciacca L, et al. Obesity and cancer. Nutr Metab Cardiovasc Dis. 2006;16(1):1–7.
3. Adams KF, Schatzkin A, Harris TB, et al. Overweight, obesity, and mortality in a large prospective cohort of persons 50 to 71 years old. N Engl J Med. 2006;355(8):763–78.
4. Overweight, obesity, and health risk. National Task Force on the Prevention and Treatment of Obesity. Arch Intern Med 2000;160 (7):898–904.
5. Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults-The Evidence Report. National Institutes of Health. Obes Res 1998; 6 Suppl 2:51S–209S.
6. Horton ES. Effects of lifestyle changes to reduce risks of diabetes and associated cardiovascular risks: results from large scale efficacy trials. Obesity (Silver Spring). 2009;17 Suppl 3: S43–8.
7. Long SD, O'Brien K, MacDonald KG, et al. Weight loss in severely obese subjects prevents the progression of impaired glucose tolerance to type II diabetes. A longitudinal interventional study. Diabetes Care. 1994;17(5):372–5.
8. Despres JP, Lemieux I, Prud'homme D. Treatment of obesity: need to focus on high risk abdominally obese patients. BMJ. 2001;322(7288):716–20.
9. Wing RR. Use of very-low-calorie diets in the treatment of obese persons with non-insulin-dependent diabetes mellitus. J Am Diet Assoc. 1995;95(5):569–72.
10. Doldi SB, Micheletto G, Perrini MN, et al. Intragastric balloon: another option for treatment of obesity and morbid obesity. Hepatogastroenterology. 2004;51(55):294–7.
11. Imaz I, Martinez-Cervell C, Garcia-Alvarez EE, et al. Safety and effectiveness of the intragastric balloon for obesity. A meta-analysis. Obes Surg. 2008;18(7):841–6.
12. 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 (6):927–33.
13. Dumonceau JM. Evidence-based review of the Bioenterics intragastric balloon for weight loss. Obes Surg. 2008;18 (12):1611–7.
14. 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(5):671–6.
15. Angrisani L, Lorenzo M, Borrelli V, et al. Is bariatric surgery necessary after intragastric balloon treatment? Obes Surg. 2006;16 (9):1135–7.

16. Frutos MD, Morales MD, Lujan J, et al. Intragastric balloon reduces liver volume in super-obese patients, facilitating subsequent laparoscopic gastric bypass. Obes Surg. 2007;17(2):150–4.
17. Roman S, Napoleon B, Mion F, et al. Intragastric balloon for "non-morbid" obesity: a retrospective evaluation of tolerance and efficacy. Obes Surg. 2004;14(4):539–44.
18. Herve J, Wahlen CH, Schaeken A, et al. What becomes of patients 1 year after the intragastric balloon has been removed? Obes Surg. 2005;15(6):864–70.
19. 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.
20. Genco A, Cipriano M, Bacci V, et al. Intragastric balloon followed by diet vs intragastric balloon followed by another balloon: a prospective study on 100 patients. Obes Surg. 2010;20(11):1496–500.
21. Lopez-Nava G, Rubio MA, 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(1):5–9.
22. 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(8):1084–8.
23. Genco A, Balducci S, Bacci V, et al. Intragastric balloon or diet alone? A retrospective evaluation. Obes Surg. 2008;18(8):989–92.
24. Mathus-Vliegen EM. Intragastric balloon treatment for obesity: what does it really offer? Dig Dis. 2008;26(1):40–4.
25. 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(3):227–31.
26. Dastis NS, Francois E, Deviere J, et al. Intragastric balloon for weight loss: results in 100 individuals followed for at least 2.5 years. Endoscopy. 2009;41(7):575–80.
27. James WP, Caterson ID, Coutinho W, et al. Effect of sibutramine on cardiovascular outcomes in overweight and obese subjects. N Engl J Med. 2010;363(10):905–17.
28. Deitel M, Gawdat K, Melissas J. Reporting weight loss 2007. Obes Surg. 2007;17(5):565–8.
29. Matsuda M, DeFronzo RA. Insulin sensitivity indices obtained from oral glucose tolerance testing: comparison with the euglycemic insulin clamp. Diabetes Care. 1999;22(9):1462–70.
30. Vetter ML, Faulconbridge LF, Webb VL, et al. Behavioral and pharmacologic therapies for obesity. Nat Rev Endocrinol. 2010;6(10):578–88.