OBES SURG (2010) 20:692–697
DOI 10.1007/s11695-010-0127-x

CLINICAL RESEARCH

Single vs Repeated Treatment with the Intragastric Balloon: A 5-Year Weight Loss Study

Jean-Marc Dumonceau · Erik François · Axel Hittelet · Abdel Ilah Mehdi · Marie Barea · Jacques Deviere

Published online: 30 March 2010

Abstract
Background Saline-filled intragastric balloons (IB) may be inserted for 6 months to promote weight loss. We aimed to assess potential benefits of repeating IB therapy.
Methods One hundred eighteen consecutive subjects (median body mass index, 34.0 kg/m^2; interquartile range [IQR], 31.2–36.9) treated with IB were included in a prospective non-randomized multicenter study.
Results Nineteen (16%) subjects had repeat IB therapy at their own request, either to prolong first treatment (n=8) or after a IB-free interval (n=11). Higher weight loss 3 months after first IB insertion independently predicted repeat therapy (P=0.008). Median weight loss in subjects who had repeat therapy was lower with second vs first IB (9.0 vs 14.6 kg; 30.4% vs 49.3% excess weight [EW]; P=0.003). Compared to subjects with single treatment (n=99), those with repeat treatment (n=19) had greater weight loss at first IB extraction (14.6 vs 11.0 kg; 49.3% vs 30.7% EW; P=0.026) and 1 year later (12.0 vs 6.0 kg; 40.9% vs 20.8% EW; P=0.008) but the difference became less than 2 kg starting at 3 years. At final follow-up (4.9 years; IQR, 3.4–6.7), the whole subject population had lost a median of 2.0 kg (IQR, −3.0 to 10.3) or 6.2% EW (IQR, −8.1 to 31.6) and identical proportions of subjects with single/repeat treatment had ≥10% baseline weight loss (26%) or bariatric surgery (32%).
Conclusion Higher weight loss at 3 months independently predicted repeat IB therapy; weight loss with the second IB was lower compared to first IB. Repeat treatment had no effect on proportions of subjects with ≥10% baseline weight loss or bariatric surgery at final follow-up.

Keywords Obesity · Gastrointestinal endoscopy · Gastric balloon · Weight loss

Abbreviations

BMI	body mass index
IB	intragastric balloon
IQR	interquartile range
LOCF	last observation carried forward

J.-M. Dumonceau
Service of Gastroenterology and Hepatology,
Geneva University Hospitals,
Micheli-du-Crest street 24,
1205 Geneva, Switzerland

E. François · A. Hittelet · M. Barea · J. Deviere
Department of Gastroenterology and Hepato-Pancreatology,
Erasme University Hospital,
Lennikstreet 808,
1070 Brussels, Belgium

E. François
e-mail: erik.francois@ulb.ac.be

A. Hittelet
e-mail: ahittelet@euphonynet.be

M. Barea
e-mail: mbareafe@ulb.ac.be

J. Deviere
e-mail: jacques.deviere@erasme.ulb.ac.be

A. I. Mehdi
Department of Digestive Surgery, Erasme University Hospital,
Lennikstreet 808,
1070 Brussels, Belgium
e-mail: a.mehdi@skynet.be

J.-M. Dumonceau (✉)
Division of Gastroenterology and Hepatology,
Geneva University Hospitals,
Micheli-du-Crest street 24,
1205 Geneva, Switzerland
e-mail: jmdumonceau@hotmail.com

Introduction

Three models of intragastric balloon (IB) are currently available to promote weight loss in obese subjects [1]. The liquid-filled Bioenterics IB is by far the most often used; it decreases preprandial hunger, increases postprandial satiety and promotes weight loss at short term [2–4]. The manufacturer recommends removing the IB 6 months after insertion, due to the risk of leakage after prolonged exposure to gastric content and ensuing IB migration into the small bowel. This 6-month period corresponds to the active weight loss phase described in most weight loss programs [5]; during this period, the IB is thought allowing subjects to modify their eating habits to favor long-term weight loss [6]. However, weight regain is common after IB removal.

Some subjects ask for repeat IB insertion, either at the time of first IB removal (to prolong IB therapy beyond the recommended 6-month period, in order to lose more weight or to obtain more sustainable modifications of the eating habits), or during follow-up after IB extraction (mainly to treat weight regain). Intuitively, subjects who ask for repeat IB insertion are those who made the most of initial IB therapy (they are self-selected based on a high degree of personal motivation and of IB-mediated effects such as decreased hunger and early satiety).

We hypothesized that repeating IB therapy in self-selected patients would allow to demonstrate that longer IB therapy provides more weight loss at long term than the standard 6-month treatment period.

We have prospectively followed a cohort of subjects for a median of about 5 years after IB implantation for weight loss; some of these received repeat IB therapy at their own request. We analyze factors associated with repeat IB therapy and compare long-term outcome in subjects who received single vs repeat IB therapy.

Materials and Methods

Patients

Consecutive subjects who received an IB between June 25, 1999 and April 18, 2006 at Brussels (Belgium) or Geneva (Switzerland) University Hospitals were included, after exclusion of 13 subjects who had received an IB to induce weight loss in order to facilitate bariatric surgery (n=9) or who were lost to follow-up (n=4). Indications for IB treatment, contra-indications, and work-up prior to IB insertion were as previously described [1]. Insertion of a second IB was performed if this option was requested by the patient, either (1) as an extension of treatment, where the IB was replaced with a new one during the same endoscopy session or (2) as a repeat treatment, during follow-up. Neither option was proposed to the patient by health care givers at our institutions. Data collected prospectively included baseline body height, weight and comorbidities, duration of IB therapy, number of visits with the dietician, details of endoscopic procedures, intake of a fiber-enriched, fat restricted, diet and performance of moderate-intensity exercise ≥30 min daily during IB therapy, potential complications, intake of weight loss drugs, and body weights at 3, 6, 18 and 30 months after first IB implantation as well as at an intermediary and final follow-up (November 2007–January 2008 and January–March 2009, respectively). In case of repeat IB insertion, body weight was registered at the time of repeat IB insertion, as well as 3 and 6 months later. The study complied with the Declaration of Helsinki regarding investigation in humans and was approved by the institutional ethics committees. This was an investigator-initiated study with no industry involvement in the design, conduct, funding, analysis of the results or decision to submit the manuscript for publication.

Interventions

Only Bioenterics IBs (BIB™, Allergan, Irvine, CA, USA) were implanted during the study period. Placement was performed as previously described [4] and endoscopic IB extraction (scheduled 6 months after implantation) was immediately followed by upper gastrointestinal endoscopy to detect potential lesions in all cases. In case of repeat IB implantation, the IB was filled with 100 ml saline more than for the first IB implantation. No structured weight-maintenance program was proposed after IB extraction, but subjects were strongly recommended to attend visits with the dietician once a month for 6 months.

Definitions and Study Endpoints

The study population was divided in two groups of subjects, i.e., subjects who received a single IB or those who had repeat IB insertion, irrespective of the time of repeat IB insertion. Ideal body weight was calculated according to the Lorentz equation [7]. Weights at yearly intervals after the 30-month follow-up were obtained by extrapolation using weights recorded at intermediary and final follow-up. For subjects who underwent bariatric surgery, body weight at the time of operation was carried forward up to the end of follow-up (last observation carried forward, or LOCF analysis). All durations, including that of follow-up, were calculated since insertion of the first IB except for Figs. 2 and 3.

The primary study endpoint was a comparison of weight loss at yearly intervals in subjects treated with single vs repeat IB insertion. Secondary endpoints included the identification of factors associated with repeat IB therapy and a comparison of first vs second IB therapy in terms of weight loss and of associated morbidity.

Statistical Analysis

All analyses were performed on an intention-to-treat basis including all subjects. Continuous variables were described by their medians with interquartile range (IQR) under parentheses. Comparisons of continuous variables was performed using ANOVA or the Kruskal–Wallis test if they were found to be non-normally distributed after Shapiro–Wilk normality test using a P value<0.05; comparisons of continuous variables in identical subjects at different time points were performed using the paired t test. Categorical data were compared using the Fisher exact test (or the McNemar's test for comparison of complications in identical subjects with the first vs the second IB). We also examined which factors—including age, gender, baseline body mass index (BMI), number of visits with the dietician during first IB therapy, weight loss at 3 months, performance of moderate-intensity exercise ≥30 min daily and intake of a fiber-enriched, fat restricted diet during first IB therapy, duration of treatment with the first IB and previous intake of weight loss drugs—were associated with repeat IB therapy, using stepwise logistic regression analysis. All tests were two-sided; P values less than 0.05 were considered as statistically significant. Analyses were performed with JMP software (version 7.0.1, SAS, Cary, N.C.).

Results

Among 118 subjects included in the study, 19 (16%) had a second IB inserted, either immediately after removal of the first IB to prolong IB therapy ($n=8$), or after a IB-free interval ($n=11$; median duration of the IB-free interval, 16.3 months [IQR, 7.1–28.4]). No significant difference was found at baseline between groups of subjects who finally received single or repeat IB insertion (Table 1). Two thirds (13/19 [68%]) of repeat IB insertions were performed during the year following first IB extraction.

Among factors available during initial IB therapy, the only independent predictor of repeat treatment was a higher weight loss at 3 months after IB insertion (Table 2). More frequent visits with the dietician and a longer duration of IB therapy were also associated with repeat treatment, but these associations became weaker ($P=0.142$ and $P=0.129$, respectively) after inclusion of weight loss 3 months after first IB insertion.

Compared with first IB therapy, repeat treatment was associated with a significantly smaller weight loss and a trend toward more complications (Table 3). Lower weight loss with the second IB was mainly related to the relatively low weight loss that was observed in subjects who received the second IB to prolong treatment with the first IB, as opposed to subjects who received it after a IB-free interval (Fig. 1). The latter subjects had regained 13.6 kg (IQR, 9.6–22.5), corresponding to 28.4% excess weight (EW; IQR, 16.3–42.1), during the IB-free interval.

Figure 2 discloses a comparison of weight loss curves after extraction of the first IB between the two groups of subjects (treatment with one vs two IBs). During the first 2 years, weight regains were similar for both groups and the curves were almost parallel; during the third year, weight regain was more important in subjects treated with two IBs vs one IB (4 [IQR, 0–15] vs 1 kg [IQR, 0–4], 9.6% EW [IQR, 0–54.9] vs 3.1% EW [IQR, 0–10.9]; $P=0.005$) and weight loss curves joined together at ≥3 years. Compared to baseline, body weight was significantly lower up to 2 years

Table 1 Subjects' characteristics at the time of first IB insertion ($n=118$)

	Single IB ($n=99$)	Repeat IB ($n=19$)	P value
Female sex - no.	82 (83%)	17 (89%)	0.735
Age (years)	39.0 (34.0–49.0)	37.0 (31.0–45.0)	0.412
Baseline weight (kg)	92.0 (84.0–105.0)	93.0 (85.7–97.0)	0.540
Baseline BMI (kg/m^2)	34.0 (31.2–36.9)	31.9 (31.2–37.7)	0.767
Excess weight (kg)	33.8 (25.2–42.8)	31.0 (25.5–38.8)	0.663
Previous therapies—no.			
Dietary guidance by a dietician	94 (95%)	18 (95%)	1
Structured weight loss program	56 (57%)	14 (74%)	0.207
Weight loss drugs	21 (21%)	5 (26%)	0.763
Comorbidities—no.			
Dyslipidemia	25 (25%)	6 (32%)	0.577
Arterial hypertension	19 (19%)	1 (5%)	0.191
Osteoarthropathy	16 (16%)	3 (16%)	1
Diabetes mellitus	10 (10%)	2 (11%)	1
Sleep apnea	5 (5%)	0	1
Non-alcoholic steatohepatitis	1 (5%)	1 (1%)	0.297

BMI body mass index, *IB* intragastric balloon

Values with ranges are medians with interquartile range in parentheses

Table 2 Logistic regression analysis of variables associated with repeat IB therapy

Variable	*P* value
Higher weight loss 3 months after first IB insertion	0.008
Higher number of visits with the dietician during IB therapy	0.028
Longer duration of IB therapy	0.048
Intake of a fiber-enriched, fat restricted, diet during IB therapy	0.052
Performance of moderate-intensity exercise ≥ 30 min daily during IB therapy	0.152
Younger age	0.449
Female gender	0.515
Intake of weight loss drugs prior to IB therapy	0.659
Lower baseline BMI	0.851

BMI body mass index, *IB* intragastric balloon

post IB extraction in the group of subjects who had repeat IB insertion ($P<0.001$ for both comparisons, at 1 and 2 years) and up to three years post IB extraction in the group of subjects who received a single IB (*P* values for comparison at 1, 2, and 3 years; <0.001, <0.001, and =0.001, respectively). The proportion of subjects with ≥5% baseline weight loss was significantly greater in the group of subjects with repeat vs single IB therapy at 1 and 2 years post IB extraction only (Fig. 3). At the end of follow-up (4.9 years; IQR, 3.4–6.7), the proportions of subjects with≥5% and with ≥10% baseline weight loss (and no bariatric surgery) were 46/118 (39%) and 31/118 (26%), respectively.

During follow-up, 32% of subjects underwent bariatric surgery after either single or repeat IB therapy (32/99 [32%] vs 6/19 [32%], respectively; $P=1$). Bariatric surgery was delayed in subjects with repeat vs those with single IB therapy (interval between first IB insertion and surgery, 3.0 [IQR, 2.3–5.2] vs 2.2 years [IQR, 1.3–2.8], respectively; $P=0.016$); at the time of surgery, weight regain since first IB extraction tended to be higher in subjects with repeat vs single IB therapy (19.0 [IQR, 8.3–30.0] vs 13.1 kg [IQR, 5.5–19.3]; 61.2% EW [IQR, 25.9–109.5] vs 34.4% EW [IQR, 14.7–56.5]; $P=0.097$).

Complications with the second IB tended to be more frequent compared to the first one (Table 3); they consisted of esophagitis ($n=2$) and digestive intolerance that was treated by early IB extraction ($n=2$) and IV drugs plus electrolyte administration during a 2-day hospital stay ($n=1$).

Discussion

Repeating IB therapy at patient's request was felt an acceptable option to help patients maintaining weight loss at long term (≥2 years); it was performed in a proportion of subjects (16%) almost identical to those previously reported without severe side-effect [8, 9]. However, this strategy proved disappointing as, 3 years after extraction of the first IB, weight loss curves and proportions of subjects with ≥10% baseline weight loss were almost identical for subjects treated with single vs repeat IB insertion. These results were observed despite the fact that IB therapy was repeated in self-selected subjects who had experienced superior weight loss with the first treatment (higher weight loss 3 months after first IB insertion was the single predictor of repeat IB therapy).

Even though repeating IB therapy in a subset of subjects did not improve long-term results, these were not inferior to those reported with alternative non-surgical weight loss techniques. Our subjects who completed 5-year follow-up had ≥10% and ≥5% baseline weight loss in 41% and 31% of cases, respectively. This compares to fewer than 10% of subjects with dietary/lifestyle weight reduction methods (≥5% baseline weight loss at 4 years) and to 34–57% of subjects treated with orlistat or sibutramine (≥5% baseline weight loss at 2 years; present series, 49%) [10].

Few effective options are available to prevent weight regain after any non-surgical weight loss intervention [11].

Table 3 Comparison of first vs second IB therapy ($n=19$)

	First IB	Second IB	*P* value
BMI at IB insertion (kg/m^2)	31.9 (31.2–37.7)	31.5 (28.1–34.5)	0.019
IB fill volume (ml)	500 (500–600)	600 (600–700)	<0.001
Weight loss (kg)	14.6 (11.5–23.0)	9.0 (1.0–13.0)	0.003
Excess weight loss (%)	49.3 (27.2–61.0)	18.2 (2.4–42.1)	0.004
Complications—no.	2 (11%)	5 (26%)	0.375

BMI body mass index, *IB* intragastric balloon

Values with ranges are medians with interquartile range in parentheses

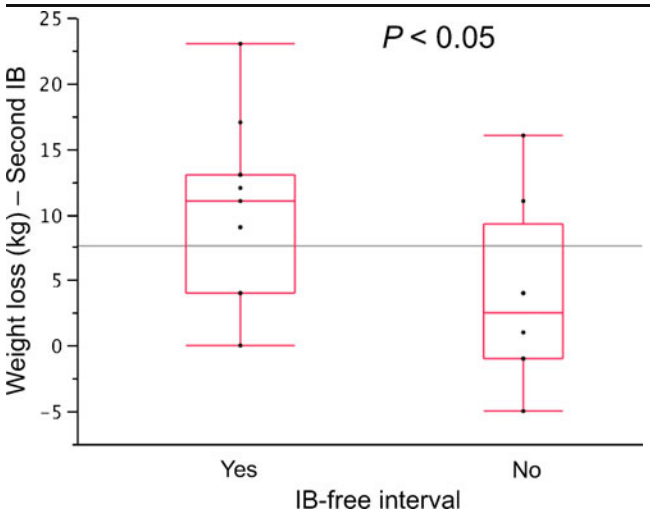

Fig. 1 Weight loss observed with the second intragastric balloon (IB). Box-whisker graph of weight loss observed during treatment with the second IB in subjects who received the second IB immediately after extraction of the first one (n=8) or after a IB-free interval (n=11). Each *box* represents the interquartile range (between Q1 and Q3); the *horizontal line across the box* represents the median value; the *vertical lines* extend from the box to the lowest and highest values. Median excess weight losses were 4.1% (IQR, 16.3–42.1) and 28.5% (IQR, 16.3–42.1) for subjects who received the second IB immediately after extraction of the first one or after a IB-free interval, respectively

Fig. 3 Percentages of subjects with ≥5% and with ≥10% baseline weight loss. For each time point, the *higher and the lower bars* indicate the percentage of subjects with ≥5% and with ≥10% baseline weight loss, respectively, for subjects treated with one vs two intragastric balloons (IB). Last observation carried forward analysis. *P<0.05 for comparison of subjects treated with one vs two IBs

We had proposed no structured weight-maintenance program to our subjects because we estimated that the cost-benefit ratio of such programs was too high [12]. Instead, we recommended monthly visits with the dietician for 6 months following IB removal, but a median of only one visit was achieved. This had likely little or no impact on the final results because a recent meta-analysis has found that, during the maintenance phase of weight loss, the frequency of meetings of dietary counseling was not predictive of weight change (contrary to that being predictive during the active weight loss phase) [11]. Combination of IB therapy with weight loss drugs is another option to help maintaining weight loss: a 6-month course of sibutramine following IB extraction has allowed to decrease weight regain at 1 year by 5 kg compared to controls (P<0.001) [13]. However, major problems with weight loss drugs include the extremely high attrition rates (>90% in common clinical practice, 40–50% in clinical trials) [14, 15] and short durations of approved treatment (1 and 2 years for orlistat and sibutramine, respectively) [16].

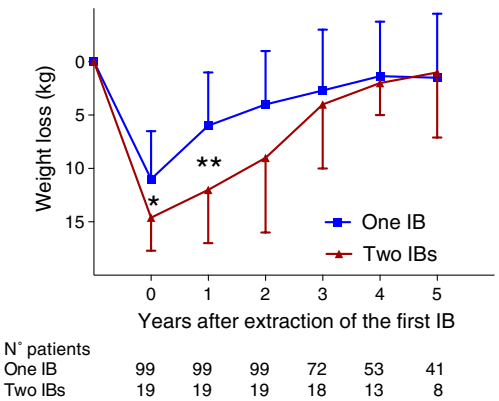

Fig. 2 Comparison of weight loss from baseline in the two groups of subjects (treatment with one vs two intragastric balloons [IB]). Last observation carried forward analysis. *P<0.05. **P<0.01 for comparison between groups. Median excess weight losses in subjects who received one vs two IBs, respectively, were, at IB extraction, 30.7% (IQR, 18.6–44.2) vs 49.3% (IQR, 27.2–61.0) and, at 5 years, 4.6% (IQR, −15.2 to 30.6) vs 2.6% (IQR, −11.2 to 30.6)

After a median follow-up of 5 years, bariatric surgery had been performed in an equally high proportion of subjects after single vs repeat IB therapy (32%). Repeat IB therapy was associated with a longer delay and a higher weight regain before recourse to bariatric surgery. As reported by Melissas [17], temporary weight loss associated with IB therapy and related benefits likely facilitated the election of bariatric surgery by some of our subjects who initially refused bariatric surgery. Hence, for a significant proportion of subjects, the IB can be viewed as a stage in the patient's quest for weight stabilization. However, it should be clear that surgeons have to stick upon international guidelines with regard to indications for bariatric surgery, and should refuse "cosmetic" indications. This was not the case for a significant proportion of our patients, who underwent bariatric surgery outside of our institutions.

In subjects who requested to prolong IB therapy, we exchanged the IB because treatment with the same IB for periods >6 months has been associated with high rates of spontaneous IB migration (19–28%) [18, 19] that may cause small bowel obstruction requiring surgery [19–21].

Filling the IB with a small amount of methylene blue is common practice to detect IB leakage early (through staining of the urines), and ultrasound examination at regular intervals has also been proposed for this purpose [9]. However, all these measures do not allow avoiding intestinal occlusion, even with the current generation of IB [9].

The main limitation of our study is the relatively small number of subjects who underwent repeat IB therapy. The choice of performing repeat IB insertion at patient's request and not in all patients, as previously reported [4], or in a randomized manner was dictated by the vanishing of IB-related effects on appetite and satiety in a majority of patients. A sham-controlled study has found that the IB decreased appetite and increased satiety at 4 weeks, but not at 12 weeks, post insertion [3]. However, as only 11 subjects received an IB in that study, a type II statistical error cannot be excluded. Indeed, in our study, subjects who requested for "IB exchange" at the theoretical date of IB extraction were still experiencing IB effects on appetite and satiety, and they estimated that modifications of their eating habits were too frail. On the other hand, subjects who requested repeat treatment after a IB-free interval had incurred a weight regain of almost 14 kg before repeat IB insertion, and this was performed as a "second chance" to modify their eating habits more durably. Conversely, the main strengths of our series include unique follow-up duration and our absence of relationship with the weight loss industry.

In conclusion, repeating IB therapy at subjects' request to help maintaining weight loss only had a temporary effect. It did not yield greater weight loss starting at 3 years of follow-up and it did not decrease recourse to bariatric surgery, which was relatively common.

Potential Conflicts of Interests The authors declare that they have no conflict of interest.

Funding No funding was obtained for this work.

References

1. Dumonceau JM. Evidence-based review of the bioenterics intragastric balloon for weight loss. Obes Surg. 2008;18:1611–7.
2. 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.
3. Martinez-Brocca MA, Belda O, Parejo J, et al. Intragastric balloon-induced satiety is not mediated by modification in fasting or postprandial plasma ghrelin levels in morbid obesity. Obes Surg. 2007;17:649–57.
4. 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.
5. National Institutes of Health. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults—the evidence report. Obes Res. 1998;6 Suppl 2:51S–209.
6. Zago S, Kornmuller AM, Agagliati D, et al. Benefit from bio-enteric Intra-gastric balloon (BIB) to modify lifestyle and eating habits in severely obese patients eligible for bariatric surgery. Minerva Med. 2006;97:51–64.
7. Lorentz FH. Der konstitutionsindex der frau. Klin Wochenshr. 1929;16:734–6.
8. Doldi SB, Micheletto G, Perrini MN, et al. Treatment of morbid obesity with intragastric balloon in association with diet. Obes Surg. 2002;12:583–7.
9. Francica G, Giardiello C, Iodice G, et al. Ultrasound as the imaging method of choice for monitoring the intragastric balloon in obese patients: normal findings, pitfalls and diagnosis of complications. Obes Surg. 2004;14:833–7.
10. Douketis JD, Macie C, Thabane L, et al. Systematic review of long-term weight loss studies in obese adults: clinical significance and applicability to clinical practice. Int J Obes. 2005;29:1153–67.
11. Dansinger ML, Tatsioni A, Wong JB, et al. Meta-analysis: the effect of dietary counseling for weight loss. Ann Intern Med. 2007;147:41–50.
12. Eddy DM, Schlessinger L, Kahn R. Clinical outcomes and cost-effectiveness of strategies for managing people at high risk for diabetes. Ann Intern Med. 2005;143:251–64.
13. Machytka E, Klvana P, Hanuskova L, et al. Use of pharmaco-therapy for long-term maintenance of weight loss following explantation of intragastric balloon (BIB). Gut. 2007;57:A290.
14. Padwal R, Kezouh A, Levine M, et al. Long-term persistence with orlistat and sibutramine in a population-based cohort. Int J Obes. 2007;31:1567–70.
15. Rucker D, Padwal R, Li SK, Curioni C, Lau DC. Long term pharmacotherapy for obesity and overweight: updated meta-analysis. BMJ. 2007;337:1194–9.
16. Williamson DF. Pharmacotherapy for obesity. JAMA. 1999;281:278–80.
17. Melissas J, Mouzas J, Filis D, et al. The intragastric balloon—smoothing the path to bariatric surgery. Obes Surg. 2006;16:897–902.
18. Herve J, Wahlen CH, Schaeken A, et al. What becomes of patients one year after the intragastric balloon has been removed? Obes Surg. 2005;15:864–70.
19. Roman S, Napoleon B, Mion F, et al. Intragastric balloon for "non-morbid" obesity: a retrospective evaluation of tolerance and efficacy. Obes Surg. 2004;14:539–44.
20. Sallet JA, Marchesini JB, Paiva DS, et al. Brazilian multicenter study of the intragastric balloon. Obes Surg. 2004;14:991–8.
21. Evans JD, Scott MH. Intragastric balloon in the treatment of patients with morbid obesity. Br J Surg. 2001;88:1245–8.