Intragastric Balloons in Comparison With Standard Therapy for Obesity—A Randomized, Double-Blind Trial

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Intragastric balloons are new but commonly used devices for the treatment of obesity; however, their safety and efficacy have not been established. We report our results of a small, double-blind, randomized trial in which the effectiveness of intragastric balloons was compared with that of conventional medical therapy for obesity. Twenty-two patients, who were 21 to 77% over ideal body weight, were studied. Eleven underwent insertion of an intragastric balloon, and 11 underwent sham procedures. One patient with a gastric balloon withdrew from the study after 3 days. Weight loss at 2 to 3 months in the conventional therapy group averaged 2.8 kg; in the balloon-treated group, the mean weight loss was 5.8 kg ($P>0.15$). Of the 10 balloons, 8 spontaneously deflated, and 1 was passed in the stools. We noted gastric erosions in five patients and multiple gastric ulcers in one. We conclude that the intragastric balloon was not clearly effective in inducing weight loss, had a high rate of spontaneous deflation, and was damaging to the gastric mucosa. Controlled trials should be done before similar weight-reduction devices are used in routine clinical practice.

Obesity is a common condition in the United States. Hypertension, hyperlipidemia, and diabetes are more common in overweight persons than in persons who are not obese,[1] and successful weight reduction ameliorates these conditions. Traditional dietary counseling, very low calorie diets, and therapeutic fasting have achieved disappointing results.[2-5]

Because medical approaches have failed in most obese patients, surgical treatments have been devised. A gastric reduction surgical procedure is relatively safe and effective for patients with morbid obesity but is not without associated morbidity and mortality,[6] and delayed complications are now being described.[7,8] Although weight reduction is more likely with a gastric reduction operation than with medical regimens, permanent success is by no means ensured.[6]

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Intragastric balloons were developed as an alternative method of treating obesity that would not entail the surgical risks. A balloon developed by Drs. L. R. and M. L. Garren was approved by the Food and Drug Administration in December 1985. This balloon, made from an elastomeric plastic with a self-sealing inflation valve (Fig. 1), is inflated in the stomach after endoscopic inspection of the upper digestive tract. The balloon displaces 200 to 220 ml, thought to be a sufficient volume to cause early satiety and to decrease food intake.

The effectiveness and safety of these balloons have not been clearly established. In order to determine whether the intragastric balloon was more effective than a sham balloon insertion in producing weight loss, 22 patients were randomized in a double-blind fashion to either conventional dietary therapy or intragastric balloon placement. The results of this study are reported herein.

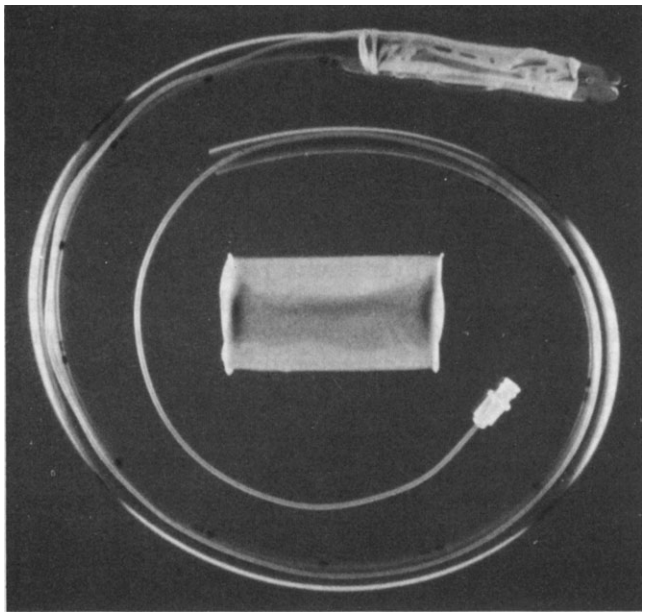

Fig. 1. Photograph of intragastric balloon and introducer tube used for treatment of obesity.

PATIENTS AND METHODS

Study Subjects.—Informed, written consent was obtained from 22 patients after referral to and evaluation in the Nutrition Clinic. To qualify for entrance in the study, these persons had to be 25 to 55 years old and 20 to 80% above ideal body weight, as determined from the midpoint of the ideal range on the 1983 Metropolitan Life Insurance Company tables.[9] Previous attempts at weight loss must have been unsuccessful. Patients were excluded from the study because of the following factors: pregnancy; severe liver or cardiopulmonary disease; alcohol or drug abuse; serious psychiatric disorders; a history of ulcers or a gastrointestinal operation; a need for aspirin, nonsteroidal anti-inflammatory agents, corticosteroids, or anticoagulants; persistent, unexplained nausea and vomiting; endoscopic evidence of esophageal strictures, varices, or large diaphragmatic hernias; gastric polyps, angiodysplasia, ulcers, or more than three gastric erosions; and duodenal ulcers or more than three duodenal erosions.

Study Design.—The study was initially designed to allow 4 months of observation after randomization, followed by a second 4-month period of crossover treatment, and finally an additional 8 months of observation during which no patients would have intragastric balloons.

The initial 4-month period was designed to be the main period of observation. Patients were referred from the Nutrition Clinic to an endoscopist. If no factors were identified that would exclude a patient from the study, a randomization card was drawn, and the appropriate procedure was performed (balloon or sham insertion). All patients were sedated; most received 5 mg of midazolam and 50 mg of meperidine. In addition, patients had their eyes covered with a towel during the procedure. In those receiving the balloon, a loaded introducer tube (American Edwards Laboratory, Irvine, California) was inserted, and its position was confirmed fluoroscopically. The balloon was then inflated with 200 ml of air. The catheter was disconnected, and the introducer was withdrawn. In the patients randomized to sham insertion, an empty introducer tube was inserted, its position was confirmed fluoroscopically, and 200 ml of air was pumped into the stomach. The sedative and blindfold effectively prevented patients from perceiving whether an intragastric balloon had been inserted. Care was taken to ensure that physicians and the dietitian in the Nutrition Clinic were unaware of whether the patient had a balloon inserted.

All patients received instructions for diets designed to result in a daily 400- to 800-calorie deficit, as assessed by indirect calorimetry and reported activity. Moreover, all patients were instructed to take therapeutic doses of the antacid of their choice four times a day, consume a liquid diet for 2 to 3 days after endoscopy, and inform the endoscopist if they experienced abdominal discomfort or vomiting. Fecal hemoglobin (determined by HemoQuant assay) was measured before balloon placement and at regular intervals after initial endoscopy.

Estimates of the sample size needed to ensure adequate statistical power were based on weight loss in a historical cohort of 16 patients. We determined that 71 patients would be needed in each treatment group to be 90% certain of detecting a 50% difference in weight loss over that observed in the historical cohort (6.5 kg versus 4.3 kg), assuming that the standard deviation was 3.9 and that a two-sided, two-sample t test would be performed.

Three months after we initiated this study, the death of a patient elsewhere as a result of a gastric balloon led to a change in the manufacturer's indications for use of such balloons. Initially, the balloon had been approved for use in patients whose weight exceeded their ideal body weight by more than 20%. The indications were changed so that the balloon was to be used only as a substitute for surgical treatment of morbid obesity (100% or 100 pounds [45.4 kg] above ideal body weight) in patients medically unfit for operation or unwilling to undergo an operation. Furthermore, because of reports of high rates of spontaneous deflation and complications due to the deflated balloon, the balloon was to be removed after 3 months rather than 4 months. At the time of notification from the company and after discussion with the Mayo Institutional Review Board, our study was discontinued. Patients were informed of the decision by registered mail and offered the choice of immediate withdrawal or continuation of the study until 3 months after entry. Most patients chose to remain in the study; the shortest period of observation was 2 months.

Those patients without an intragastric balloon were asked to return for regular monitoring of their weight but did not have repeat endoscopy. The patients with balloons had repeat endoscopy followed by removal of the balloon. The balloon was punctured with a 25-gauge, 6-mm needle attached to a catheter (Microvasive, Inc., Milford, Massachusetts), and any remaining air was withdrawn. The balloon was then grasped with a rat-toothed forceps and withdrawn. The endoscope was reinserted, and the upper gastrointestinal tract was reinspected specifically for evaluation of the area in contact with the balloon. During endoscopy, the presence of air in the balloon could be readily determined by visual inspection, a collapsed balloon being distinctly different from one fully inflated. These patients were also asked to return for monitoring of weight while remaining on the recommended diet. At the conclusion of the study period, we recorded the weight of all patients. The mean weight loss between the treatment groups was compared by using a two-sample Student *t* test.

RESULTS

The 22 patients (20 women and 2 men) entered in the study ranged in age from 25 to 51 years. The percentage above ideal body weight ranged from 21 to 77%. Of the 22 patients, 11 underwent insertion of an intragastric balloon, and 11 had sham insertions. The clinical characteristics of these patients at the time of entry into the study were similar in both groups (Table 1). Two patients who underwent sham insertions had one or two gastric erosions associated with recent use of aspirin; no patients who received gastric balloons had gastric erosions at the time of entry into the study. One patient with an intragastric balloon experienced abdominal distress and requested removal of the balloon 3 days after insertion; the stomach was normal at the time of balloon removal. This patient was excluded from further analysis.

Table 2 shows the outcome in the study patients. The mean weight loss in the sham-

Table 1.—**Characteristics of Patients at Time of Entry Into Study of Treatment of Obesity With or Without Intragastric Balloons***

Case†	Age (yr) and sex	% over IBW‡
	With intragastric balloon	
1	42 M	46
2	25 F	26
3	39 F	58
4	36 F	60
5	50 F	33
6	33 F	59
7	29 F	44
8	51 F	21
9	31 F	55
10	26 F	32
Mean	36	43
Median	34.5	45
Range	25-51	21-60
	Without intragastric balloon	
1	33 M	48
2	38 F	37
3	30 F	47
4	29 F	77
5	34 F	59
6	48 F	32
7	37 F	56
8	27 F	33
9	32 F	39
10	28 F	52
11	35 F	70
Mean	34	50
Median	33	48
Range	27-48	32-77

*No statistically significant difference in weight reduction was noted between the two treatment groups.
†One patient who underwent insertion of an intragastric balloon withdrew from the study after 3 days.
‡IBW = ideal body weight.

procedure group was 2.8 ± 3.9 kg. Among the patients in whom gastric balloons were inserted, the mean weight loss was 5.8 ± 5.9 kg. This loss of weight was not significantly greater than in those without an intragastric balloon ($P>0.15$); the 95% confidence interval for weight loss with the balloon was -1.5 to 7.7 kg.

Eight of 10 balloons were found to be deflated at the conclusion of the study. One balloon deflated and passed through the intestinal tract. Five patients had gastric erosions; one patient had multiple gastric ulcers surrounding a deflated balloon. Patients with deflated balloons did not necessarily lose weight differently from those who had inflated balloons at the time of removal. HemoQuant monitoring for fecal hemoglobin did not show elevated levels in any of the patients entered into the study, including those with gastric erosions or ulcers.

DISCUSSION

We compared the efficacy of use of intragastric balloons in conjunction with standard dietary therapy and counseling with the use of standard therapy alone in a prospective, randomized, double-blind trial in patients with nonmorbid obesity. Despite discontinuation of the study before the projected completion, several important observations were made. No clinically important differences in weight reduction were noted with use of the intragastric balloon, and the rate of spontaneous deflation of the balloon and damage to the gastric mucosa was unacceptably high. These observations cast doubt on both the safety and the efficacy of this new device as an adjunct in the treatment of obesity.

Table 2.—**Results of Treatment of Obesity in Patients With or Without Intragastric Balloons**

Case*	Weight loss (kg)	Duration of treatment (mo)	Balloon deflation	Damage to gastric mucosa
		With intragastric balloon		
1	13.0	3	Yes; passed into stool	None
2	7.5	3	Yes	Linear erosions
3	2.5	2	No	Erosions
4	14.0	3	Yes	Gastric ulcers (3)
5	0	2	Partial	None
6	7.0	2	Partial	Erosions
7	9.0	3	No	None
8	-5.0	3	Yes	Erosions
9	8.0	3	Yes	Erosions
10	2.0	3	Yes	None
		Without intragastric balloon		
1	0	2	...	...
2	-2.0	3	...	...
3	0	3	...	...
4	0	3	...	...
5	0	2	...	...
6	7.0	3	...	...
7	4.0	2	...	...
8	5.0	2	...	...
9	0	3	...	...
10	6.0	3	...	...
11	10.5	3	...	...

*One patient who underwent insertion of an intragastric balloon withdrew from the study after 3 days.

No other randomized observation of safety and efficacy of gastric balloons has been published to date, although several trials are in progress. Uncontrolled observations by the developers of this device, reported in abstract form,[10] revealed a mean 41-pound (18.6-kg) weight loss at 6 months (range, 11 pounds [5 kg] to 75 pounds [34 kg]) in 70 patients with morbid obesity. Spontaneous deflation occurred in an unspecified number of patients, and gastric ulcers occurred in 5 of the 70 patients. No gastric erosions or fecal blood loss was reported in that study.

The reasons for the discrepancy in results between our study and the study by Garren and Garren[10] are unclear. Their patients were morbidly obese, whereas ours were less overweight. During treatment, heavier patients may lose weight more readily than those who are less obese. We did not use formal behavioral modification in our patients but rather relied on standard dietary and behavior counseling, as routinely used in our clinical practice. The lack of a control group treated only with behavioral modification without intragastric balloons in the study by Garren and Garren precludes assessment of the relative effects of the balloon and the formal behavioral modification on weight loss. Our results suggest that the intragastric balloon itself is not a major contributor to the reported weight loss.

In the current study, the high rate of spontaneous deflation of intragastric balloons was distressing. Complications such as intestinal obstruction or ballon regurgitation may occur because the deflated balloon can exit the stomach in either an antegrade or a retrograde direction. The high rate of spontaneous deflation does not seem to be unique to our study because reports of this occurrence prompted the manufacturer to alter a recommendation for replacement of

the balloon at 3-month rather than 4-month intervals.

Although the intragastric balloon did not significantly increase the amount of weight loss in our patients, the small sample size weakened the statistical power to detect minor differences. Nevertheless, any small differences in weight loss attributable to the balloon must be balanced against the complications and cost of the device. Although no life-threatening complications occurred in our small series, the high rate of spontaneous deflation and mucosal damage was worrisome. The cost of the balloon and the endoscopic examination is substantial. The balloon and introducer cost approximately $400, and the endoscopic charges for insertion and removal of each balloon are $1,200 to $1,600 in addition. In our 3-month study, this translated into an additional $600 for each kilogram of weight lost with the balloon.

CONCLUSION

The lack of efficacy, the damaging effects on the gastric mucosa, and the high cost of the intragastric balloon make the routine use of this device for the treatment of obesity difficult to justify. The underlying rationale for using a per orally placed temporary device such as a balloon to reduce gastric capacity remains plausible. Effective treatment of obesity involves not only initial weight reduction but maintenance of weight loss as well. Less irritative devices that are efficacious in both causing weight reduction and allowing sustained weight loss should be considered. Future devices for use in weight reduction should be prospectively evaluated in controlled clinical trials before their role in clinical practice is assumed.

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