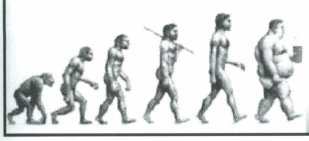
臺北醫學大學附設醫院
微創手術中心
TAIPEI MEDICAL UNIVERSITY HOSPITAL
MINIMAL INVASIVE SURGERY CENTER

Intragastric Balloon for the Treatment of Obesity

體重管理中心主任 - 王 偉 醫師



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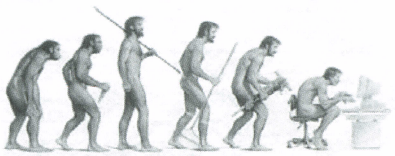
Energy Imbalance
A modern society with stone age genes



- Copious supply of food
- Labor-saving technologies - activity is optional
- The net result is Calories In > Calories Out

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病態性肥胖症

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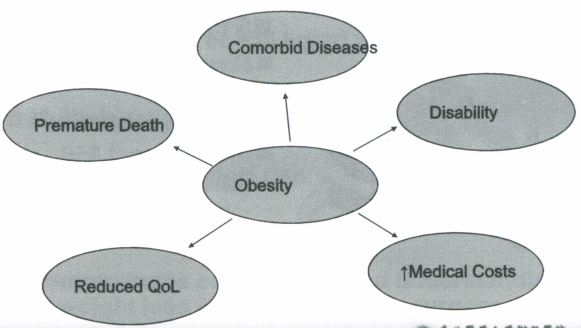
Impact of Obesity



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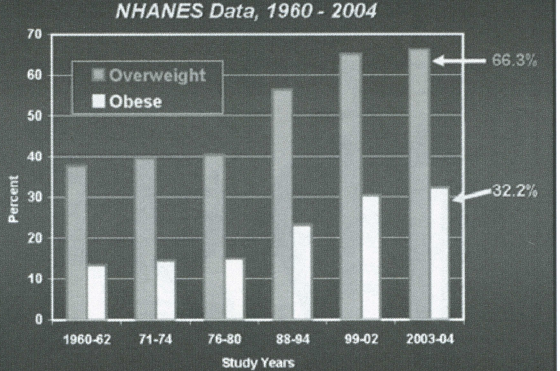
The Rising Tide of Obesity in USA
NHANES Data, 1960 - 2004



Overweight = BMI 25 – 30 kg/m²; Obese = > 30 kg/m²

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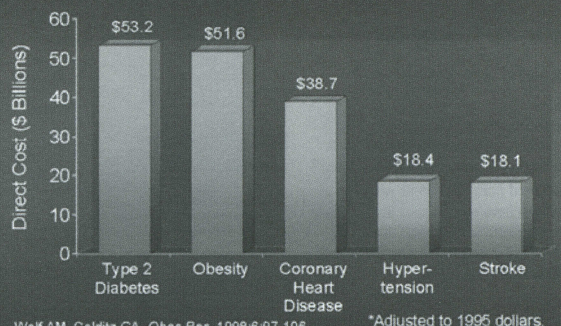
Direct Cost * of Chronic Diseases in the United States



*Adjusted to 1995 dollars.

Wolf AM, Colditz GA. *Obes Res.* 1998;6:97-106.
Hodgson TA, Cohen AJ. *Med Care.* 1999;37:994-1012.

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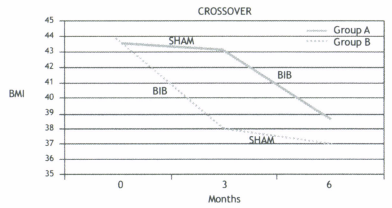
第五講題簡報

Intragastric Balloon vs. Sham Italian Study:

Significant Efficacy Results

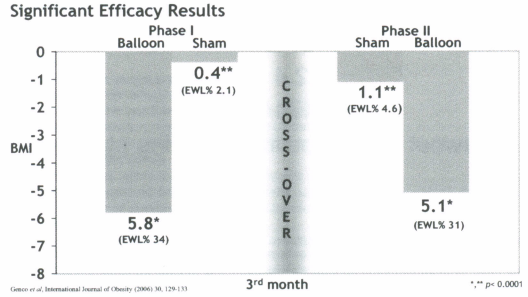
BMI Trend During Different times of the study



Genco *et al*, International Journal of Obesity (2006) 30, 129-133

Intragastric Balloon vs. Sham Italian Study:

Significant Efficacy Results



Genco *et al*, International Journal of Obesity (2006) 30, 129-133

Brazilian Multicenter Study of the Intragastric Balloon:

Significant Efficacy Results

Six month follow-up, n=323, p<0.000

Weight Reduction	15.2 ± 10.5 kg
% EWL	48.3 ± 28.1%
Baseline BMI	38.2 ± 9.4 kg/m²
Change in BMI	-5.3 ± 3.4 kg/m²

Sallet *et al*, Obesity Surgery, 14, 991-998

Brazilian Multicenter Study of the Intragastric Balloon:

Long Term Efficacy Results

One-year follow-up, n=85

- Maintained 90% of their BMI reduction observed at the 6 month follow-up

Sallet *et al*, Obesity Surgery, 14, 991-998

RESEARCH ARTICLE

Initial Japanese Experience with Intragastric Balloon Placement

Masayuki Ohta · Seigo Kitano · Seiichiro Kai · Akio Shiramizu · Hidetoshi Eguchi · Yuichi Endo · Takayuki Masaki · Tetsuya Kakuma · Hiromobu Yoshimatsu

Conclusions Intragastric balloon placement is a safe and effective procedure in obese Japanese patients, and about half of the patients will maintain their weight loss after the balloon is removed.

Table 1 Comorbidities at time of the balloon removal

Comorbidities	Improvement[a]	No change
Type 2 diabetes	5/5 (100%)	0/5 (0%)
Hypertension	8/10 (80%)	2/10 (20%)
Dyslipidemia	12/14 (86%)	2/14 (14%)
Liver dysfunction	9/9 (100%)	0/9 (0%)
Metabolic syndrome[b]	10/10 (100%)	0/10 (0%)

[a] Lower drug dosage, shift to other therapy or improvement of serum data

[b] Diagnosed by Japanese criteria [6]

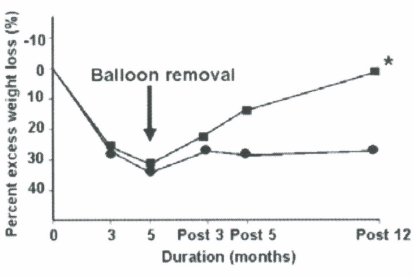


Fig. 1 Changes in %EWL after start of intragastric balloon (BIB® system) placement in eight obese Japanese patients who did not consecutively undergo bariatric surgery after removal of the balloon and were followed up under medical treatments for 12 months. After removal of the balloon, weight loss was maintained in half of the patients (%EWL >20%, *n*=4, *circles*), and the remaining patients returned to their pretreatment weight (*n*=4, *squares*). *Asterisk*, $p<0.01$ compared between the groups 12 months after balloon removal

第五講題簡報

OBES SURG

Table 2 Published outcomes of weight loss 1 year after the balloon removal

Author (Year)	Reference	Weight loss	
		At time of balloon removal	After 1 year follow up
Dakik (2004)	[23]	15.5 kg (female)	−1.3 kg (14 months)
Herve (2005)	[24]	12.0 kg	8.6 kg
Mathus-Vliegen (2005)[a]	[25]	21.3 kg	12.6 kg
Melissas (2006)[b]	[26]	41.6%EWL[c]	23.9%EWL (6–30 months)
Angrisani (2006)	[27]	32.9%EWL	27.1%EWL
Genesh (2007)	[16]	4.4 kg	1.5 kg (6–12 months)
Present study		12 kg	6.4 kg

[a] One-year balloon treatment
[b] Data in the successful group were used
[c] Percent excess weight loss

OBES SURG (2008) 18:841–846
DOI 10.1007/s11695-007-9331-8

RESEARCH ARTICLE

Safety and Effectiveness of the Intragastric Balloon for Obesity. A Meta-Analysis

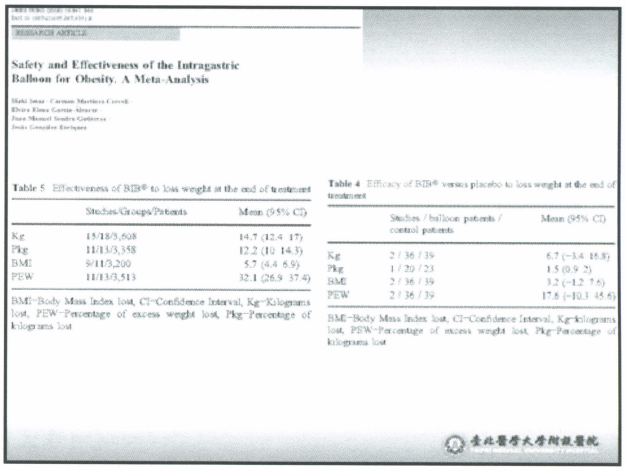
Iñaki Imaz · Carmen Martínez-Cervell · Elvira Elena García-Alvarez · Juan Manuel Sendra Gutiérrez · Jesús González-Enríquez

Conclusion The use of the BIB®, within a multidisciplinary weight management program, is a short-term effective treatment to lose weight, but it is not yet possible to verify its capacity to maintain the weight lost over a long period of time.

Table 2 Early removed balloons and their causes

Causes	N[a]	%[b]
Voluntary early remove	62	1.8
Abdominal pain and other mild digestive disorders[c]	31	0.9
Obstruction in the digestive tract	21	0.6
Deflation without displacement of the balloon[d]	9	0.3
Nausea and vomiting	7	0.2
Gastric perforation	5	0.2
Dehydration	4	0.1
Deflation and displacement of the balloon[d]	3	0.1
Gastric ulcer	1	0.1
Total (removed/total)	143/3,442	4.2

[a] Absolute number of patients with early removed balloon
[b] Percentage of patients with early removed balloon
[c] Dyspepsia, heartburn, flatulence, and digestive subocclusion
[d] Deflation more than 50% of the volume



RESEARCH ARTICLE

Safety and Effectiveness of the Intragastric Balloon for Obesity. A Meta-Analysis

Table 5 Effectiveness of BIB® to loss weight at the end of treatment

	Studies/Groups/Patients	Mean (95% CI)
Kg	15/18/3,608	14.7 (12.4 17)
Pkg	11/13/3,358	12.2 (10 14.3)
BMI	9/11/3,200	5.7 (4.4 6.9)
PEW	11/13/3,513	32.1 (26.9 37.4)

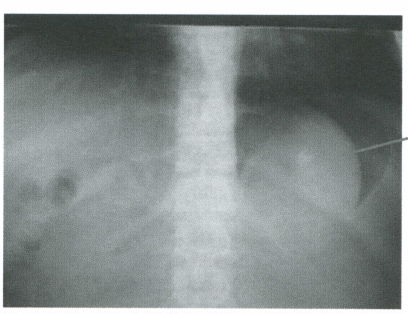
BMI=Body Mass Index lost, CI=Confidence Interval, Kg=Kilograms lost, PEW=Percentage of excess weight lost, Pkg=Percentage of kilograms lost

Table 4 Efficacy of BIB® versus placebo to loss weight at the end of treatment

	Studies / balloon patients / control patients	Mean (95% CI)
Kg	2 / 36 / 39	6.7 (−3.4 16.8)
Pkg	1 / 20 / 23	1.5 (0.9 2)
BMI	2 / 36 / 39	3.2 (−1.2 7.6)
PEW	2 / 36 / 39	17.8 (−10.3 45.6)

BMI=Body Mass Index lost, CI=Confidence Interval, Kg=kilograms lost, PEW=Percentage of excess weight lost, Pkg=Percentage of kilograms lost

胃內水球置入



Potential complications of BIB therapy

- Mild
  - Nausea, vomiting at first week
    - IVF, antiemetic,psychological support
  - Acid reflux esophagitis
    - PPI
  - Gastric ulcer
    - PPI
  - Intolerance
    - Early vs. delay
  - Dehydration
    - Readmission for rehydration
- Biochemical distrubances
  - Hypokalaemia; pre-renal azotaemia
- Nutritional
  - Rare; anaemia may occur

Study Results

Minor Complications

73 / 3824 (1.9%)

Early removal (no compliance)	13	(0.33%)
Early rupture	20	(0.52%)
Esophaghitis	40	(1.04%)

Italian experience (G.I.L.B)

Potential complications of BIB therapy

- Severe
  - Gastric perforation
    - Rare if given PPI, avoid NASID and smoking
  - Premature rupture
    - Rare if removed within 6 month
  - Intestinal obstruction
    - Rare if removed within 6 month; may require surgery or endoscopic therapy

Study Results

Major Complications

37 / 3824 (0.96%)

Gastric Occlusion	19	(0.49%)
Gastric Perforation	5	(0.13%)*
Gastric Ulcer	10	(0.26%)
Bowel Occlusion (Prior Gynecological surgery)	3	(0.07%)

Italian experience (G.I.L.B)

Italian Experience with the Intragastric Balloon:

Complication Rate

- Intragastric Balloon positioning was uncomplicated in all but two cases (0.08%) with acute gastric dilation treated conservatively
- Overall complication rate was 2.8%
  - Gastric perforation occurred in 5 patients (0.19%)
    - 4 of whom had undergone previous gastric surgery
      - 2 died, 2 were successfully treated by laparoscopic repair after balloon removal
  - Nineteen gastric obstructions (0.76%) presented in the 1st week after positioning and were successfully treated by balloon removal
  - Balloon rupture (n=9; 0.36%) was not prevalent within any particular period of balloon treatment and was also treated by balloon removal

Genco *et al*, Obesity Surgery, 14, 1161-1164

Brazilian Multicenter Study of the Intragastric Balloon:

Safety Results

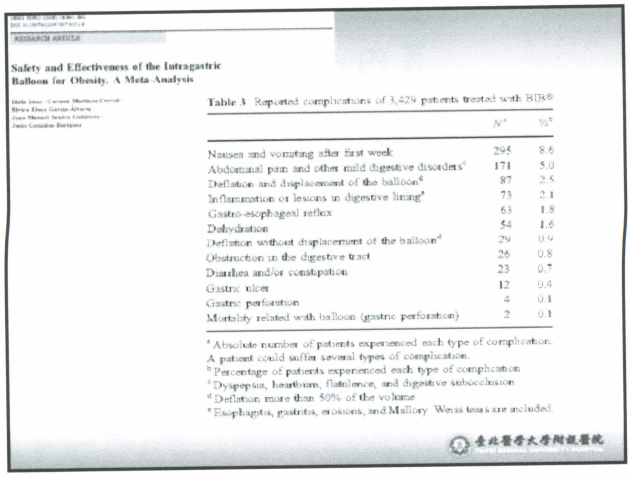
Most Common Side Effects

Nausea & vomiting	129	(39.9%)
Epigastric pain	65	(20.1%)

Complications

Clinically controlled reflux esophagitis	40	(12.4%)
Dehydration requiring IV	15	(4.6%)
Early intolerance leading to removal	11	(3.4%)
Balloon impaction	2	(0.6%)
Spontaneous deflation	1	(0.3%)

Sallet *et al*, Obesity Surgery, 14, 991-998



Safety and Effectiveness of the Intragastric Balloon for Obesity. A Meta-Analysis

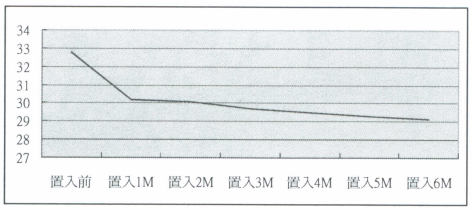
Table 3 Reported complications of 3,429 patients treated with BIB®

	N°	%b
Nausea and vomiting after first week	295	8.6
Abdominal pain and other mild digestive disorders[c]	171	5.0
Deflation and displacement of the balloon[d]	87	2.5
Inflammation or lesions in digestive lining[e]	73	2.1
Gastro-esophageal reflux	63	1.8
Dehydration	54	1.6
Deflation without displacement of the balloon[d]	29	0.9
Obstruction in the digestive tract	26	0.8
Diarrhea and/or constipation	23	0.7
Gastric ulcer	12	0.4
Gastric perforation	4	0.1
Mortality related with balloon (gastric perforation)	2	0.1

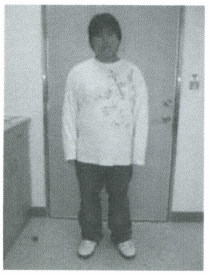
[a] Absolute number of patients experienced each type of complication. A patient could suffer several types of complication.
[b] Percentage of patients experienced each type of complication
[c] Dyspepsia, heartburn, flatulence, and digestive subocclusion
[d] Deflation more than 50% of the volume
[e] Esophagitis, gastritis, erosions, and Mallory Weiss tears are included.

BMI 變化曲線

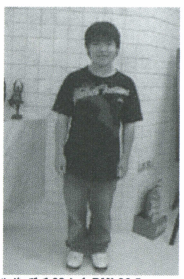
■ 平均前三個月減重效果最佳，幾乎是藥物減重的2.5倍



胃水球案例-減22公斤

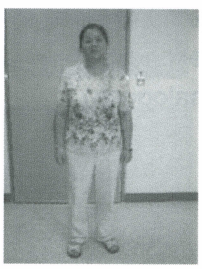


術前:身高160公分 體重90公斤 BMI:35

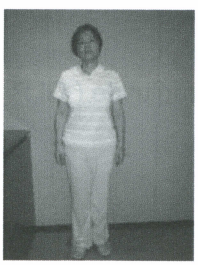


術後:體重68公斤 BMI:26.5

胃水球案例-減14公斤



術前:體重68.2公斤-腰臀圍93-105.5公分



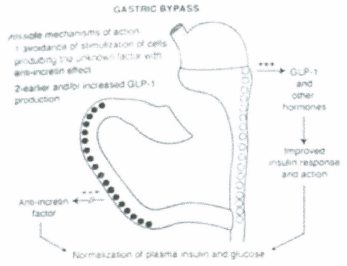
術後:體重54公斤-腰臀圍-75.5-91公分

胃水球案例-減22公斤

術前:身高162公分 體重78公斤 BMI:30

術後:體重56公斤 BMI:21.3

Surgery for Curing T2 DM
IS Procedure Matter ?



Francesco Rubino, et al. Ann Surg 2002:236:554-559

Hindgut theory – GLP-1

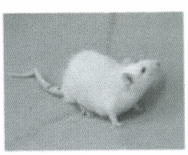
- Hyperinsulinemic hypoglycemia with nesidioblastosis after gastric-bypass surgery *NEJM 2005;353:249-54*
- Exenatide(synthetic exendin-4)
- Liraglutide (GLP-1 analogues)

Foregut theory – GIP
Rubino: Goto-Kakizaki Rat (GK)

Rubino: Goto-Kakizaki Rat (GK)

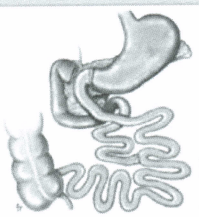
Animal model of type 2 diabetes
- The most-widely used lean model in type 2 diabetes research

(Nature Genet 1996)
- Non-obese
- Normolipidemic
- Hyperinsulinism
- Insulin resistance



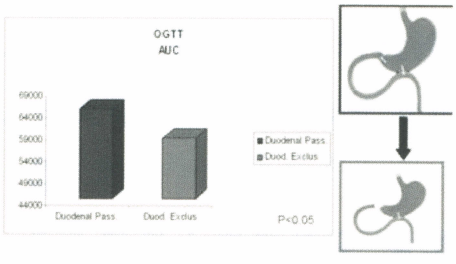
Exclusion of the duodenum with preservation of the stomach in diabetic (GK) rats

Exclusion of the duodenum with preservation of the stomach in diabetic (GK) rats

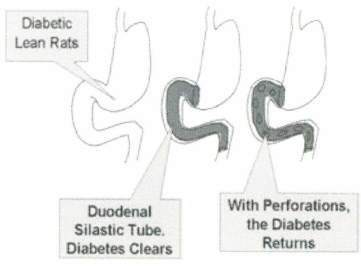


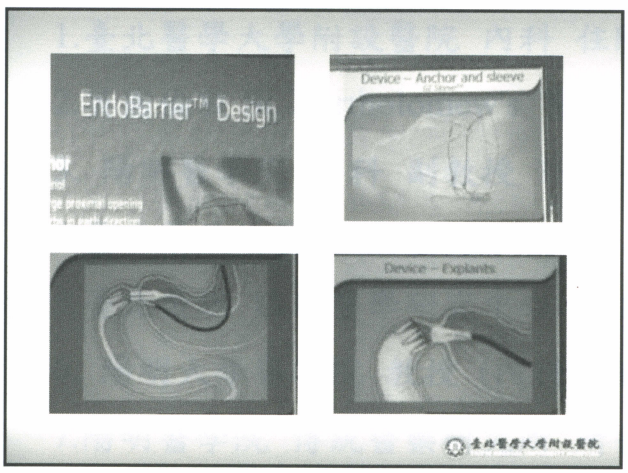
Rubino 2006

Diabetes Disappears in Diabetic Rats After Duodenal Exclusion (Rubino)



Rubino, F: Annals of Surgery Nov 2006 ;244:741-9





FIRST HUMAN EXPERIENCE WITH AN ENDOSCOPICALLY DELIVERED AND RETRIEVED DUODENAL-JEJUNIAL BYPASS SLEEVE

ASBS annual meeting 2007,6,12

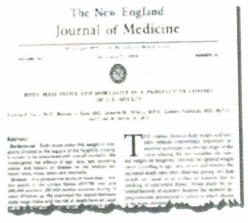
- Rodrigue L, Ramos A, Neto G, Tarnoff M. Chile, Tufts-New England Medical Center
- 61 cm DJBS
- 12 patients, 12 weeks safety study
- % EWL: 24%
- 4 T2DM: no more medication
- No severe event

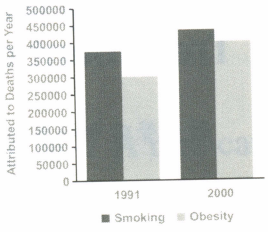
Leading Attributable Factors in Deaths-USA,2000 CDC Data

Makdad et al, JAMA,2004

Smoking	435,000	18.1% of all deaths
Obesity	365,000	15.6%
Malignancy	85,000	
Infectious	75,000	
Toxic agents	55,000	
Motor vehicle	43,000	
Guns	29,000	
Sexual behavior	20,000	
Illegal drugs	17,000	

Obesity is Associated with Higher Mortality Rates


The New England Journal of Medicine



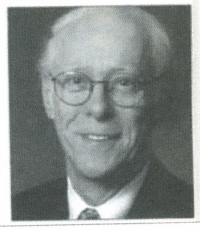
The Mortality Rate due Obesity is climbing at a much higher rate than that due to smoking

Calle et al, N Eng J Med, 1999; (15)341:1097-105, Ali H. Mokdad, AH et al JAMA. 2004;291:1238-1245.

Economic Costs in US

- $117 billion
- Direct cost $61 billion
  - Health care costs
- Indirect cost $56 billion
  - Lost wages and future earnings

Obesity Management Vol.1, No.1



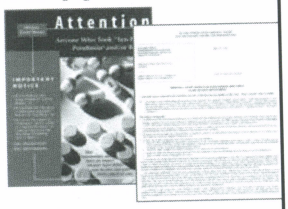
"We aren't going to cure obesity with diets."

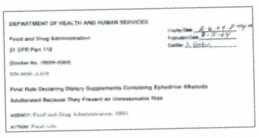
George Bray
Pennington Biomedical Research Center

Medical Therapy

Minimal Long-term Weight Loss

- A two-year randomized study of Orlistat among 892 Adults 30-43 kg/m2 found weight loss of 10% at one year and 8% at two years.*
- Medical complications with weight loss medicines and dietary supplements has lead the FDA to prohibit sale and distribution of certain drugs.





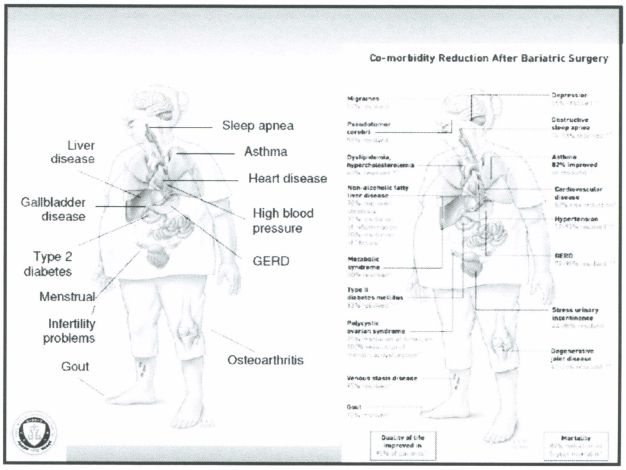
*Davidson, MH, et al. JAMA. 1999;281:235-242

What Are My Options?

Why do we treat obesity??

- Co-morbidities
- Quality of life
- Survival – Life Expectancy

臺北醫學大學附設醫院



Resolution of Comorbidities

	Number Prior to Surgery	% Worse	% No Change	% Improved	% Resolved
Osteoarthritis	64	2	10	47	41
Hypercholesterimia	62	0	4	33	63
GERD	58	0	4	24	72
Hypertension	57	0	12	18	70
Sleep Apnea	44	2	5	19	74
Hypertriglyceridemia	43	0	14	29	57
Peripheral Edema	31	0	4	55	41
Stress Incontinence	18	6	11	39	44
Asthma	18	6	12	69	13
Diabetes	18	0	0	18	82
Average		1.6%	7.8%	35.1%	55.7%
				90.8% Improved or Resolved	

Schauer, et al, Ann Surg 2000 Oct;232(4):515-29

臺北醫學大學附設醫院

Indications for Surgery(NIH)

- BMI >40 kg/m^2, or >35 kg/m^2 with significant co-morbid illnesses
- Multiple failed weight loss attempts
- Acceptable surgical risk
- Age 18-60
- Demonstrates commitment and understanding of weight loss following bariatric surgery

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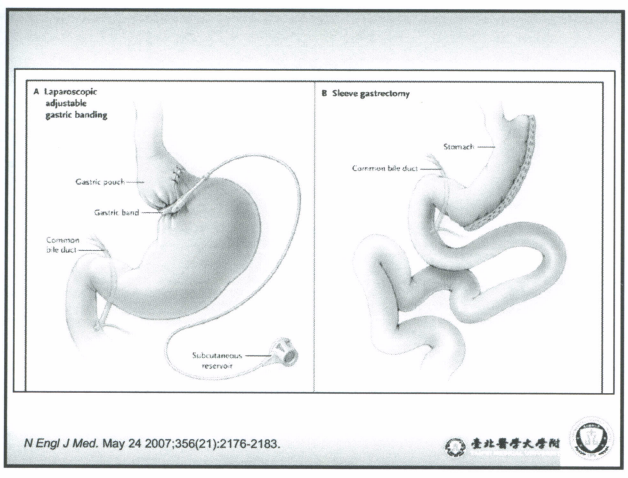
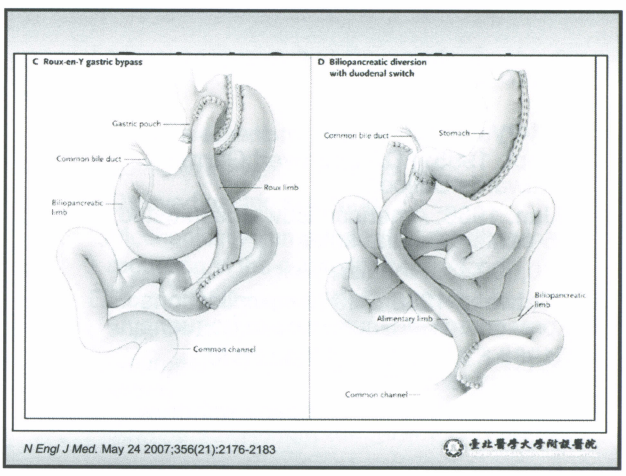


N Engl J Med. May 24 2007;356(21):2176-2183.

臺北醫學大學附



N Engl J Med. May 24 2007;356(21):2176-2183

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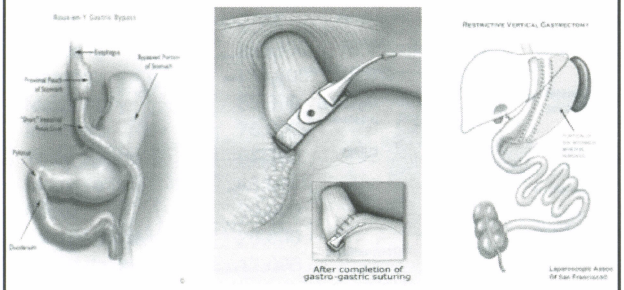
Most Common Procedures



%EWL
33%

Intragastric Balloon & Implanted Gastric Stimulator

%EWL
23% (40%)

Endoscopic Treatment of Obesity Device Categories

1. Occupy a space in the gastric lumen
2. Create a restriction in the gastric lumen
3. Alter food absorption

Hashiba, Gastrointest Endoscopy Clin N Am 17 (2007) 545-557

Gastric Volume - Displacing Weight Loss Device:

Balloon History

1921: **Davies (U.K.)**
Bezoar

Early 1980s: **Ballobes**
Polyurethane, Air-Filled, 400-500 ml

1982: **Frimbergen (Germany)**
11 patients with latex balloon

1982: **Nieben/Harboe (Denmark)**
5 patients with rubber balloon

1982: **Miller (USA)**
Dog study with polyethylene bottles

Garren-Edwards Bubble

History

- Sept. 1985: FDA approved Garren-Edwards Balloon
- ☐Jan. 1986: American Edwards initiated 5-center trial and sales
- ☐20,000 sold the first year
- ☐Between 1986 & 1988 complications presented and increased in frequency:
- ☐1988 FDA restricted the use to "investigation trials"
- ☐May 15, 1988 the company withdrew the product from the market

Features of Balloons Used in the 1980's

Complications

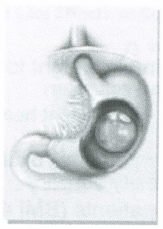
GASRIC EROSION	26%
GASTRIC ULCERS	14%
SMALL BOWEL OBSTRUCTION	2%
MALLORY-WEISS TEAR	11%
ESOPHAGEAL LACERATIONS	1%

- Not effective
- Unsafe

Benjamin SB et al. Gastroenterology,1988 Sep;95(3):581-8
Meshkinpour H et al. Gastroenterology,1988 Sep;95(3):589-92
Kramer FM et al. Arch Int Med,1989 Feb;

Tarpon Springs Scientific Conference - 1987

- Scientific conference held with 75 international experts from the fields of gastroenterology, surgery, obesity, nutrition and behavior medicine to develop a general consensus on this technology/treatment option
- Conference Conclusions with respect to a Gastric Volume - Displacing Weight Loss Device:
  - Be effective at promoting weight loss
  - Be filled with liquid (not air)
  - Be capable of adjustment to various sizes
  - Have smooth surface and low potential for causing ulcers and obstructions
  - Contain a radiopaque marker that allows proper follow-up of the device if it deflates
  - Be constructed of durable materials that DOES NOT LEAK



BioEnterics Intragastric Balloon

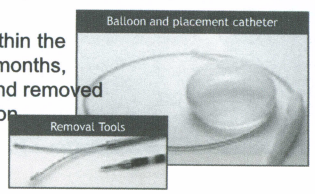
BioEnterics Intragastric Balloon System

- 1980's developed by Dr. Fred Gau and IDC
  - Intended to be part of a comprehensive program:
    - medical evaluation, behavior modification therapy, psychological test, nutritional counseling and dietary instruction
- 1991: first European clinical trial completed
- 1991 to present: the Balloon is sold to limited centers in Europe , Australia, South America and certain countries in Asia

BioEnterics Intragastric Balloon

The Intragastric Balloon is:

- a spherical silicone balloon placed within the stomach
- filled, under endoscopic guidance, with up to 700 ml of normal saline
- designed to remain within the stomach for up to six months, and is then deflated and removed under endoscopic vision



Bioenteric Intragastric Balloon Package Insert

Old and Current Devices

Comparison

	Garren Edwards	Heliosphere	Intragastric Balloon
Shape	Cylinder with sharp edges	Sphere	Sphere
Fill	Air	Air - as balloon is overfilled, it become more rigid and pressurized	Liquid - remains flexible throughout placement
Volume	220cc	650-1000cc	400-700cc
Material	Polyurthane	Polymer covered with silicone envelope	Silicone
Radiopaque	No		Yes
Duration	3 mths	6 mths	6 mths
Ulcer	Yes		rare
Occlusion	13-20%		0.5%

BioEnterics Intragastric Balloon

- The true mechanisms are inconclusive
- Hypothesis for weight loss include:
  - Delayed gastric emptying
  - Mechanical volume reduction resulting in a reduction in the capacity to store food
  - Hormonal changes which may lead to appetite suppression and satiety
  - Neuronal changes leading to the feeling of satiety

Hashiba, Gastrointest Endoscopy Clin N Am 17 (2007)545-557

BioEnterics Intragastric Balloon

Indications

In patients:

- ☐ Who failed to achieve and maintain weight loss with a supervised weight control program
  - ☐ In patients (BMI 30-39) who have significant health risks related to their weight
- ☐ In patients (BMI 40 or BMI 35 with comorbidities) who are not candidates for obesity surgery
- ☐ Pre-surgical temporary use in patients (BMI 40 and above or a BMI of 35 with comorbidities) prior to obesity or other surgery, in order to reduce surgical risk

Bioenteric Intragastric Balloon Package Insert

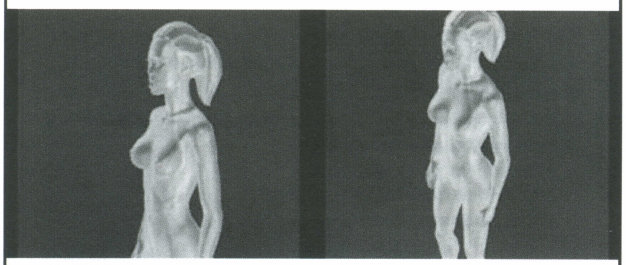
BioEnterics Intragastric Balloon

ContraIndications

- Use of the BIB System is contraindicated for weight loss in patients with a BMI less than 30, unless accompanied by comorbidities associated with obesity that would be expected to improve with weight loss
- Contraindications include:
  - ☐ Patients with previous gastrointestinal surgery
  - ☐ Any inflammatory disease of the gastrointestinal tract
  - ☐ Potential upper gastrointestinal bleeding conditions
  - ☐ A large hiatal hernia
  - ☐ A structural abnormality in the esophagus or pharynx
  - ☐ Any other medical condition which would not permit elective endoscopy
  - ☐ Major prior or present psychological disorder
  - ☐ Alcoholism or drug addiction.
  - ☐ Patients unwilling to participate in an established medically-supervised diet and behavior modification program, with routine medical follow-up
  - ☐ Patients receiving aspirin, anti-inflammatory agents, anticoagulants or other gastric irritants, not under medical supervision
  - ☐ Patients who are known to be pregnant or breast-feeding

Bioenteric Intragastric Balloon Package Insert

Intragastric Balloon



ITALIAN EXPERIENCE WITH THE INTRAGASTRIC BALLOON

18 Center s May 2000 – July 2007

Patients Comorbidities: 3824

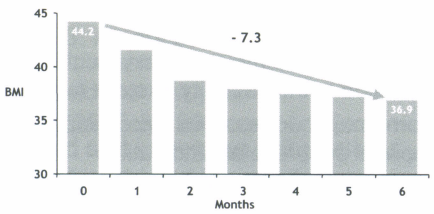
Diabetes	Night apnea
Hipertension	GERD
Arthrosis	Phlebitis
Dislipidemia	Amenorrea
Resp. Disf.	Others

Single Comorbidities	Multiple Comorbidities
63.1%	36.9%

Italian experience (G.I.L.B)

Study Results

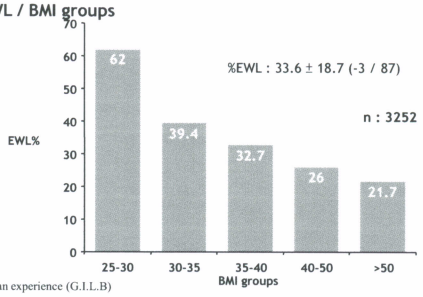
Results (n = 3824)
6 months BMI: 36.9±6.4 (range:27-50 Kg/m²)



Italian experience (G.I.L.B)

Study Results

EWL / BMI groups



%EWL : 33.6 ± 18.7 (-3 / 87)

n : 3252

Italian experience (G.I.L.B)

Study Results

Failures
As defined by weight loss < 10 % of initial weight

12.4 %
pts. 474/ 3824
sweet eaters, bulimic, grazing pts.

Italian experience (G.I.L.B)

Study Results

Weight Loss Effects on Comorbidities

n = 2179 / 3824

Cleared up comorbidities: (stopped drug treatment)	980	(44.3%)
Improved comorbidities: (reduction of drug treatment)	1002	(45.8%)
Unchanged:	197	(9.9%)

Italian experience (G.I.L.B)

Study Results

Minor Complications

73 / 3824 (1.9%)

Early removal (no compliance)	13	(0.33%)
Early rupture	20	(0.52%)
Esophaghitis	40	(1.04%)

Italian experience (G.I.L.B)

Study Results

Major Complications

37 / 3824 (0.96%)

Gastric Occlusion	19	(0.49%)
Gastric Perforation	5	(0.13%)*
Gastric Ulcer	10	(0.26%)
Bowel Occlusion (Prior Gynecological surgery)	3	(0.07%)

Italian experience (G.I.L.B)

BIOENTERICS INTRAGASTRIC BALLOON (BIB®): A SHORT-TERM, DOUBLE-BLIND, RANDOMISED, CONTROLLED, CROSSOVER STUDY ON WEIGHT REDUCTION IN MORBIDLY OBESE PATIENTS.

Genco A, Cipriano M, Bacci V, Cuzzolaro M, Materia A, Raparelli L, Docimo C, Lorenzo M, Basso N.

International Journal of Obesity (2006) 30, 129-133

Intragastric Balloon vs. Sham Italian Study:

Patient Profile

- January 2003 - December 2003
- 32 patients entered the study

Sex:	8 men/24women
Mean age:	36.2 + 5.6
Mean BMI:	43.7+ 1.5 kg/m2
Mean excess weight:	43.1 + 13.1 kg
Mean time of Intragastric Balloon positioning:	15 + 2 min

Genco *et al*, International Journal of Obesity (2006) 30, 129-133