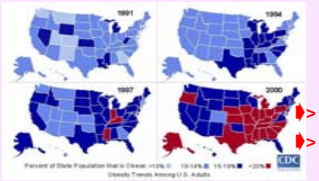
Pseudofood (Temporary Controllable Gastric Pseudobezoars) as an Alternative to Intragastric Balloons for the Treatment of Obesity: Results from a Chronic Human Study

Martin P. Mintchev*, Marlena G. Deneva+, Orly Yadid-Pecht*, Michel Fattouche*, Robert C. Bray*

*University of Calgary, Calgary, AB, Canada; + Bulgarian Academy of Sciences, Sofia, Bulgaria

1. BACKGROUND

- **Recent statistics from 106 countries** (88% of the world population):



> 22% overweight

> 9% obese [1, 2].

- **Five major treatment streams in obesity research**:

(A) Diets, dietary regiments and supplements [3];
(B) Pharmacological [4];
(C) Gastric electrical stimulation [5];
(D) Intragastric balloons [6]-*effective but problematic;*
(E) Bariatric surgery, incl. gastric banding [7] -
the only long-term successful technique.

- **Non-invasive techniques** for dynamically achieving volume reduction from inside the stomach– *still lacking.*

2. AIMS

- **To propose a design of temporary, permeable, controllable pseudobezoars (pseudofood) for non-invasive but long-term sustainable gastric volume reduction;**
- **To test this design in chronic human study.**

3. METHODS
3.1. DESIGN CRITERIA FOR THE PSEUDOBEZOARS

I. SAFETY

- **Biocompatible carrier and expandable polymers.**
- **Components:** ▸ **nonirritating;**
  ▸ **expandable in the stomach.**
- **Carrier:** ▸ **biodegradable;**
  ▸ **permeable for liquids and gases;**
  ▸ **stable but sufficiently soft not to injure gastric mucosa;**
  ▸ **with optimal and pH-dependent chemical and mechanical strength.**

II. DIETARY COMBATABILITY

- **Non nutritional components.**
- **Heavy upon swelling to sink in the antrum.**

III. DIMENSIONS

- **Pseudobezoar expulsion through the pylorus – impossible.**
- **Dimensions should exceed 1.5cm in all directions even if forces higher than 1.5N are applied on the pseudobezoar from any side.**

IV. TIMING

- **Immediate swelling of the pseudobezoar in gastric liquid upon swallowing- achieved by optimization of composition and quantity of expandable components;**
- **Gastric retainment for several days.**

V. EASE OF ADMINISTRATION – capsule form.

3. METHODS
3.2. MATERIALS AND TECHNOLOGY

CARRIER: microporous carboxycellulose gauze; suture-carboxycellulose thread (12 tex).

EXPANDABLE BLEND: proprietary and optimized mixture of granulated:

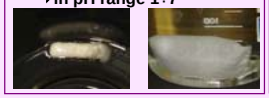
PolyGlycopleX *(Natural Factors, Vancouver, BC, Canada)* **and Sodium Polyacrylate** *(Waco Pure Chemical Industries, Tokyo, Japan)*

TECHNOLOGY:

- **Carrier sutured into a pillow-like sac,**
- **filled with the expandable blend and**
- **packed in a standard 000 gelatin capsule** *(Capsugel, Peapack, NJ, USA).*

3. METHODS
3.3. LABORATORY TESTING

Optimization of expandable blend for:
- **rapid (10 min) and**
- **maximal (15 cc) swelling**
- **and sinking**
- **in pH range 1÷7**



Optimization of design for:
- **retaining dimensions when force of 1.5N applied from all directions**

3. METHODS
3.4. REGISTRATION AND MANUFACTURING

- **The Implement is registered as a dietary supplement with the Regional Directorate for Public Health Protection in Sofia, Bulgaria according to the European Union regulations.**
- **More than 3000 capsules manufactured in an ISO-9001 and HACCP certified dietary supplement facility in Sofia, Bulgaria.**

3. METHODS
3.5. CHRONIC HUMAN TESTING

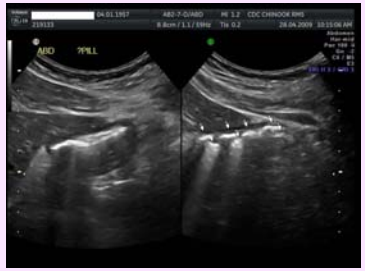
- **TEST DESIGN:**
  Four volunteers -overweight healthy adults:
  Subject 1: male, 79.6 kg/176 cm, BMI 25.7 kg/m², girth 83.9 cm;
  Subject 2: male, 90.3 kg/175 cm, BMI 29.5 kg/m², girth 87.8 cm;
  Subject 3: female, 76.5 kg/166 cm, BMI 27.8 kg/m², girth 82.0 cm;
  Subject 4: female, 60.7 kg/168 cm, BMI 21.5 kg/m², girth 71.0 cm;
  Three distinct periods: Baseline, Therapy and Washout period, 1 month each;
  Baseline and Washout periods: Water intake only, ½ hour before meals, no capsules;
  Therapy period: 2 capsules, 3 times/day, ½ hour before meals with 300 to 500 ml of water.
  Daily routines, eating habits and diets not changed;
  Weight and girth recorded daily; Satiety Scale of Haber [8] filled daily;
  3D abdominal ultrasound tests *(GE Voluson E8, Fairfield, CT, USA)*- **at the end of Therapy and Washout months.**
- **STATISTICS: Student's two-tailed test to compare weight and girth dynamics between the Baseline, Therapy and Washout periods, p< 0.05.**

4. RESULTS
4.1. CHRONIC HUMAN TESTING

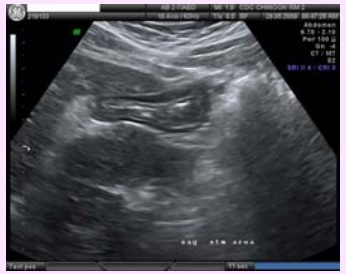
	Volunteer 1 (M)	*Volunteer 2 (M)*	*Volunteer 3 (F)*	*Volunteer 4 (F)*
Haber Satiety Scale (Baseline)	6.4+/-0.7	6.3+/-0.9	5.8+/-0.6	6.7+/-0.7
Haber Satiety Scale (Therapy)	8.8+/-1.1 *B ↑	9.0+/-0.8 *B ↑	9.2+/-1.0 *B ↑	9.6+/-1.2 *B ↑
Haber Satiety Scale (Washout)	6.7+/-0.7, *T ↓	6.2+/-1.1, *T ↓	6.5+/-0.9, *T ↓	6.8+/-1.0, *T ↓
Girth (Baseline)	83.7+/-0.3 cm	87.8 +/- 0.1cm	82.3 +/- 1.3 cm	71.4 +/- 0.9 cm
Girth (Therapy)	81.3+/-1.3 cm *B↓	84.4 +/- 2.1 cm*B↓	76.1 +/- 2.3 cm*B↓	70.0 +/- 1.6 cm*B↓
Girth (Washout)	81.5+/-0.6cm *B↓	84.0 +/- 1.7 cm*B↓	76.2 +/- 1.9 cm*B↓	70.1 +/- 1.1 cm*B↓
Weight (Baseline)	79,4+/-0.4 kg	90.5 +/- 0.2 kg	76.6 +/- 0.3 kg	60.5 +/- 0.3 kg
Weight (Therapy)	76.5+/-1.7 kg, *B↓	86.4 +/- 2.2 kg *B↓	70.1 +/- 2.0 kg*B↓	58.9 +/- 1.5 kg*B↓
Weight (Washout)	76.0+/-0.4 kg, *B↓	84.3 +/- 1.4 kg *B↓	69.8 +/- 1.2 kg*B↓	58.7 +/- 0.7 kg*B↓

4. RESULTS
4.2. ULTRASOUND

Typical sonographic view at the end of therapy month:



Typical view at the end of washout month:



5. CONCLUSIONS

- **Temporary Controllable Gastric Pseudobezoars - novel alternative approach in obesity management through dynamic non-invasive gastric volume reduction from inside of the organ.**
- **The integrity of the Temporary Controllable Gastric Pseudobezoars is pH-dependent:**
  pH=1÷3:long-term integrity, pivotal for effectiveness;
  pH>5-6: fast disintegration- in a couple of hours.
- **Temporary Controllable Gastric Pseudobezoars are tested in chronic human study. The feasibility of this approach is clearly demonstrated: four volunteers exhibited approximately 5% weight reduction in 1 month of therapy.**

6. REFERENCES

[1] Kelly T, et al. Global Burden of Obesity in 2005 and Projections to 2030. Int J of Obes , 2008, 32:1431-1437.

[2] James WPT, The epidemiology of obesity: the size of the problem. Journal of Internal Medicine, 2008, 263:336-352.

[3] Katz DL, Competing Dietary Claims for Weight Loss: Finding the Forest Through Truculent Trees. Annu. Rev. Public Health 2005, 26:61-88.

[4] Bray GA, Medications for Weight Reduction. Endocrinol Metab Clin N Am, 2008, 37: 923-942.

[5] Aelen P et al. Manipulation of food intake and weight dynamics using retrograde neural gastric electrical stimulation in a chronic canine model. Neurogastroenterol Motil 2008, 20: 358-368.

[6] Bult MJF, van Dalen T, Muller AF. Surgical treatment of obesity. Eur J of Endocrinol 2008, 158:135-145.

[7] Dumonceau JM. Evidence-based Review of the Bioenterics Intra-gastric Balloon for Weight Loss. Obes Surg 2008, 18:1611-17.

[8] Haber GB et al. Depletion and Distruption of Dietary Fibre: Effect s on Satiety, Plasma- Glucose and Serum-Insulin. The Lancet 1977, 310:679- 682.