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RESTING METABOLIC RATE IN OBESE TYPE 2 DIABETIC PATIENTS CANDIDATES FOR METABOLIC SURGERY

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Resting metabolic rate (RMR) accounts for two-thirds of the total energy expenditure in sedentary individuals and is very important for estimating energy requirements. It is hypothesized that a low RMR could contribute to the pathogenesis of obesity. Obesity on its turn represents the major risk factor for type 2 diabetes (T2D). The aim of this study was to analyze the baseline characteristics of patients included in the CREDOR (Collaborative Romanian Efforts for Diabetes and Obesity Research) study. Twenty two participants, obese males (BMI between 30 and 50 kg/m^2) with a previous diagnosis of T2D (1 up to 15 years) were included. Patients, aged between 30 and 65 years, were randomized in 2 groups: conservatory treatment of diabetes and obesity (group 1, n=16), respectively patients that will undergo laparoscopic sleeve gastrectomy (group 2, n=6). In all patients we measured anthropometric, clinical, biochemical parameters, and RMR. In addition, body composition was analyzed with the bioimpedance method. Mean age was 45.19 ± 6.44 years in the conservatory group vs 50.5 ± 7.09 years in the surgical one, while the BMI was 42.13 ± 5.94 kg/m^2 for the conservatory treatement subjects and 41.51 ± 3.22 kg/m^2 for patients prior to surgery. Mean waist circumference was 134.5 ± 12.62 cm in the first group and 129.17 ± 12.81 cm in the second one. There were some minor differences for total cholesterol, albumin and plasma proteins between the two groups proving the validity of randomization.

Keywords: basal metabolic rate, indirect calorimetry, type 2 diabetes, metabolic surgery

INTRODUCTION

The total energy expended depends on the four main factors: the rest metabolic rate, the thermogenic effect of food, the physical activity and the environmental temperature. Resting metabolic rate (RMR) accounts for two-thirds of the total energy expenditure in sedentary individuals and is very important for estimating energy requirements[1]. It is hypothesized that a low RMR could contribute to the pathogenesis of obesity. Obesity on its turn represents the major risk factor for type 2 diabetes (T2D)[2-4]. The relative risk of diabetes increases about 42-fold in men as the BMI increases from 23 kg/m^2 to 35 kg/m^2 [5] and approximately 93-fold in women as BMI increases from 22 kg/m^2 to 35 kg/m^2 [6].

The 2014 World Health Organisation estimations were that more than 1,9 billion adults are overweight; of these more than 600 million are obese; overall 13% of world's adult population (11% men and 15% of women) were obese in 2014, whereas 39% of adults aged 18 years and over (38% of men and 40% of women) were overweight. Furthermore, 42 million children under the age of 5 were overweight or obese in 2013.The worldwide prevalence of obesity was more than doubled from 1980 to 2014[7].

In 2014 the global prevalence of diabetes was estimated to be 9% among adults aged > 18 years[8]. The estimation of the WHO established that diabetes will be the 7th leading cause of death in 2030[9]. Type 2 diabetes comprises 90% of people with diabetes around the world[10], and is largely the result of excess body weight and physical inactivity. Currently, bariatric surgery is the most effective treatment for obesity and is indicated for patients with a BMI >40 kg/m^2, or for individuals with a BMI>35 kg/m^2 and significant obesity-related comorbidities[11,12]. In view of its favorable metabolic effects[13], bariatric surgery is also referred to as ‘‘metabolic surgery” and is supported for the treatment of type 2 diabetes even in overweight individuals who do not meet the current BMI criteria[14]. The aim of this report was to analyze the baseline characteristics of patients included in the CREDOR (Collaborative Romanian Efforts for Diabetes and Obesity Research) study.

MATERIAL AND METHODS

Twenty two participants, obese males (BMI between 30 and 50 kg/m^2) with a previous diagnosis of T2D were included in this study. The inclusion criteria were as follows: age between 30 and 65 years, diabetes duration between 1 and 15 years, medical insurance and the possibility of supplementary costs coverage after the laparoscopic sleeve gastrectomy. Exclusion criteria were: type 1 diabetes, fasting C-peptide < 0,81 ng/ml, HbA1c < 6,5%, serum creatinine > 1,2 mg/dl or GRF < 60ml/min/1,73 m2, anemia (Hb< 10g/ml), positive test for B or C hepatitis or HIV, congestive heart failure (NYHA III or IV) or respiratory failure, acute myocardial infarction or stroke in the last 12 months, arterial revascularisation (coronary, carotidians or lower limbs) in the last 6 to 12 months, hepatic cirrhosis, hepatic failure, any chronic pathology of the digetive system. All patients provided written informed consent before inclusion in the study. All patients were randomized in 2 groups: conservatory treatment of diabetes and obesity (group 1, n=16), respectively patients that will undergo laparoscopic sleeve gastrectomy (group 2, n=6). In all patients we measured anthropometric, clinical, biochemical parameters, and RMR (using indirect calorimetry, measured by Cosmed Quark CPET). Predicted RMR was calculated according to the Harris Benedict equations[15]. The Weir equation was used to calculate resting metabolic rate, as follows: RMR (kcal/day) = [3.941(VO2 (ml/min)) + 1.11(VCO2 (ml/min))] 1.44[16]. In addition, body composition was analyzed with the bioimpedance method, using the Tanita Body Composition Analyser BC-418MA.

Statistical Analysis Results are expressed as mean ± standard deviation. Paired Student's *t*-tests were used to compare data from the 2 groups. p-value<0.05 was considered statistically significant. All statistical analyses were performed using SPSS version 20.

RESULTS AND DISCUSSIONS

The main characteristics of the patients studied are presented in Table 1. Mean age was 45.19±6.44 years in the conservatory group vs 50.5±7.09 years in the surgical one, while the BMI was 42.13±5.94 kg/m^2 for the conservatory treatment subjects and 41.51±3.22 kg/m^2 for patients prior to surgery. Mean waist circumference was 134.5±12.62cm in the first group and 129.17±12.81cm in the second one. All patients had a poor glyceamic control, as evidenced by HbA$_{1c}$ >7% and all patients had high triglycerides and low HDL cholesterol levels.

In Table 2 are presented the results for the determined RMR and for the predicted RMR in the 2 groups. We noticed that the patients in the group 1 had a lower RMR than those in the group 2. Also, the conventional group had a lower determined RMR than the predicted RMR, probably in connection with their higher percentage of fat, and a lower fat free mass (Table3).

We found no correlations between the RMRd and the fat free mass in the 2 groups studied (figure 1) and no significant correlation between the RMRd and the percentage of fat in the same groups (figure 2).

	Conventional	**Prior to surgery**	***P* value**
	n=16	**n=6**	
Clinical Characteristics			
Age (years)	45.19 ± 6.44	50.5 ± 7.09	0.14
Waist circumference (cm)	134.5 ± 12.62	129.17 ± 12.81	0.49
Height (cm)	176.44 ± 5.63	177.33 ± 6.83	0.78
Weight (kg)	131.13 ± 19.35	131.03 ± 18.12	0.99
BMI (kg/m^2)	42.13 ± 5.94	41.51 ± 3.22	0.76
SBP (mmHg)	136.23 ± 12.62	134.8 ± 9.7	0.8
DBP (mmHg)	86.69 ± 5.8	78.33 ± 14.37	0.22
Metabolic blood analyses			
HbA$_{1c}$ (%)	7.95 ± 1.09	8.8 ± 2.13	0.39
Glycemia (mg/dl)	188.2 ± 52.31	229.3 ± 122.00	0.45
Total cholesterol (mg/dl)	206.37 ± 37.66	148.99 ± 23.82	**0.00**
HDLc (mg/dl)	36.94 ± 7.67	30.4 ± 8.97	0.14
Triglycerides (mg/dl)	195.62 ± 72.41	226.31 ± 95.81	0.50
Uric acid (mg/dl)	5.17 ± 1.73	6.77 ±2.03	0.11
Serum creatinine (mg/dl)	1.01 ± 0.3	1.17± 0.23	0.35
Albumin (g/dl)	4.81 ± 0.41	4.32 ± 0.21	**0.01**
Total proteins (g/dl)	7.35 ± 0.64	6.79 ± 0.35	**0.01**

BMI: body mass index; SBP: systolic blood pressure, DBP: diastolic blood pressure, HDLc: high-density lipoprotein cholesterol.

Table 1. Clinical and Biochemical characteristics for the 2 groups studied

Rest metabolism rate (RMR)	Conventional group	Prior to surgery group	*P* value
RMRd (kcal/day)	2334 ± 314.6	2569.83 ± 386.89	0.22
RMRp (kcal/day)	2428.93 ± 281.87	2419 ± 299.47	0.94
RMRd-RMRp (kcal/day)	-94.93 ± 309.81	226.31 ± 95.81	0.14
VO2 rest (ml/min)	341 ± 45.53	373.5 ± 54.40	0.23
VCO2 rest (ml/min)	385.87 ± 57.44	300 ± 53.39	0.20

RMRd - determined resting metabolism rate, RMRp - predicted resting metabolic rate, VO2 rest - Oxygen uptake , VCO2 rest - Carbon Dioxide production

Table 2. Resting metabolic rate and other calorimetry data for the 2 groups studied

Body composition analysis (Bioimpedance)	Conventional group	Prior to surgery group	*P* value
Fat (%)	34.5 ± 4.95	27.11 ± 7.19	0.051
Fat free mass (kg)	8.06 ± 14.62	94.5 ± 18.13	0.17

Table 3. Bioimpedance results for the 2 groups studied

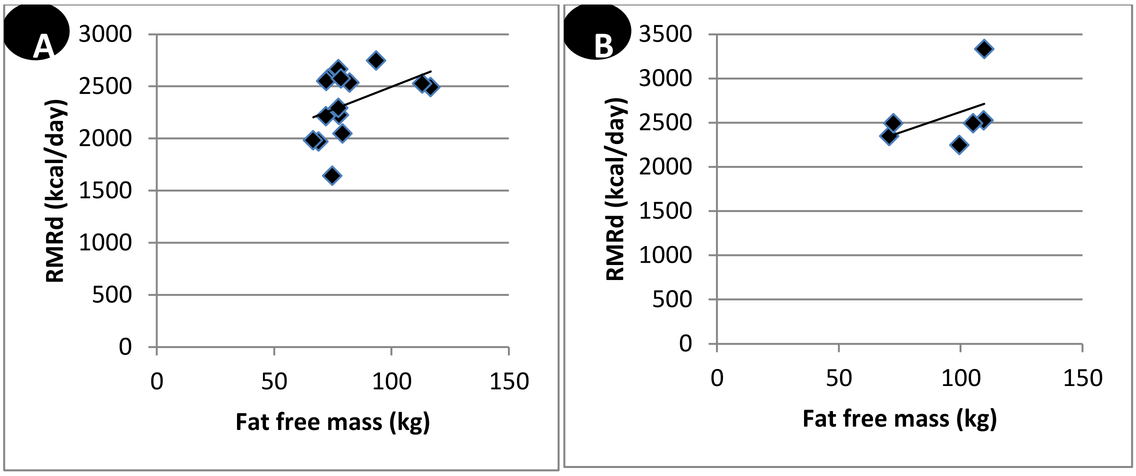

Figure 1 Correlations between the RMRd and the fat percentage in the group 1 **(A)** and group 2 **(B)**

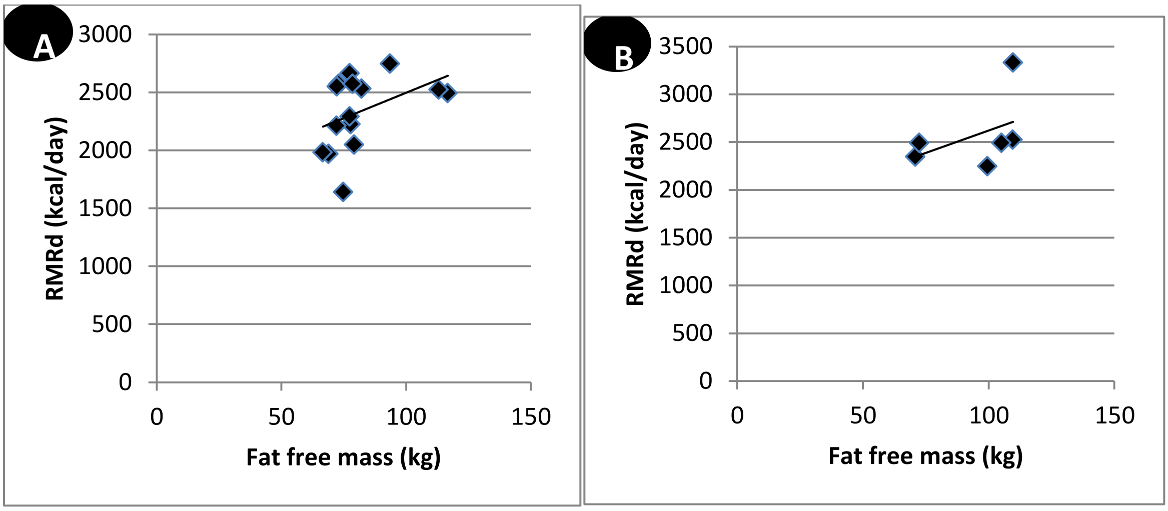

Figure 2 Correlations between the RMRd and the fat free mass (kg) in the group 1 **(A)** and group 2 **(B)**

CONCLUSIONS

The RMR was higher in the group prior to surgery, but without any statistical significance. There were some minor differences for total cholesterol, albumin and plasma proteins between the two groups. As expected, the two groups were quite similar, proving the validity of randomization. Further work is needed in order to complete this study.

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