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Super obese behave different from simple and morbid obese patients in the changes of body composition after tailored one anastomosis gastric bypass (BAGUA)

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Abstract

Introduction: **Super obese patients behave different from simple and morbid obese patients when they reach final changes of body composition (BC) after bariatric surgery. This has led us to tailor One Anastomosis Gastric Bypass (BAGUA) to achieve better results in this group of patients.**

Patients and Methods: **We studied 83 (37 diabetic and 46 non-diabetic BMI 30 and up) patients who completed all evaluation appointment (preoperative, 10 days, 1, 3, 6 and 12 months) after tailored BAGUA for diabesity. We used the Tanita body composition analyzer BC-420 MA by the method of single frequency impedance to analyze the evolution of BC in patients classified by BMI 30 - 34,9, 35 - 50, and >50.**

Results: **While preoperative excess weight presented dramatic decreases after tailored BAGUA in all the groups, super obese have different final BC. Diabetics retained more fat mass and visceral fat, where super obese have double (14 kg) that simple obese patients (6 kg), they lost more muscle mass, and have higher basal metabolism. The final BC is altered in all parameters if diabetes is added.**

Conclusions: **The reduction of the preoperative excess weight is motivated largely by the tailored effect of BAGUA. Patients BMI 30-50 behaved homogeneous in BC after surgery while patients BMI >50 behave different. Super obese lose less weight, retained more fat mass, visceral fat, bone mass, and total water. This effect should be treated by more aggressive surgery by measuring the entire small intestine to make a proper exclusion (tailored) to achieve homogeneous effects.**

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Key words: *Body composition. Diabetes. BAGUA. BMI. tailored.*

LOS SÚPER OBESOS SE COMPORTAN DE FORMA DIFERENTE A LOS PACIENTES CON OBESIDAD SIMPLE U OBESIDAD MÓRBIDA CON RESPECTO A LOS CAMBIOS EN LA COMPOSICIÓN CORPORAL TRAS LA CIRUGÍA PERSONALIZADA DE DERIVACIÓN GÁSTRICA DE UNA ÚNICA ANASTOMOSIS (BAGUA)

Resumen

Introducción: **Los pacientes súper obesos se comportan de manera distinta a los pacientes con obesidad simple y obesidad mórbida cuando alcanzan los cambios finales de la composición corporal (CC) tras la cirugía bariátrica. Esto nos condujo a individualizar la anastomosis única de derivación gástrica (BAGUA) para conseguir mejores resultados en estos pacientes.**

Pacientes y métodos: **Estudiamos a 83 pacientes (37 diabéticos y 46 no diabéticos, con IMC ≥ 30) que completaron todos las visitas de evaluación (preoperatorio, 10 días, 1, 3, 6 y 12 meses) tras la cirugía personalizada BAGUA para la obesidad. Empleamos el analizador de la composición corporal Tanita CC-420 MA mediante el método de impedancia de un única frecuencia para analizar la evolución de la CC en pacientes clasificados por el IMC 30 - 34,9, 35 - 50, y > 50.**

Resultados: **Mientras que el exceso de peso preoperatorio mostró unas reducciones drásticas tras la cirugía BAGUA personalizada en todos los grupos, los súper obesos tuvieron una CC final diferente. Los diabéticos retuvieron más masa grasa y grasa visceral, mientras que los súper obesos mostraban el doble (14 kg) que los pacientes con obesidad simple (6 kg), perdieron más masa muscular y tuvieron un mayor metabolismo basal. La CC final se altera en todos sus parámetros si se añade la diabetes.**

Conclusiones: **La reducción del exceso de peso preoperatorio está motivada en gran medida por el efecto de la cirugía BAGUA personalizada. Los pacientes con un IMC entre 30-50 se comportan de forma homogénea en la CC tras la cirugía mientras que los pacientes con un IMC > 50 se comportan diferentemente. Los súper obsesos pierden menos peso, retienen más masa grasa, grasa visceral, masa ósea y agua total. Este efecto debería tratarse con una cirugía más agresiva midiendo todo el intestino delgado para realizar una exclusión adecuada (personalizada) para conseguir unos efectos homogéneos.**

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Palabras clave: *Composición corporal. Diabetes. BAGUA. IMC. Personalizada.*

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Introduction

The study of body composition (BC) is the measurements of the different components and compartments of the body and the quantitative relationships among them. The knowledge of these parameters are important for all surgeons performing bariatric surgery.

The measurement of BC began in the 1940s in the laboratory of Behnke[1]. Since then, BC has been introduced in different methods of clinical and research field, where the study of BC has emerged as a new field within biomedical disciplines.

In the 1960s, Siri[2] measured different body compartments especially total body fat, and developed the two-compartment model, where the body is divided of two compartments: fat mass (FM) and fat-free mass (FFM). The fat mass compartment is relatively homogeneous in composition, but the FFM compartment is a heterogeneous mixture in protein-mineral and watery, causing variability between individuals and even within the same individual in different pathophysiological states such as obesity or diabetes, and considering differences of age, sex and race.

Therefore, total body mass is composed by FFM and FM[3]. Lean body mass not only includes FFM but water, muscle, bone, connective tissue and viscera, and also have small amounts of essential fats[4]. FM has non-essential and essential fats[5]. Hence, BC is influenced for total water (TW) in FFM when evaluating.

Kelley et al[6] found that obesity is associated with increased adipose tissue and density reduction of lean tissue. Obesity increases selectively of low-density lean tissue without altering the volume of tissue from normal density. Therefore, the average density of muscle tissue decreased reciprocally to obesity.

When there is weight lost through caloric restriction, loss is only about 75% of fat and 25% of FFM. However, if caloric restriction is associated with an exercise program, the loss of lean tissue can be reduced to approximately 5% of the overall body mass loss. The true effectiveness of an intervention depends not only on the prescription of exercise (mode, frequency, duration, intensity, progression), but also for compliance by the patient. Has also been shown that repeated cycles of weight loss and regain is detrimental to health because weight is recovered disproportionately compound for grease[7]. Therefore, the ultimate goal of any weight loss program is to get long-term weight control, while immediate weight loss is achieved by bariatric surgery.

Once bariatric surgery is performed, the reduction in energy metabolism after weight loss can be attributed to the reduced mass of the body after weight reduction, especially loss of FFM, low power consumption after slimming, therefore, there is a reduction in the thermogenic response to food, and decrease in energy expenditure of physical activity for the same level of activity[8].

Nevertheless, 10% of weight loss was associated with changes in organ weights with high metabolic activity (liver, heart and kidneys); however, there is no change in cerebral mass. Nevertheless, it is known that the brain mass decreases after severe weight loss in patients with anorexia nervosa, predominantly gray matter, which is reversible after nutritional recovery[9]).

The search for the pathogenesis of obesity-related diseases have shown a close relationship between excess nutrients and alterations in cellular and molecular mediators of immunity and inflammation. This has led to the concept of metainflammation to describe the inflammatory response of low-grade in obesity. Inflammation is a coordinated response to noxious stimuli in order to return the system to a normal baseline. The metainflammation in obesity is unique compared with other inflammatory diseases. The chronic nature of obesity causes a low-grade activation of the innate immune system that affects metabolic homeostasis over time. Furthermore, the involvement of multiple organs in inflammation induced by obesity is unique and presents a challenge for researchers trying to unravel the mechanisms of obesity in complex metabolic systems. Multiple inputs contribute to inflammatory metabolic dysfunction that allows a patient to reach the super obesity and they respond differently than expected when faced with weight loss induced by surgery[10].

The tailored One Anastomosis Gastric Bypass (BAGUA) performed in our patients was according to BMI. In super obese patients, the gastric pouch was always smaller size than for morbid obese patients[11]; because of super obese patients behave different in weight loss and final changes in BC from simple and morbid obese patients. For this situation, it is important to tailor the BAGUA surgery, looking for an optimal grade of feeding and malabsorption, proportional to excess preoperative weight, BMI, age and total small intestine length[12].

Bariatric surgery is gaining acceptance as an effective treatment modality in the long-term for obese patients, but it is necessary to have accurate explanations of the effects of bariatric surgery on BC and fat distribution that are still limited, and its complete knowledge give us the opportunity to provide better control of complications in postoperative outcomes.

The aim of the present study is to show that super obese patient (BMI > 50) behave different on postoperative changes of BC from simple (BMI 30-34.9) and morbid obese (BMI 35-49.9) patients undergoing to tailored BAGUA.

Patients and methods

Patients

The study group consisted in 83 (37 diabetic and 46 non-diabetic) patients, distributed by BMI groups: BMI 30-34.9 (12 non-diabetics and 16 diabetics), BMI 35-50 (25 non-diabetics and 17 diabetics) and BMI > 50 (9 non-diabetics and 4 diabetics). They had undergone tailored One Anastomosis Gastric Bypass (BAGUA) for obesity, diabetes or diabesity, and completed all evaluation appointment (preoperative, 10 days, 1, 3, 6 and 12 months), during the first postoperative year.

The distribution of the patients was performed according to the presence or absence of diabetes and BMI ranges (BMI 30 -34.9, BMI 35-50, and BMI > 50).

Preoperative evaluation

In all patients, a preoperative study were conducted following the indications of the Clinical Practice Guideline (CPG) of the European Association for Endoscopic Surgery (EAES)[13].

Body composition analysis

The analysis of BC was performed using a single frequency impedance BC analyzer (TANITA brand, model BC-420MA). This equipment provides estimated values for FM, MM, bone mass, VF, BM and TW calculated by passing an alternating current through the patient to measure the water content, where approximately 73% corresponds to MM. The FM is obtained by subtracting to the weight of FFM to the TBW. The other components are calculated using validated mathematical formula[14]. PEW was calculated subtracting the ideal weight given by the impedance analyzer to the preoperative weight of the patient. All our patients were evaluated in the morning after breakfast. This analysis was performed preoperatively and in the next evaluation follow up appointment after surgery.

Surgical procedure

Before surgery, all patients eat only liquid diet during 5 (BMI 34-34.9) to 7 days (BMI 35-50) depending of preoperative BMI, received antibiotic and antithrombotic prophylaxis. Tailored BAGUA consisted in the construction of a gastric pouch from the gastroesophageal junction to the end of the minor gastric curvature at the lower level of the cisura angularis. The stapler line of the gastric pouch was fixed approximately 12 cm to the intestinal loop (first layer of the anti-reflux mechanism of BAGUA), and it was anastomosed in a laterolateral position to the mesenteric border of a small bowel loop 120 cm (BMI 30-32), 150 cm (BMI 33-34.9), 200 cm (BMI 35-40), 250 cm (BMI 40-44.9), and 280 cm distal (BMI 45-50) to the treitz ligament when the total length of small intestine is 6-7 m. If the total length was more than that measure, we excluded proportionally. The anti-reflux mechanism is completed fixing the afferent loop to the gastric remnant and the efferent loop to the antrum.

The size of the gastric pouch depends on the BMI of the patient. In BMI 30-34.9 we performed a floppy 36 French bougie pouch, while in BMI > 33 a narrow 36 French bougie one s is performed. We left systematically a drainage during the 48 h of hospital stay. After surgery, they eat liquid diet in the 1st week, semifluids in 2nd week, purée in 3-4th weeks and normal diet after one month of surgery. The patient were reviewed at 10 days, 1, 3, 6 and 12 months.

Follow up

The data were collected prospectively according with the protocol, including a baseline evaluation preoperatively that analyzed parameters related to the evaluation of the BC, comorbidities, weight and BMI. After tailored BAGUA surgery, according to the protocol outline, the follow up was performed analyzing BMI and BC in the next 10 days, 1, 3, 6 and 12 months.

Statistical analysis

We used descriptive statistics (mean, median and standard deviation). To test possible significant differences of these parameters between the different study groups we used Student's T test for independent samples. The differences less than 5% were considered significant.

Analyses were performed using SPSS (version 21 for Windows, SPSS, Chicago IL) and Excel 2013.

Results

The results were evaluated by BMI range, presence or not of diabetes, and changes in BC (FM, MM, bone mass, VF, BM, and TW) in the different evaluation appointments.

Preoperative body composition in the study groups

Differences in BC (table I) in the preoperative status of patients, clearly shows some aspects: the relationship among greater BMI with higher levels of all parameters of BC except MM. We also found a correlation between increased both BMI and FM, and higher BM especially in diabetic patients.

Bone mass shows a linear increase especially in non-diabetic patients. Preoperative over-weight ranges between 92 to 159 kg. Levels of VF, BM and TW also show an increment in higher BMI. VF is predominant in all groups of diabetics.

Body composition changes in patients after tailored BAGUA

One month after surgery

Table II shows greater changes over time in BC in regards to FM with respect to other parameters, especially

Table I
Body composition in the six preoperative study groups

	Weight (kg)		BMI		FM (kg)		MM (kg)		Bone M (kg)		VF (kg)		BM (kcal/day)		TW (kg)	
BMI	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Non-diabetics 30-34.9	92	15	32	1	35	14	55	10	2.8	0.6	11	2	1,785	353	44	9
Diabetics 30-34.9	95	17	33	2	37	14	62	11	3.1	0.7	14	3	1,841	360	47	9
Non-diabetics 35-50	110	14	41	4	52	10	55	6	2.9	0.4	18	4	1,852	232	44	6
Diabetics 35-50	115	14	42	3	50	10	61	13	3.1	0.7	22	2	1,998	368	48	11
Non-diabetics > 50	150	23	53	3	80	14	69	17	3.5	0.7	26	2	2,612	547	56	14
Diabetics > 50	159	26	52	2	86	20	63	7	3.3	0.3	25	1	1,795	601	61	9

This data represent mean values (Mean) and standard deviation (SD) of the weight, body mass index (BMI), fat mass (FM), muscle mass (MM), bone mass (Bone M), visceral fat level (VF), basal metabolism (BM) and total water (TW) patients in the preoperative period.

Table II
Changes in body composition in all study groups one month after tailored BAGUA

	Weight (kg)		BMI		FM (kg)		MM (kg)		Bone M (kg)		VF (kg)		BM (kcal/day)		TW (kg)	
BMI Ranges	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Non-diabetics 30-34.9	79	14	28	2	24	9	55	9	2.8	0.5	8	2	1,641	313	40	8
Diabetics 30-34.9	83	16	29	3	26	9	58	11	3.0	0.7	10	3	1,677	329	42	8
Non-diabetics 35-50	94	14	35	5	37	9	54	9	2.8	0.4	13	3	1,688	209	40	7
Diabetics 35-50	98	14	36	4	35	8	59	11	3.0	0.7	17	2	1,795	326	42	9
Non-diabetics > 50	125	19	44	3	55	12	65	15	3.4	0.7	21	1	2,297	444	52	13
Diabetics > 50	130	13	43	4	61	11	66	12	3.4	0.4	20	2	2,400	390	54	6

Data represent mean values (Mean) and standard deviation (SD) of the weight, body mass index (BMI), fat mass (FM), muscle mass (MM), bone mass (Bone M), visceral fat level (VF), basal metabolism (BM) and total water (TW) of patients at one month after surgery.

in patients with a BMI > 50 were the largest decreases achieved, especially in non-diabetic patients. VF, BM and TW continued down continuously but without major changes. MM in this group (diabetic BMI > 50) continued to show a proportional increase of MM compared to preoperative status a month after surgery.

MM diabetics BMI > 50 had less decline after a month of surgery. In total, values decline ratio of preoperative excess weight (PEW) is proportional to initial BMI: higher preoperative BMI greater decrease in PEW. Patients with BMI > 50, showed declines of 46 kg (diabetic) and 37 kg (non-diabetic) group respectively.

3 months after surgery

FM has the highest percentage of registered decline (table III). Values were less decline in MM and TW. In

6 months after surgery

In table IV, FM continued to decline but at a slower rate, with a mean decrease in the overall group, repre-

Table III
Changes in body composition in all study groups at 3 months after tailored BAGUA

	Weight (kg)		BMI		FM (kg)		MM (kg)		Bone M (kg)		VF (kg)		BM (kcal/day)		TW (kg)	
BMI Ranges	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Non-diabetics 30-34.9	73	14	26	2	17	6	53	9	2.8	0.5	5	2	1,576	312	39	7
Diabetics 30-34.9	77	16	27	3	19	8	56	12	3.0	0.7	9	2	1,603	316	41	9
Non-diabetics 35-50	82	12	31	4	29	7	51	8	2.7	0.5	11	2	1,574	184	39	6
Diabetics 35-50	88	12	32	3	28	7	56	10	3.0	0.7	15	2	1,683	291	40	9
Non-diabetics > 50	113	19	40	4	45	13	61	14	3.4	0.8	18	2	2,152	418	50	12
Diabetics > 50	113	10	37	5	47	9	65	11	3.4	0.4	18	3	2,176	311	50	6

Data represent mean values (Mean) and standard deviation (SD) of the weight, body mass index (BMI), fat mass (FM), muscle mass (MM), bone mass (Bone M), visceral fat level (VF), basal metabolism (BM) and total water (TW) of patients at 3 moths after surgery.

Table IV
Changes in body composition in all study groups at 6 months after surgery

	Weight (kg)		BMI		FM (kg)		MM (kg)		Bone M (kg)		VF (kg)		BM (kcal/day)		TW (kg)	
BMI Ranges	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Non-diabetics 30-34.9	69	15	24	2	13	5	52	9	2.8	0.5	5	2	1,529	307	36	7
Diabetics 30-34.9	73	14	25	2	15	8	54	11	3.0	0.7	7	2	1,549	291	40	9
Non-diabetics 35-50	74	11	28	4	22	6	49	7	2.7	0.5	9	2	1,486	164	38	6
Diabetics 35-50	79	11	29	3	22	5	53	9	3.0	0.7	13	2	1,581	264	39	8
Non-diabetics > 50	101	15	36	4	36	11	58	12	3.4	0.8	17	2	2,000	340	46	11
Diabetics > 50	104	11	34	4	37	8	62	10	3.4	0.4	16	2	2,058	312	48	7

This data represent mean values (Mean) and standard deviation (SD) of the weight, body mass index (BMI), fat mass (FM), muscle mass (MM), bone mass (Bone M), visceral fat level (VF), basal metabolism (BM) and total water (TW) of patients at within 6 months after surgery.

Table V
Postoperative body composition a year after tailored BAGUA in the six groups

	Weight (kg)		BMI		FM (kg)		MM (kg)		Bone M (kg)		VF (kg)		BM (kcal/day)		TW (kg)	
BMI Ranges	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Non-diabetics 30-34.9	65	14	23	2	10	4	49	9	2.8	0.5	5	2	1484	296	34	6
Diabetics 30-34.9	68	14	24	2	12	8	53	11	3.0	0.7	6	2	1488	278	38	8
Non-diabetics 35-50	68	12	26	4	19	7	47	7	2.8	0.5	8	2	1430	152	36	6
Diabetics 35-50	73	11	27	3	18	6	51	9	3.0	0.7	11	2	1513	244	36	8
Non-diabetics > 50	92	13	33	5	30	9	55	11	3.3	0.7	14	2	1884	285	43	10
Diabetics > 50	90	10	29	3	28	5	57	9	3.4	0.4	14	2	1880	285	45	7

They represent mean values (Mean) and standard deviation (SD) of the weight, body mass index (BMI), fat mass (FM), muscle mass (MM), bone mass (Bone M), visceral fat level (VF), basal metabolism (BM) and total water (TW) of patients one year after surgery.

senting a reduction with respect to preoperative value. In the case of TW, diabetic patients BMI >50 reported greater proportional decrease in this measure. MM continued to show the same trend as the above measures.

One year after surgery

In the last measure (table B), FM presented impressive descent levels in BMI > 50 (non-diabetics and diabetics patients). The TW ended up showing a direct relationship between preoperative BMI and evolution of this value. MM had more random changes in comparison to other groups, as initial values.

The biggest decline corresponds to non-diabetic patients BMI > 50 a difference of patients with diabetes BMI > 50 which showed smaller decrease.

In absolute terms, the group of diabetic patients lost 10 kg in mean, compared to 9 kg of MM loss in non-diabetic patients. Although the biggest decline all parameters was BMI > 50 patients, the way to get the last changes was different.

Discussion

The BC analysis has been used for decades to study possible changes in activities or situations that could cause major alteration of one or more body components in sports[15,16]. Soon it began to be used to control different weight loss diets[17].

Nevertheless, surgeons not measure the BC routinely to monitor their patients. While it is true that some anthropometric measures are used to control the use of clinical nutrition diets enteral or parenteral, with former plicometers still in use. However, consultations neither have bio-impedance devices easy to use nor trained surgeons to understand the clinical significance of changes in FM, FFM, VF, resting energy expenditure (metabolic rate), total energy expenditure, and other BC components in the short, medium and long term after bariatric surgery. The next step is to understand the biological and clinical significance of each of the components of the BC.

However, it is surprising that there is no systematic use of BC analysis after bariatric surgery to analyze if the weight loss is healthy because of loss of excess fat and no other components. In fact, our group used to measure BC before and after BAGUA routinely to ensure that weight loss is proper and correct.

The loss of excess of fat and body weight is the result of the reversal of obesity and expected result of any type of bariatric surgery. Gastric bypass (GB) is one of the most effective surgical procedures to get a large weight loss sustained over time in obese subjects[18,19]. It is important to note that super obese patients behave different from the others groups, with less weight loss than the other group using the same technique. Although super-obesity is a selection criterion for prioritizing the surgery in the waiting list, there are insufficient studies to demonstrate why super obese behave differently after bariatric surgery[20]. Large patient studies show that super-obese patients overall required longer operating room times and longer hospital length of stay[21].

Therefore, it is important to improve the surgery making it a more aggressive technique. In our group, surgery is tailored according to each patient for best results, first by measuring the total length of the small intestine and make the bypass and limb length according to BMI to lose enough weight[11,12]. However, there are studies like Sarhan et al[22] which mention that the sustained weight loss long-term of patients with super obesity is just obtained by standard bariatric surgery.

Weight loss after bariatric surgery has three phases. An initial phase of rapid weight loss mainly due to severe reduction in energy intake, in part caused by non-specific effects of surgery. A second phase of slower weight loss after intake has returned to near normal levels. Third phase characterized by stable body weight or slow regain[23]. Our results have followed this pattern.

Body weight loss in our patients are mainly due to the loss of FM, with a proportionally lower loss of MM. However, the meta-analysis of Chaston et al[24] shows that the relative loss of FFM through dietary restriction, behavior modification, and several types of bariatric surgery, is correlated positively with the degree of caloric restriction.

After one month of tailored BAGUA, changes in BC are greater in the preoperative BMI ≥ 50, where had the greatest decrease, especially in non-diabetics. In this phase, diabetic group BMI ≥ 50 have an increment of MM (mean 4 kg).

At 3 months after surgery, FM decreased, but not the TW and MM, except for diabetic patients BMI ≥ 50. At this time, it is more noticeable the decrease in both body weight and BMI. On the other hand, 6 months postoperatively, fat decreases but at a slower pace, but in proportion to the preoperative BMI, not the TW. However, one year after surgery, it is appreciated spectacular data regarding the preoperative, where non-diabetic patients with higher BMI were the most favored. At this point, the TW is already about the new weight. As for MM loss, diabetic are more affected than non-diabetic patients are. BM decreases but remains higher in diabetics and patients BMI > 50.

In this sense, the loss of MM is a challenge for the physician and a real problem for the patient, so that Savastano et al[25] suggest the use of growth hormone for 6 months (P = 0.000) after bariatric surgery to reduce loss of lean body mass. With our tailored BAGUA, the loss of MM is around 15%, but up to 30% is considered healthy. Therefore, the surgery demonstrated a good protein absorption without malnutrition effects.

Christou et al[26], in their study of 1,035 patients undergoing bariatric surgery were followed for five years, finding that since the first quarter, up to 2 years, weight loss is progressive, and that depending on the characteristics of the patient, it can be achieved to surgery successful if it reaches at least BMI 35. In their data, after reviewing the two years, some patients had weight loss, but they did not measure BC to know which parameters were modified. Nevertheless, Strain et al[27] demonstrates that changes in body composition after bariatric surgery in super obese patients are different; they lost less body fat than the morbid obese patients did.

This data show us that in the overall assessment of BC changes over time, certain groups with particular characteristics had changes in the loss of any parameter studied. Date et al[20] mentions that morbid obese patients are more benefited than super obese patients in the aspects of health, quality of life, and employment outcomes after bariatric surgery.

Logically, the most notorious change was in FM loss due to tailored surgery performed. Some of the important features found in our study are that patients that had little weight loss, had more total water (p = 0.005).

Over time, BM is higher in the diabetic patients (p = 0.003). Furthermore, after tailored BAGUA, BM (p = 0.001) and MM (p = 0,000) remains higher in diabetic patients.

Although super obese patients are considered higher risk than other types of obesity, bariatric surgery is considered safe in super obese and super-super obese patients[28].

We are aware that the main limitation of our study was the number of patients analyzed, however the resultant data are troubling and require study of a larger number of patients and longer-term studies. However, this study is a watershed in the ideas importance of conducting BC in all patients undergoing surgery for obesity, diabetes, diabesity.

These results have motivated us to continue with the tailored One Anastomosis Gastric Bypass (BAGUA) to achieve better results in this group of patients, unlike other techniques that do not.

Conclusions

To achieve better outcomes after bariatric surgery, it is important to both measure the total length of the gut and tailor the BAGUA surgery according to patient's BMI. The systematic measurement of BC in patients undergoing bariatric surgery should be routinely in all patients to operate since it has proven to be a vital parameter for metabolic control and nutrition of patients after GB.

The behavior of the BC (FM, VF, MM and BM) are different between patients BMI > 50 and BMI 30-50. After tailored BAGUA, patients with BMI 30-50 behave homogeneous in final body composition. Patients BMI > 50 behave different. They lose less weight, retain more fat mass, visceral fat, bone mass and total water. This effect should be treated by more aggressive surgery, having to measure the entire small intestine to make a proper exclusion (tailored effect) to achieve homogeneous effects. Besides, bearing diabetes alter the finally result of body composition.

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