Case Report

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Monitoring the Effect of a Hypocaloric Diet in an Obese Patient, with Multifrequency Bioelectrical Impedance Analysis: A Case Report

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ABSTRACT

Obesity is a multifactorial disease that leads to the development of chronic diseases such as type 2 diabetes mellitus, systemic arterial hypertension, and dyslipidemia. The use of a Multifrequency Bioelectrical Impedance Analysis (MF-BIA) device is necessary in the management and monitoring of a patient with obesity. We present the case of a 35-year-old woman, with a diagnosis of nonalcoholic fatty liver disease and grade 1 obesity. The intervention was with medical nutrition therapy. The patient achieved a reduction in her body weight, at the expense of fat mass, while preserving her muscle mass. The monitoring was with a MF-BIA because it is an accurate tool that will allow us to make timely adjustments in treatment if necessary. Success in the treatment of this disease can only be confirmed if the patient's adiposity is objectively quantified.

Keywords: Adipose Tissue; Bioelectrical Impedance; Body Composition; Obesity

Abbreviations: FMI: Fat Mass Index; BMI: Body Mass Index; MF-BIA: Multifrequency Bioelectrical Impedance Analysis; SGA: Subjective Global Assessment; NAR: Nutrient Adequacy Ratio; DEXA: Dual-Energy X-Ray Absorptiometry

Introduction

According to the Obesity Society in its 2018 statement, obesity is defined as a multifactorial chronic disease, which can occur due to a chronic positive energy imbalance, resulting in the development of adipose hypertrophy with structural, physiological, and functional disturbances throughout the body [1]. The Fat Mass Index (FMI) is an equation with the same mathematical basis as the Body Mass Index (BMI), this equation allows us to determine the adiposity of an individual, with the advantage of considering only the fat mass, and objectively classifying the adiposity of a person [2].

$$FMI = \left[\frac{fatmass(kg)}{hight(m^2)} \right]$$

Although there are no standardized cut-off points yet, in 2020 we published a proposal for cut-off points, based on regression and determination of the BMI and its different grades, [3] which are similar

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to those published by Kelly, et al. [4] The change in body composition can currently be measured with indirect and direct methods, but one of the most used in clinical practice is the molecular model (Figure 1). We discuss the case of a patient suffering from obesity and how the use of the Multifrequency Bioelectrical Impedance Analysis (MF-BIA) allows us to know exactly if the variation in the patient's weight is due to fatty or muscular tissue. This case report is based on the CARE guidelines (Case Report Guidelines).

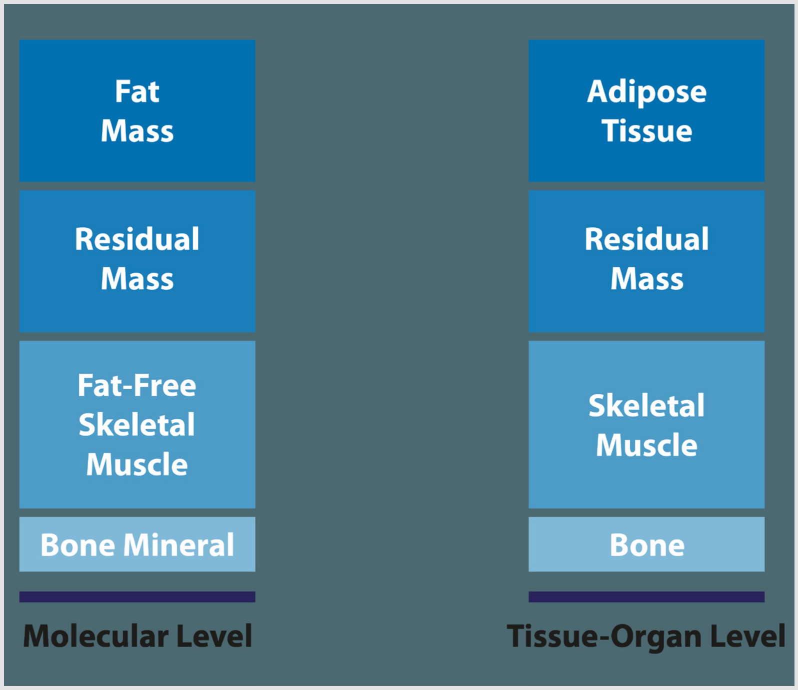

Figure 1: Components at molecular and organs and tissues level.

Note: Adapted from: Prado & Heymsfield [6]..

Case History

Female patient, 35 years old, native, and resident of the State of Mexico. The patient denies pathological hereditary family history, as well as alcoholism, smoking and drug addiction. She is referred by her endocrinologist to the department of Clinical Nutrition of the Specialized Center for Diabetes, Obesity and Prevention of Cardiovascular Diseases, to receive assessment, diagnosis, treatment, and monitoring, since the patient presented involuntary weight gain within five years of evolution. With a history of nonalcoholic fatty liver disease diagnosed with one month of evolution. The patient gave her consent for the development of this case report, giving her signature on the center's internal format. The Nutritional Care Process was applied to the assessment by the Clinical Nutrition service, which allowed us to determine the nutrition-related background, anthropometric measures, and biochemical data of all visits from baseline to the last (Table 1). The Subjective Global Assessment (SGA) is applied, with a final score of 6 (score A), adequate nutrition. The patient is assigned the following diagnoses:

1) Inadequate energy intake, related to a hypocaloric diet, evidenced by a Nutrient Adequacy Ratio (NAR) of 42% of its nutritional requirement.

2) Grade I obesity, related to the metabolically unhealthy obesity phenotype, evidenced by a BMI of 30.4 kg/m^2, FMI of 10.9 kg/m^2, visceral fat of 2.5 kg, and HDL-c of 49 mg/dL.

Table 1: Monitoring and evolution of treatment and body composition.

Parameters	Unit of Measure	Baseline	Visit 2	Visit 3	Visit 4
Energy	kcal/d (kcal/kg/d)	1,830 (30)	1,495 (25)	1,460 (25)	1,430 (25)
Proteins	g/d (g/kg/d)	75 (1.2)	84 (1.4)	88 (1.5)	75 (1.3)
Lipids	g/d (g/kg/d)	85 (1.4)	62 (1.0)	70 (1.2)	70 (1.2)
Carbohydrates	g/d (g/kg/d)	190 (3.1)	150 (2.5)	120 (2.1)	126 (2.2)
PAL	-	1.3	1.4	1.4	1.4
NAR, energy	%	42	80	90	95
Body weight	kg	75.9	71.9	67.7	64.4
BMI	kg/m^2	30.4	28.8	27.1	25.8
Fat mass	kg	27.2	27.5	23	18.2
FMI	kg/m^2	10.9	11	9.2	7.3
Fat-free mass	kg	48.9	44.7	44.7	46.9
FFMI	kg/m^2	19.5	17.9	17.9	18.8
Visceral fat	kg	2.5	2.3	1.8	1.4
Musculoskeletal mass	kg	23.3	21	21.1	21.7
Glycemia	mg/dL	80	ND	ND	79
Triglycerides	mg/dL	115	ND	ND	89
Total cholesterol	mg/dL	150	ND	ND	131
HDL-c	mg/dL	49	ND	ND	45
Blood pressure	mmHg	114/67	111/69	113/68	105/66

Note: Progression of treatment administered at each visit, and monitoring through body composition by MF-BIA. c-HDL, cholesterol from High-Density Lipoproteins; mmHg, millimeter of mercury; ND, Not Determined. The weight used for the calculation was the adjusted one.

An estimation calculation of basal energy expenditure is performed by tissue and organ model [5] with an estimation of organ size and objective measurement of fat-free mass and fat mass by MF-BIA device (Seca mBCA 525), resulting in 1,950 kcal/d (32 kcal/kg adjusted wt/d) + 542 kcal/d due to physical activity stress (Physical Activity Level, PAL of 1.3). The patient's estimated total energy expenditure was 2,492 kcal/d (41 kcal/kg adjusted wt/d). Subsequently, the patient underwent medical-nutrition therapy with the prescription of a hypocaloric diet of 1,830 kcal/d (30 kcal/kg of adjusted wt/d), protein 75 g/d (1.2 g/kg of adjusted wt/d), lipids 85 g/d (1.4 g/kg of adjusted wt/d), carbohydrates 190 g/d (3.1 g/kg of adjusted wt/d) and fluids 2,500 mL/d (1 mL/kcal of total energy expenditure) (Table 1). During the course of therapy, the patient did not report financial, cultural, or physiological complications. Within the first month, the patient presented symptoms of asthenia and dynapenia, which alleviated in the second month, without any subsequent adverse event.

Evolution of the Diagnosis

1) Inadequate energy intake: NAR of energy 95% (initial 42%). Resolved.

2) Obesity, grade I: BMI 25.8 kg/m^2 (initial 30.4 kg/m^2), FMI 7.3 kg/m^2 (initial 10.9 kg/m^2), and visceral fat 1.4 kg (initial 2.5 kg). Resolved.

Discussion

The use of MF-BIA allows an adequate assessment of the state of body composition of an individual, beyond a simple measurement of body weight for the determination of adiposity [6]. The patient demonstrated adherence to treatment that is not usually achieved in this population. This adherence was assessed with a 24-hour dietary recall structured in each subsequent visit. The use of a precise tool that allows an objective assessment of body composition, in a population with adipose hypertrophy, is the ideal way to determine if the treatment is a success or a failure, in addition to the use of the FMI for the correct interpretation of the adiposity analysis [2,6]. The results of this case are similar to those found in a study comparing body composition methods in patients with cirrhosis, where their analysis of the Bland-Altman graph showed a greater correlation in the determination of fat mass and fat-free mass between dual-energy X-ray absorptiometry (DEXA) and bioelectrical impedance analysis ($r = 0.73$, $p \leq 0.001$ and $r = 0.86$, $p \leq 0.001$, respectively) compared between DEXA with measurement of triceps skinfolds and mid-upper arm circumference ($r = 0.69$, $p \leq 0.01$ and $r = 0.61$, $p \leq 0.01$) [7].

Without a precise methodology for determining body composition, and solely based on body weight or anthropometric measurements, we could resort to the very common mistake of thinking that any excess or reduction of this is at the expense of adipose tissue.

Subsequently, it can be seen how, thanks to an effective modify of the medical intervention, the patient had better adherence to treatment (energy NAR in 42% in the baseline visit; 95% in the final one) [8]. The strengths of this case report were the use of accurate and objective MF-BIA equipment and the structuring of nutritional assessment and therapy through the process of nutritional care. The weaknesses of this case report were that no laboratory studies were collected to reflect the degree of inflammation or any imaging study to assess whether the hepatic steatosis was cured [9].

Conclusion

Treatment can only be measured if it is successful or not, through monitoring that allows the precise and objective assessment of the result of the therapy in accordance with the goals set during the consultation, therefore, using subjective parameters of obesity evolution, such as body weight or BMI, can only compromise the health of those who suffer from it and result in a state of malnutrition, instead of a reversal of their obesity.

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Statement of Ethics Written informed consent was obtained from the participant for the publication of the data of his medical case and the accompanying image and table.

Conflict of Interest

The authors have no conflicts of interest to declare.

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Author's Contribution

Melchor Alpízar-Salazar: data acquisition, literature review, manuscript review. Jesús Manuel De Aldecoa-Castillo: Concept and design, data acquisition, data analysis, literature review, manuscript writing, manuscript review. Metztli Guadalupe Rojo-Langruen: Data analysis, literature review, manuscript writing, manuscript review. María Alpízar-Sánchez: Data acquisition, literature review, manuscript review.

Data Availability Statement

All data generated or analyzed during this study are included in this article and its supplementary material files. Further enquiries can be directed to the corresponding author.

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