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ORIGINAL ARTICLE

Phase angle and World Health Organization criteria for the assessment of nutritional status in children with osteogenesis imperfecta

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Received 21 September 2015; accepted 28 February 2016

KEYWORDS

Osteogenesis imperfecta;
Phase angle;
Nutritional status

PALAVRAS-CHAVE

Osteogênese imperfeita;
Ângulo de fase;
Estado nutricional

Abstract

Objective: To compare the phase angle of patients with osteogenesis imperfecta treated at a tertiary university hospital with patients in a control group of healthy children, and to assess the nutritional status of these patients through the body mass index proposed by the World Health Organization.

Methods: Cross-sectional study carried out in a university hospital that included seven patients with osteogenesis imperfecta and a control group of 17 healthy children of the same gender and age. Weight and height were measured and bioelectrical impedance was performed. Subsequently, the phase angle was calculated based on resistance and reactance values.

Results: The phase angle of the group of children with osteogenesis imperfecta was significantly lower than that of the control group ($p < 0.05$). The body mass index criterion for age of the World Health Organization showed no difference between groups.

Conclusions: Children with osteogenesis imperfecta have a nutritional risk detected by the phase angle, which is a useful tool for nutritional screening. The calculation result could help in the diet therapy of patients with osteogenesis imperfecta.

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Ângulo de fase e critérios da Organização Mundial de Saúde na avaliação do estado nutricional em crianças com osteogênese imperfeita

Resumo

Objetivo: Comparar o ângulo de fase de pacientes com osteogênese imperfeita atendidos em um hospital universitário terciário com pacientes de um grupo controle de crianças saudáveis, bem como avaliar o estado nutricional desses pacientes pelo índice de massa corporal proposto pela Organização Mundial de Saúde.

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<http://dx.doi.org/10.1016/j.rppede.2016.03.010>

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Please cite this article in press as: Nogueira-Pileggi V, et al. Phase angle and World Health Organization criteria for the assessment of nutritional status in children with osteogenesis imperfecta. Rev Paul Pediatr. 2016. <http://dx.doi.org/10.1016/j.rppede.2016.03.010>

Métodos: Estudo transversal feito em hospital universitário que incluiu sete pacientes com osteogênese imperfeita e um grupo controle composto por 17 crianças saudáveis de mesmo sexo e idade. Foram aferidos peso e estatura e foi feito o exame de impedância bioelétrica. Posteriormente, o ângulo de fase foi calculado a partir dos valores de resistência e reactância.

Resultados: O ângulo de fase do grupo de crianças com osteogênese imperfeita foi significativamente menor do que o do grupo controle ($p < 0,05$). O critério de índice de massa corporal por idade da Organização Mundial de Saúde não mostrou diferença entre os grupos.

Conclusões: Crianças com osteogênese imperfeita têm um risco nutricional detectado pelo ângulo de fase, é uma ferramenta útil para triagem nutricional. O resultado do cálculo poderia auxiliar a dietoterapia de pacientes com osteogênese imperfeita.

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Introduction

Osteogenesis imperfecta (OI) is an inherited disease characterized by bone fragility and predisposition to fractures that occur with minimal or even in the absence of trauma. Patients with this disease often have low bone mass, but studies on the nutritional status of children with OI are scarce.¹

In 2012, a study of patients with OI types I and III indicated the need for knowledge of body composition, as it is associated with fracture onset.² The authors indicated the need to individualize the diet of individuals with OI to achieve body composition improvement.

The phase angle (PA), obtained from the secondary analysis of bioelectric impedance for analyzing body composition without the use of anthropometric parameters could be used in patients with osteogenesis imperfecta, as anthropometry, especially height measurement, is difficult to perform accurately.^{3,4} The PA is the arctangent of resistance and reactance ratio (Xc/R), that is, it derived from the bioelectrical impedance evaluation with the use of direct measurements of the components of the R and Xc vector; when used as nutritional status indicator and body cell mass (BCM), it considerably eliminates the errors of analysis by bioelectrical impedance.⁵ Its use has been recommended as an indicator of prognosis in clinical practice. In adults, positive associations have been found between PA and survival of HIV-positive patients,^{6,7} and those with pulmonary cancer,⁸ as well as sepsis and those undergoing hemodialysis.⁹

In this context, the objective of this study was to compare the PA of patients with osteogenesis imperfecta treated at Hospital das Clínicas of Faculdade de Medicina de Ribeirão Preto of Universidade de São Paulo (HCFRMP-USP) with a control group of healthy children and to assess the nutritional status of these patients using the World Health Organization (WHO) parameters of body mass index for age (BMI/A).

Method

This was a secondary analysis of a cross-sectional study that included seven children diagnosed with osteogenesis

imperfecta (types I, III and IV) treated with pamidronate in HCFMRP-USP. All patients were followed at the Pediatric Endocrinology and Orthopedic Outpatient Clinic at the same hospital. These children do not represent all pediatric patients with OI treated at the hospital. They were randomly assigned to another study and were analyzed separately due to the disease complexity. Data from these patients were compared with those from 17 healthy children of the same gender and age, which comprised the control group. The children from the control group attend the Child Care and Pediatric Outpatient Clinic of Cuiabá Health Unit in the municipality of Ribeirão Preto. This location was chosen as it cares for healthy children of the same socioeconomic level of those treated at the study tertiary hospital. They were stratified by gender and age. There was no pairing, as they are independent groups.

Four children from the study group and 12 from the control group signed the term of consent (aged >7 years); all patients had the informed consent form signed by their parents/tutors. This was a secondary analysis of the study on the prevalence of malnutrition in HCFMRP-USP carried out in 2013.⁹ The study was approved by Institutional Review Board of HCFMRP-USP.

Data on weight and bioelectrical impedance were collected according to international procedures.¹⁰ The height/length was measured, in some cases, on the patients' own bed, as they were unable to remain in the standing position ($n=6$). Body mass index (BMI) was calculated for BMI/A classification according to the WHO charts.¹¹

The PA was calculated according to the formula: $\Phi = (Xc/R) \times (180^\circ / \pi)$, in which Xc is the reactance value, R is the resistance value and pi is the mathematical value of 3.1415. This conversion is performed to convert the final value from radians into degrees.¹²

For the statistical analysis of data, the following software were used: SPSS 20.0 (Statistical Package for the Social Sciences, Westlands Road, Quarry Bay, Hong Kong, 2009) and R (R Foundation for Statistical Computing, University of Auckland, New Zealand, 1993).

Nonparametric statistics were used, considering that there is no certainty of normal distribution for the anthropometric data of patients with OI. The Mann-Whitney test for independent samples was used to compare the variables of interest.

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