Open Access
Volume 6 Issue 1
Case Report

International Journal of Case Reports and Clinical Images
ISSN: 2694-3816

PUBTEXTO

Healthier Body Composition with High Phase Angle (PhA) In an Early Elderly Case by Blood Flow Restriction (BFR) Training

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Article Info

Article History:
Received: 30 January 2024
Accepted: 02 February 2024
Published: 05 February 2024

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Abstract

The case is 66-year-old male physician, who continued Masters sports and can dash 100m sprint as 13.0 sec for half century. He keeps regular lifestyle with adequate stretch, aerobic training (AT), strength training (ST). and KAATSU (Blood Flow Restriction, BFR) training for long. The bioelectrical impedance analyses (BIA) by InBody showed BMI 22.0 kg/m^2, body fat 15.5%, skeletal muscle mass index (SMI) 8.0 kg/m^2, Extracellular water (ECW) /Total body water (TBW) 36.8, whole body phase angle showed 8.0 degree. The PhA values in university athletes are reported to be 7.7/6.9(PhA) in average. Then, this case has higher results than usual.

Keywords: Bioelectrical impedance analyses (BIA); Phase angle (PhA); Extracellular water/total body water (ECW/TBW); Skeletal muscle mass index (SMI); Blood Flow Restriction (BFR) Training; InBody

Introduction

For decades, the importance of primary care medicine and anti-aging medicine has been emphasized. In developed countries, the quality of life (QOL) of the elderly has been in discussion [1]. Among them, authors and collaborators have continued various medical and health problems of sarcopenia in middle and older people in the light of rehabilitation and sports medicine [2].

In recent years, the assessment of sarcopenia showed development using CT, MRI, dual energy x-ray absorptiometry (DXA) and bioelectrical impedance analyses (BIA) [3]. Using BIA, we can obtain important biomarkers values such as total body water (TBW), extracellular water (ECW), ECW/TBW ratio and phase angle (PhA) [4,5]. In the elderly people, general tendency has shown as elevated ECW/TBW and decreased PhA from several reports [6,7].

Through our medical practice, we have experienced an impressive 66-year-old male case who showed excellent values of ECW/TBW and PhA. His general outlines and some perspectives are described will be described in this article.

Case and Methods

Present and Sports History

The case is 66-year-old male. He is a physician and also a Masters athlete of baseball, skating and athletic of short sprint for long years. When he was a child, he was in rather weak health for bronchial asthma. From junior high school, he tried to lead regular life with running every day for training himself. He has maintained the same body weight for half century associated with regular exercise habit.

As sports history, he has continued baseball from childhood, speedskating from 35 years old, and short distance athletics from 45 years old. he could run 100-meter sprint as 13.0 sec for half century. He continues several physical trainings such as stretching, aerobic training (AT) and strength training (ST). Furthermore, he continues KAATSU training (giving pressure method in upper arm and thigh for short time, that originated in Japan (Figure 1). It consists of the combined words, where Ka; adding or giving, and Atsu; pressure. It has been called as Blood Flow Restriction (BFR) Training in the field of sports medicine [8,9].

Figure 1: *Daily exercise training by KAATS (blood flow restriction (BFR) training).*

Methods

Current study was calculated by using InBody, which was developed in Japan [10]. The principle of the measurement is set on the Bioelectrical Impedance Analyses (BIA) [11]. It is a useful apparatus for measuring of estimating body composition such as TBW, ECW, ECW/TBW, PhA and other various biomarkers [3]. As a matter of fact, the actual measurement is convenient and takes a few minutes, in which the examinee is sitting or standing position. From theoretical point of view, the equation has been known as $Z^2 = Rz^2 + Xc^2$ (Z: impedance, Rz: resistance, Xc: reactance). In other words, the value of the impedance (the diagonal line) has been defined as $Z = (R^2 + X^2)^{1/2}$.

Results

His current body state is almost ideal condition, associated with body weight 60.0kg, muscle mass 47.9kg, BMI 22.0 kg/m^2 and body fat 15.5% (Table 1).

1) Body Composition Analysis

	測定値	体水分量	筋肉量	除脂肪量	体重
water (L)	37.2 (33.7~41.1)	37.2	47.9 (43.3~52.9)	50.7 (45.8~56.0)	60.0 (50.9~68.9)
protein (kg)	10.1 (9.0~11.0)				
mineral (kg)	3.41 (3.11~3.81)				
fat (kg)	9.3 (7.2~14.4)				

2) Soft Lean-Fat Analysis

	低	標準	高
weight (kg)	55 70 85 100 115 130 145 160 175 190 205 %	60.0	
soft lean (kg)	70 80 90 100 110 120 130 140 150 160 170 %	47.9	
fat (kg)	40 60 80 100 160 220 280 340 400 460 520 %	9.3	

3) Obesity Index Analysis

	低	標準	高
BMI (kg/m^2)	10.0 15.0 18.5 22.0 25.0 30.0 35.0 40.0 45.0 50.0 55.0	22.0	
body fat (%)	0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0	15.5	

Table 1: *Body composition analysis.*

The segmental lean analysis for muscle is calculated as follows: Muscle mass ratios are 88--90% in arm, 95% in trunk and 105--106% in leg (Table 2). ECW/TBW ratio are in the range of 0.366--0.372, that is lower than 0.38 as standard value. Total ECW/TBW was calculated as 0.368.

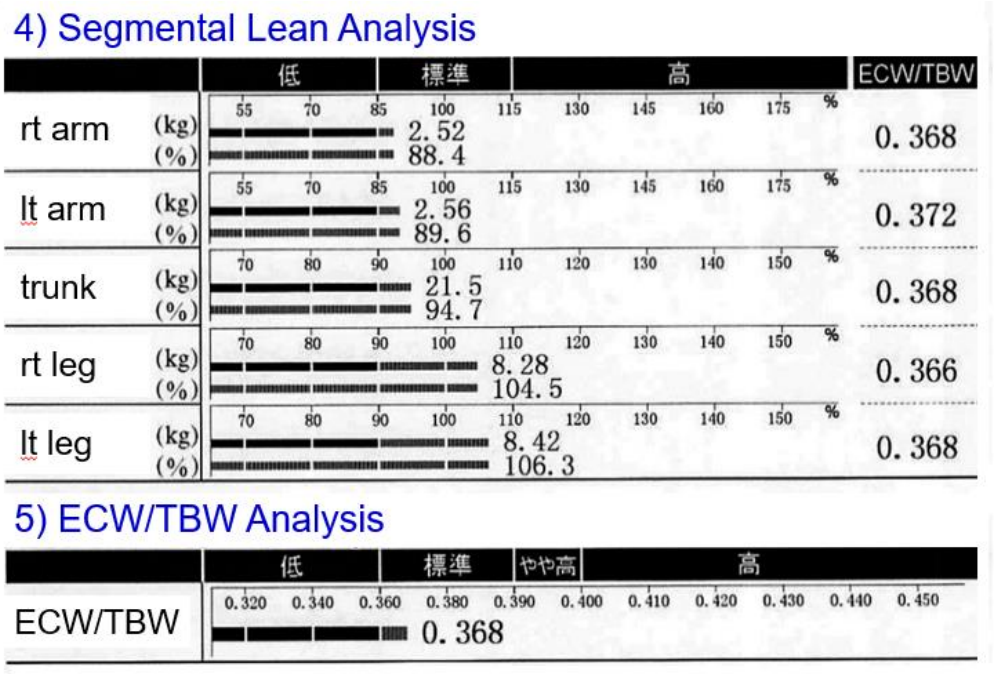

Table 2: *Muscle and water analysis.*

As body weight is related to body mass index (BMI), skeletal muscle can be evaluated as skeletal muscle mass index (SMI) 8.0 kg/m^2 (Table 3).

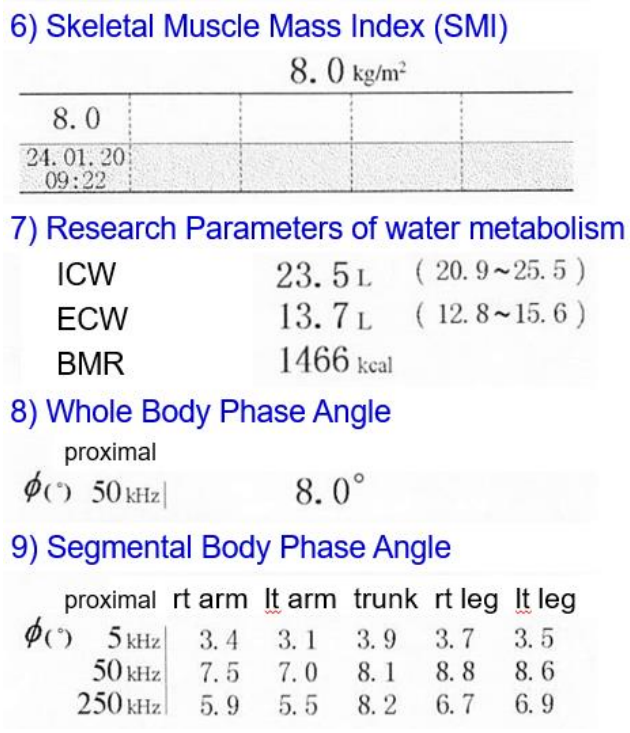

Table 3: *Phase angle analysis.*

Water parameters showed that Intracellular water (ICW) 23.5L and Extracellular water (ECW) 13.7L, where Total body water (TBW) = ICW + ECW = 37.2L and ECW/TBW is calculated as 13.7/37.2 x 100= 36.8. The impressive result was that whole body phase angle showed 8.0 degree, that is remarkably higher value compared with usual level of 66 years old. Segmental body phase angle showed high values in trunk and bilateral legs.

The result of impedance in right/left arms, trunk, right/left legs are summarized in Figure 2. Among them, bilateral arms and legs showed similar values.

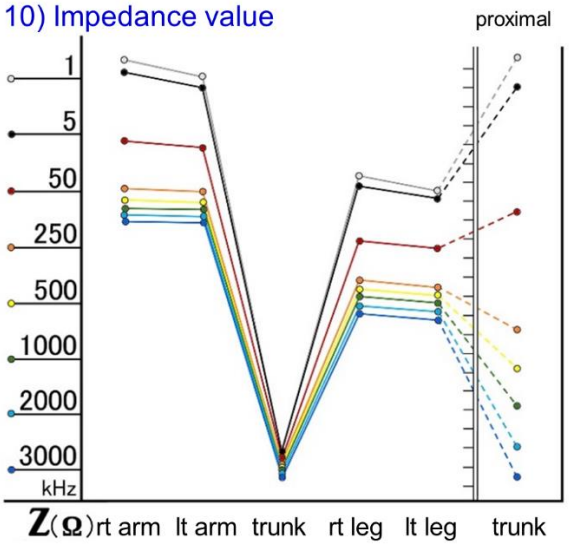

Figure 2: *Impedance analysis.*

Discussion

In this article, the characteristic results of anthropometry and BIA measurements were found. They are weight 60 kg, soft lean mass 47.9kg, fat 9.3kg, BMI 22 kg/m^2, ECW/TBW 0.368, and SMI 8.0 kg/m^2, and whole body phase angle (PhA) 8.0 degree. Further, segmental PhA showed higher values of more than 8.0 degree in trunk and bilateral legs. Among them, ECW/TBW is lower, and SMI and PhA is higher than standard values in 60s. The PhA value of 8.0 degrees is high compared to the younger generation. Body assessment for university athletes (n=1556) in various kinds of sports was conducted using BIA [12]. PhA value in average for male/female was 7.7±0.8 / 6.9 ± 0.8 degree, respectively. The average data were sports for endurance 7.6/6.8, sports for velocity & power 7.7/7.0, and team sports 7.6/6.8 degree, respectively.

From these data, the case seems to be rather healthy as compared with usual male in 60s. The subject is a 66-year-old physician, who has been participating in short-distance track and field, baseball, and skating for many years. He has continued aerobic exercise and occasional resistance exercise on a daily basis. Muscle training by giving pressure on upper arm and thigh has been continued by blood flow restriction (BFR) training [13]. This method aims to temporarily restrict blood flow during exercise, and then it constrains oxygen supply to the muscles and increasing the effectiveness of short training sessions. BFR training has been particularly effective for promoting muscle hypertrophy, increasing muscle strength, and recovering from injuries. Furthermore, he has been stretching for many years. In the standing forward bending test, he shows 25 cm, while the standard value is about 5 cm for people in 40s and 50s, and 3cm in 60s [14].

The result paper of BIA reveals skeletal muscle mass (SMM), total body water (TBW), body fat mass (BFM), soft lean mass (SLM) and fat free mass (FFM). In addition, PhA is calculated from the device of resistance (R) and reactance (Xc) at 50 kHz. Thus, the following equation is summarized: PhA (degree) = arctangent (R/Xc) x 180 π [15]. When evaluating clinical nutritional status, phase angle (PhA) has been gaining attention by the measurement of BIA. For the reason, it seems to be a proxy of body cell mass and water distribution. Further, it would be associated to muscle strength, leading to effective predictor of various clinical reports [16].

By the measurement of BIA, PhA is considered as an indicator of cellular health, in which higher level means higher cell function, cell membrane integrity and higher cellularity. The relationship between PhA level and physical activity or exercise habit in each case was studied [17]. The protocol included 115 people with 32-69 years old. Physical activity was evaluated for sedentary behavior (SB). Exercise habit was evaluated and categorized into no exercise (No-Ex), aerobic training exercise habit (AT) and resistance training exercise habit (RT) group. As a result, PhA was significantly higher in AT and RT than in no-Ex group. No significant difference was observed between AT and RT. Regular exercise continuation at moderate-high intensity seems to maintain or improve muscle quality and cellular health.

Resistance training (RT) is considered as valid practice against aging influence on muscle mass, which can be evaluated by BIA. A systematic review was conducted for RT effect in older adults [18]. Among them, 7 papers with 344 cases were analyzed. The quality assessment showed 71.3% of score. By continuing RT 8 weeks, bioelectrical PhA for 0.52 degree and Xc for 3.58 ohms increased, and R decreased for 28.50 ohms ($p<0.001$, respectively). Certain limitation may be present in this report. This is 66-year-old healthy male associated with usual physical training for years. Elevated values of SMI and PhA would be from his continuation of regular life so far. These data will be also followed up with attention for future situation in the light of psychosomatic medicine [19].

In summary, 66-year-old male physician was presented for higher PhA probably due to constant preservation of regular healthy life with physical training for long. This report will become hopefully useful reference for sports medicine and anti-aging medicine in the future.

Conflict of interest: The authors declare no conflict of interest.

Funding: There was no funding received for this paper.

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