MedCrave
Step into the World of Research
Journal of Diabetes, Metabolic Disorders & Control

Editorial

Open Access
CrossMark

Recent trends of diabetes and phase angle (PhA) by bioelectrical impedance analysis (BIA)

Abstract

Recent topics regarding diabetes and Phase Angle (PhA) by the Bioelectrical Impedance Analysis (BIA) method were introduced. Decreased PhA value means impaired cell function of human body. PhA was significantly lower in Type 2 diabetes (T2D). T2D cases of 30-83 years showed average data of PhA 6.84/5.99, and HbA1c 7.35/5.95% as male/female. When male cases were analyzed for lowest quartile with the data of PhA ≤4.9, they showed odds ratio (OR) 2.02 with significantly higher prevalence of diabetes. Regarding diabetic polyneuropathy (DPN), PhA value showed control 6.18, T2D without DPN 6.07 and T2D with DPN 5.71 with significant difference.

Keywords: phase angle (PhA), bioelectrical impedance analysis (BIA), skeletal muscle mass index (SMI), type 2 diabetes (T2D), diabetic polyneuropathy (DPN)

Volume 11 Issue 1 - 2024

Hiroshi Bando
Tokushima University / Medical Research, Tokushima, Japan Low Carbohydrate Diet Promotion Association, Kyoto, Japan

Correspondence: Hiroshi Bando, MD, PhD, FACP, Tokushima University /Medical Research, Nakashowa 1-61, Tokushima 770-0943, Japan, Email pianomed@bronze.ocn.ne.jp

Received: April 01, 2024 | **Published:** April 04, 2024

Editorial

Recent topics have included development of diabetes and related exams and treatments. Authors and co-researchers have continued diabetic clinical studies such as low carbohydrate diet (LCD).[1,2] Furthermore, we have presented some reports about Phase Angle (PhA) in the Bioelectrical Impedance Analysis (BIA).[3,4] Combined these fields, latest perspectives of diabetes and PhA would be introduced in this article. PhA levels has been reported to be lower in type 2 diabetes (T2D) patients than in non-diabetics, and the difference appears to increase with longer duration of diabetes. Comparative BIA study with T2D and control were studied with >40 years (n=158, n=59). PhA value was measured by 5, 50 and 250kHz impedance method.[5] As a result, PhA value was significantly lower in T2D cases. This difference would be from aging and the duration period of T2D. Especially, the mediation effect of the duration of diabetes on the decrease in PhA values was found for 29.8%-53.3% in left/right arms of male/female cases. PhA level at 50 kHz decreased in T2D, and the changes were aggravated as T2D duration increased. Thus, bioimpedance PhA values can show non-invasive method for monitoring T2D progression. From anthropometric results of body composition, PhA and glycemic parameters, relationship was found among HbA1c, fasting glucose and PhA value in T2D patients.[6] T2D cases including 133 male and 188 female (30-83 years) were investigated for PhA, body composition and glycemic parameters. Average results in male/female were PhA 6.84/5.99 and HbA1c 7.35/5.95%, respectively. Male showed higher values of PhA, HbA1c, fasting blood glucose, TBW, ECW, ICW, ECM, lean body mass (LBM) and body cell mass (BCM). Female showed higher values of fat mass, IRI, ECW/TBW, ECW/ICW and ECM/BCM. PHA showed significant relationships (male/female) with age, ECW/TBW, ECW/ICW, ECM/BCM and others. Thus, PhA may become an indicator for glucose variability in T2D cases.

T2D patients were studied for the relationship of PhA and HbA1c.[7] The protocol included 400 males, 255 females, 57.1 years old in average, HbA1c 8.1 +/- 1.9% and BMI 25.6 kg/m^2. By detail analyses, PhA showed same results for 5.3 as T1D, 5.3 as T2D. PhA is negatively affected by HbA1c and age, and it showed positive relationship with serum albumin, skeletal muscle mass index (SMI), body metabolic rate (BMR), body muscle amount. These results suggest that PhA may be used as a prognostic indicator and evaluation of complications in diabetic patients. In order to evaluate PhA values in diabetes for diagnostic or prognostic tool, 1085 applicants attended the program.[8] They included 68.11 +/- 7.7 years old in average and 60.7% of female. When male cases were analyzed for lowest quartile with the data of PhA ≤4.9, they showed odds ratio (OR) 2.02 with significantly higher prevalence of diabetes, after adjustments for BMI, age and other comorbidities. These correlations were weakened by adjustment of taking oral hypoglycemic agents (OHAs). The factors of male and OHAs showed significantly decreased PhA as -0.44. In contrast, female cases did not show such correlations. For 371 T2D patients, BIA study was conducted including PhA, ECW/TBW, SMI, hemoglobin (Hgb) and hematocrit (Hct).[9] PhA and SMI showed positive correlation with Hgb and Hct, and ECW/TBW had negative correlation with Hgb and Hct. Then, aberrant results of PhA and ECW/TBW may indicate anemia risk for T2D.

The prevalence of T2D has continued to increase with the aged society. Among macro- and micro- diabetic angiopathy, diabetic peripheral neuropathy (DPN) has been the most common complication.[10] The pathogenesis of DPN is complex, and may include impaired bioenergetics and metabolism, which shows failed operation against the glia cell and long peripheral nerve axons. In addition, T2D may bring some influences of dyslipidemia and hyperglycemia. The latest report was concerning the relationship between DPN and the changes in PhA values.[11] The protocol included T2D patients (n=697), who were divided into DPN group and non-DPN group. DPN group were further categorized for high, medium and low peripheral artery disease (PAD) groups by the vibration perception examination. Then, the association between risk of DPN risk and PhA values were analyzed. The results showed that DPN risk showed negative correlation with PhA values of arms, legs and total body. In contrast, the trunk PhA value did not show correlation with DPN. Further, the negative association was observed between PhA value of total body and DPN risk by the except for the cases with obesity of ≥ 28 kg/m^2 of BMI.

Compared study was conducted for DPN patients and control. The correlation of PhA of BIA was studied for T2D (n=205) and healthy control (n=104).[12] DPN was found in 63 cases. Nerve conduction velocity (NCV) was measured for peroneal and tibial nerves. As a result, T2D cases with DPN showed lower PhA (5.71) than T2D without DPN (6.07) and controls (6.18). By confounder-adjusted analysis, PhA showed relationships with NCV and amplitudes of two nerves. Consequently, PhA test may become a useful and beneficial

Submit Manuscript | http://medcraveonline.com

©2024 Bando. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and build upon your work non-commercially.

marker for DPN detection in T2D as a easy handling procedure in comparison with other exam systems.

T2D patients (n=159) was studied for PhA, SMI, muscle mass/strength, physical performance.[13] Furthermore, other markers included leg extension strength, grasping power, and the short physical performance battery (SPPB). As a result, PhA showed correlation with SMI, muscle power and SPPB score by simple correlation analysis, and PhA in each side showed correlation with SMI and each grasping power. Consequently, PhA may become a marker of muscle mass/strength and physical performance in T2D. Recent topics include obesity and nonalcoholic fatty liver disease (NAFLD). For overweight cases (n=953), PhA and NAFLD-related markers were studied with relationship analyses.[14] As a result, PhA values of legs and body showed significant relationships with NAFLD risk. Further, PhA values had significant association with the controlled attenuation parameter (CAP), that is the non-invasive assessment measure of liver steatosis and fibrosis. Thus, PhAs would be useful indicators for NAFLD management among overweight person.

In summary, recent topics concerning diabetes and PhA were described. Diabetes is multifaceted disease, in which various relationship would be clarified for future development. Current article becomes hopefully a useful reference for future clinical research.

Acknowledgments

None.

Conflicts of interest

The author declares that there are no conflicts of interest.

Funding

There was no funding received for this paper.

References

1. Wood M, Ebe K, Bando H. Stable Glucose Variability in a Patient with Slowly Progressive Type 1 Insulin-Dependent Diabetes Mellitus (SPIDDM) with Low-Carbohydrate Diet (LCD). *SunText Rev Endocrine Care*. 2024;3(1):115.
2. Ebe K, Wood M, Bando H. Preventing Post-Prandial Elevation of Blood Glucose by Breakfast with Less Carbohydrate. *Int J Case Rep Clin Image*. 2024;6(1):219.
3. Bando H, Urasaki H, Bando M. Healthier Body Composition with High Phase Angle (PhA) In an Early Elderly Case by Blood Flow Restriction (BFR) Training. *Int J Case Rep Clin Image*. 2024;6(1):217.
4. Urasaki H, Bando H, Bando M, et al. Characteristic body composition with high skeletal muscle mass index (SMI) and fat deposits in elderly athlete. *Int J Endocrinol Diabetes*. 2024;7(1):164.
5. Jun MH, Ku B, Kim J, et al. Mediation effect of the duration of diabetes mellitus on the decrease in bioimpedance phase angles in ethnically Korean people: A multicenter clinical study. *J Diabetes Investig*. 2021;12(5):790–802.
6. Choi HN, Kim KA, Kim YS, et al. Independent Association of Phase Angle with Fasting Blood Glucose and Hemoglobin A1c in Korean Type 2 Diabetes Patients. *Clin Nutr Res*. 2020;9(3):205–212.
7. Muramae N, Matsuda T, Inagaki S, et al. Determinants of phase angle in Japanese patients with diabetes. *Diabetol Int*. 2023;14(4):339–343.
8. Mat S, Tan MP, Mohktar MS, et al. Phase angle and diabetes in community-dwelling older adults: cross-sectional analysis from the Malaysian elders longitudinal research (MELoR) study. *Eur J Clin Nutr*. 2022;76(5):680–684.
9. Hori T, Nakamura S, Yamagami H, et al. Phase angle and extracellular water-to-total body water ratio estimated by bioelectrical impedance analysis are associated with levels of hemoglobin and hematocrit in patients with diabetes. *Heliyon*. 2023;9(4):e14724.
10. Eid SA, Rumora AE, Beirowski B, et al. New perspectives in diabetic neuropathy. *Neuron*. 2023;111(17):2623–2641.
11. Zhang J, Xu Z, Fu Y, et al. Association between phase angle and diabetic peripheral neuropathy in Type 2 diabetes patients. *Endocrine*. 2024.
12. Schimpfle L, Tsilingiris D, Mooshage CM, et al. Phase angle of bioelectrical impedance analysis as an indicator for diabetic polyneuropathy in type 2 diabetes mellitus. *J Clin Endocrinol Metab*. 2024:dgad737.
13. Oyanagi T, Sada Y, Sasaki Y, et al. Associations of phase angle obtained by bioelectrical impedance analysis with muscle mass and strength in Japanese patients with type 2 diabetes. *Endocr J*. 2023;70(9):925–932.
14. Chen G, Lv Y, Ni W, et al. Associations between Phase Angle Values Obtained by Bioelectrical Impedance Analysis and Nonalcoholic Fatty Liver Disease in an Overweight Population. *Can J Gastroenterol Hepatol*. 2020;2020:8888405.