



Bioelectrical Impedance Analysis (BIA) and Phase Angle

INTRODUCTION

Impedance analysis is based upon relating the measured electrical values of a subject to their physiologic equivalents as determined when the subject is the only unknown part of a safe and controlled electrical circuit. The properties of the circuit are well-defined and don't change over time. The method is precise, sensitive and specific in its ability to illustrate the changes inherent in the biological subject. Of particular benefit is these changes occur at a level of physiology that precedes those seen through biochemical assays, cell counts, imaging techniques and physical signs. This 'snapshot' of cellular level dynamics and architecture provide valuable additional data to clinical practice and medical research. Michael Singer (mgsinger@ipgdx.com)

HISTORY

The first electrical impedance measurements of biological variables of the circulation began at New York Post Graduate Hospital in 1939 with Dr. Jan Nyboer, Dr. Robert Halsey, Dr. Avrom Barnett and an engineer Mr. Samuel Bagno.

In 1938 Mr. Bagno was awarded U.S Patent No. 2,111,135 titled "APPARATUS AND METHOD FOR DETERMINING IMPEDANCE ANGLES," that discloses an apparatus for measuring the electrical phases displacing properties or impedance angle in humans, animals, and vital tissues. There is also disclosed a method for measuring the phase angle due to the impedance of an animal having properties of varying resistance and capacitance due to changes in muscular tension, comprising the steps of passing alternating current through the animal, and measuring the phase during changes of resistance and capacitance.

In 1967 Thomasset was awarded U.S Patent No. 3,316,896 titled "APPARATUS AND METHODS FOR MEASURE OF THE ELECTRICAL IMPEDANCE OF LIVING ORGANISMS," which discloses a method for simultaneously and associatively determining the individual impedances of the extracellular contents and the intracellular contents of a living organism, which consists in measuring the total impedance of the organism between two selected point at predetermined frequencies.

In search of the US patent office and peer review papers on topics of bioelectrical impedance analysis (BIA) and phase angle (PA) will illustrate how many years this concept has existed. A more recent patent by Michael Singer (6,587,715 July 1 2003) discusses the broad use of resistance, reactance and phase angle as a method for determining illness, progression of death, and ...ing of death of biological entities.

What is Phase Angle (PA)?

Phase angle is calculated by finding the ratio of reactance divided by resistance, and taking the arctangent of that ratio. Phase angle is normally expressed in degrees. The energy of living things comes from cells that consume oxygen and nutrients and expel carbon dioxide and waste. The quantity and efficiency of cells directly affect phase angle (PA). The outer boundary of the cell is a plasma membrane of phospholipid molecules that are dielectric to form an electrical capacitor when a radio frequency signal is introduced to the cells environment. Capacitance is fundamental to any human phase angle measurement, the higher the capacitance the greater the phase angle. An elite athlete world has a higher phase angle than a sedentary person. It has been well documented that phase angle declines with disease, age and reduce activity level.

Further discussion of Phase Angle and Capacitance can be found in the paper **Principles of Bioelectrical Impedance Analysis.**