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Review Article

A BIO-ELECTRICAL MODEL FOR PHYSIOLOGICAL EVALUATION OF NADI PARIKSHA (AYURVEDIC PULSE DIAGNOSIS)

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ABSTRACT

Physiology of the traditional Ayurvedic diagnostic technique of *Nadipariksha* has always been a matter of controversy. This diagnostic skill is based on a fine tactile sensitivity of the physician to distinguish varied intensities of mechanical vibrations elicited by radial artery pulsation, normally perceived as Pulse Pattern Variability (PPV). Ancient exponents of Yoga and Ayurveda define *Nadi* as the 'channel' of Prana which is known as the very basis of bio-energy dynamics of the body. To the modern physician *Nadipariksha* indicates an assessment of cardiac function which is an important aspect of vascular physiology. The above concept has been re-examined in this article, in the light of whole body bio-electrical activity pattern. The study suggests *Nadi* as the Energy Pulsating Pathway (EPP) encompassing cells' Pulsating Bio-Electrical Response (PBER). The observed varying intensities of PPV in *Nadipariksha* are proposed to be due to collision of weak threshold PBER with the mechanical vibration of pulsating radial artery. The underlying mechanism of *Nadipariksha* has been proposed to be associated with energy dynamics of bio-electrical waveform activity at the cellular level. This approach points at its possible implications in developing a more objective diagnostic method in assessing psycho-physiological abnormalities of a patient without having to depend on the subjective diagnostic judgment of a physician. Further, this study hints at the possible experimental evidence towards a physiological evaluation of *Nadipariksha* through the measures of bio-impedance, bio-reactance and bio-phase angle.

KEY WORDS: *Nadipariksha*, PPV, EPP, PBER, Bio-impedance, Bio-reactance and Phase angle.

INTRODUCTION

Ayurveda is a comprehensive and traditional life science which deals with the protection and preservation of total health and cure of disease states by means of 'integrating body, mind and spirit'. The fundamental principle of *Ayurveda,* based on three types of body humors termed as namely *Vata, Pitta* and *Kapha*, is collectively termed as *Tridosha*. These are said to be present, throughout the body, in varying proportions [1] and relate individual human constitution with his/her characteristically unique metabolic processes [2].The *Nadipariksha* is one of the diagnostic methods to assess health status of the subject in terms of *Tridosha*. According to *Charaka,* the *Nadi* is defined as a channel, which may facilitate the flow of nutrients and energy at the cellular level, through circulatory process, accompanied by breath activity [3,4,5]. Michael[5] described it as energy vessels connected to various energy centers. The *Tridosha* assessment by *Nadipariksha* is done by feeling radial pulse, by placing index, middle and ring fingers just below the thumb region [6]. The throbbing pulse beat

felt under index finger is referred to as *Vata*, middle finger as *Pitta*, and ring finger as *Kapha* [7]. In fact, the precision and accuracy of diagnosing and interpretation of *Nadipariksha* is dependent upon the subjective judgment, and, therefore, the outcome of the *Nadipariksha* often varies among Ayurvedic physicians due to variations in their diagnostic skills. Therefore, there is a need to develop scientific method to standardize the diagnostic procedure of *Nadipariksha* in terms of relevant physiological variables. Hence, this study proposes bio-electrical approach to deal with discrepancies among physicians in assessing health status through *Nadipariksha.*

Perspectives of *Nadipariksha* Concept

Previous research reports amply indicate physical, psychological, physiological and biochemical aspects of *Nadipariksha*. The *Nadipariksha* is the method of examining wrist pulse pattern of different levels of intensity at the region of radial fossa, sensed at index, middle and forefinger [7]. According to Ayurvedic view point, these three pulse patterns of *Nadipariksha* constitute a diagnostic tool to assess *Tridosha* [3] which could, operationally, be defined as three vital physiological functions. Fundamentally, these three pulse patterns constitute the system of physiological regulatory function [8]. The outcome of *Nadipariksha* examination or *Tridosha* may be similar to homeostasis [9]. Besides, examining the pulse pattern effect, *Tridosha* is also evaluated by health or *Prakriti* questionnaire [10]. Researchers have correlated genetic connotation of *Prakriti* with HLA alleles [11].

Nadipariksha, a diagnostic skill to assess *Tridosha,* is based on a fine tactile resolution sensed by the physician. Scientifically, *Tridoshas* can be related with three types of *Pulse Pattern Variability (PPV)* elicited by varied intensity of mechanical vibration of radial pulse. There are several environmental and subjective factors that modulate *Pulse Pattern Variability (PPV)* or *Tridosha,* such as seasonal changes [12], physical strength [13],post lunch [14,15], breathing process [16,5], metabolic process [17]. The understanding of *PPV,* according to the past research reviews is indicative of the biologic phenomenon rather than that of neuro-endocrine effect [8]. On molecular level, the three types of *PPV,* namely *Vata, Pitta* and *Kapha* are associated with the membrane bound signal transduction to different protein phosphorylation and de-phosphorylation mechanism and also with the degree of gene expression regulating the protein synthesis [18]. Parasher *et al.,*[19] revealed striking differences on physiological, biochemical and hematological parameters in three *PPV*s' and are found the same to be related to metabolizer genotype [2].

The hunch for the search of suitable physiological parameters, to assess pulse pattern in *Nadipariksha* by various researchers, include multi-resolution plethysmograph [20], Heart Rate Variability (HRV) [21,22], both HRV and ECG [23,24], impedance plethysmography [25] and photo-plethysmography [4]. Three types of *PPV* are also found correlated with platelet aggregation [26], anthropometric characteristics [27,28], Neurophysiologic variables such as hemisphere activity of cerebral functions [29] and intracellular cholesterol synthesis catabolism have also been found correlated [30]. The neurotransmitters acetylcholine, catecholamine, histamine [31], nor-adrenalin [32] and enzyme activity such as Cholinesterase, Monoamine oxidase and Histaminase [33] are also found correlated with *PPV*. Apart from this, *PPV* (*Tridosha*) variations are also found related to cardiovascular responses in isotonic exercise [34], as well as, with cardiovascular risk factors, inflammatory markers and insulin resistance, in terms of the body constitution [35].

Although, numerous studies are conducted in relation to the measure of *Nadipariksha* based on the principle of *Tridosha,* the results of these studies, however, lead to controversial views on *PPV*. The proposal of *Nadi* as energy pathway and the localization of energy content, distributed throughout the body [5,36], are clearly reflected from the past reviews. Therefore, the main purpose of this study is to propose physiological variables to represent function of *Nadipariksha* as energy pathway.

Three Modes of Bio-Energy: A Quantification Aspect of *Nadipariksha*

The existing reviews are inconclusive regarding the scientific acceptance of *Nadipariksha* technique with reference to clinician's observation of *PPV* pattern. Various scientific reports of *Nadipariksha* (*Tridosha*) propose several physiological and biochemical variables, to reflect the effect of *Tridosha.* The above review also suggests that the aforesaid variables are dependable and the observed variations are due to secondary effect of underlying cellular mechanism of *Nadipariksha*.

However, there is no convincing approach to suggest a suitable physiological variable that may match *PPV* of *Nadipariksha*. This study proposes a physiological model for explaining the concept of *Nadi* as energy channel and also could be described as bioenergetics of energy pathways as observed by Hamilton [5]. It could be physiologically described as an activation of non-specific functional energy modes, distributed all over the body, in various intensities. These energy modes, triggered by specific tissue, would serve as *PPV*. The action of the energy modes might vary for different tissues and systems through exhibiting agonistic and antagonistic physiological effects. Therefore, the proposed *PPV* could be different according to the type of energy elicited by the tissues along with the diet intake. For example, the *PPV* for *Vata* is for circulation of metabolites contributing to first type of the three energy modes; *Pitta* is the metabolic process for spending energy to sustain whole body activity, is the second type and the third type of energy mode is *Kapha* that refers to anabolism and storage function [37,38,35,8].

Three types of *PPV* ultimately can be referred to as energy conserved, energy distribution and energy storage. It can be measured through bioelectrical responses elicited by cellular energy. The bioelectrical properties i.e. bioelectrical-impedance, reactance and phase angle are also evident in nutrients that refer to stored energy in the form of complex metabolites [39]. According to Ayurveda, presence of *Tridosha* in entire body may represent whole body energy profile. Physiologists claiming, to propose cardio-vascular functions as the variable to represent *Nadipariksha,* seems logically not clear. There are various reports, based on assumption that the cardiovascular functions are source of *Tridosha,* using physiological variables such as impedance plethysmograph, HRV etc.[25,23]. However, this assumption cannot be true if one forwards the premise that *Tridoshas* are known to be present in entire human body [1] although the anatomical site of *Nadipariksha* examination is preferred as radial fossa (radial artery). Therefore, *Doshas* are of cellular origin and their response is reflected on the radial artery.

The above logical conclusion suggests that *PPV* pattern is the incidence of after-effects of the interaction of energy modes rebound with typical arterial pulse beat leading to pulsating energy modes, elicited by pulsating bio-electrical response (*PBER*). As per the literature*, Tridoshas* are localized to certain organ as per their nature and quality [8]. However, they may tend to propagate beyond the specified body region contributing to rebound effect of energy modes usually evident in a mixed state of varied intensity. Usually, the energy mode response is labeled as the extent & nature of *Vata, Pitta* and *Kapha*.

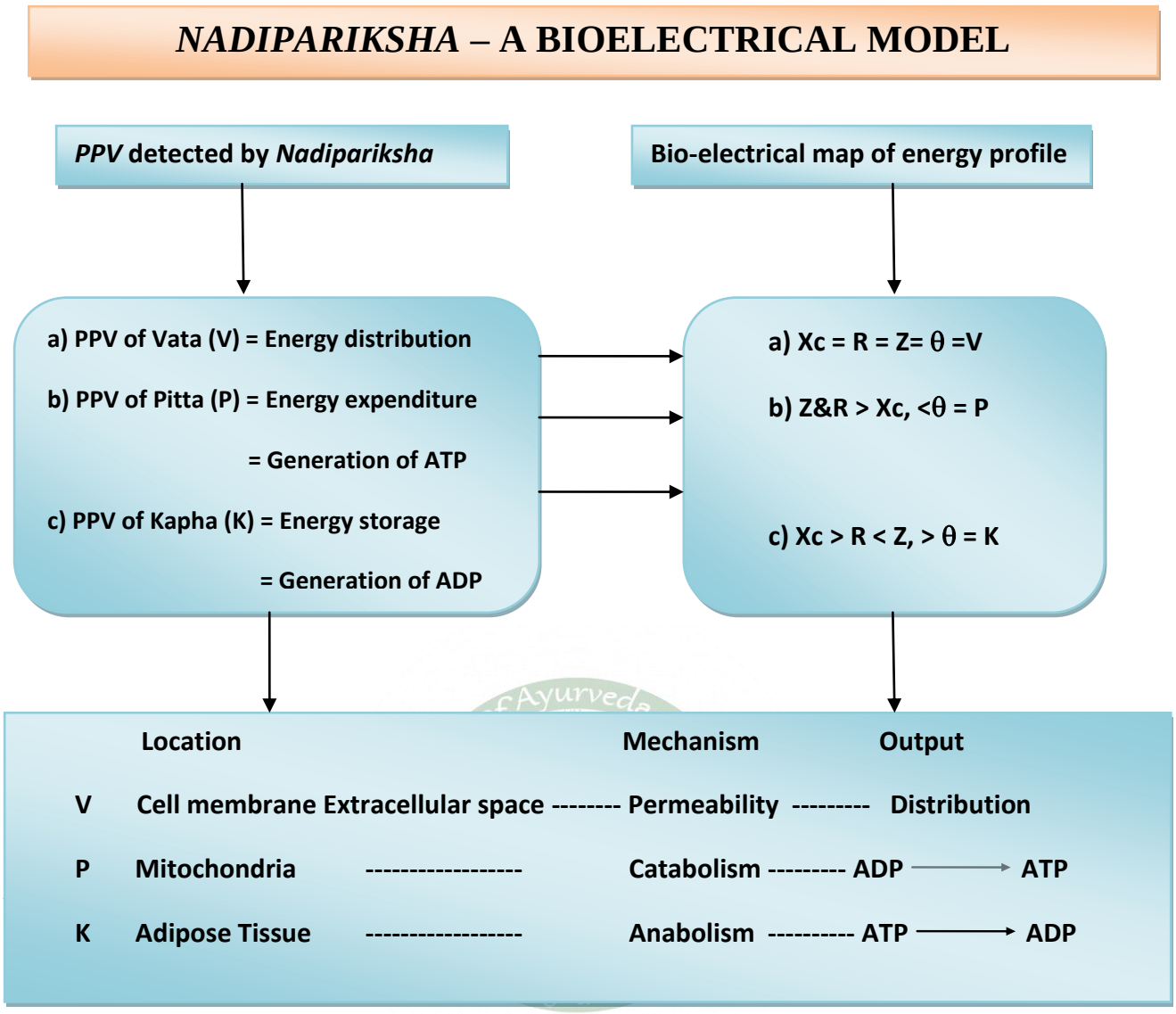
This study proposes the *Nadipariksha* technique as the measure of three distinct modes of bio-energy or *PBER* originating from cellular level. It usually reveals the presence of three *Doshas* that could exist as single predominant *Dosha* indicative of uni-modal (energy) *PBER* or mixture of two dominant *Doshas* indicative of bi-modal (energy) *PBER.* However, the tri-modal (energy) *PBER* is rarely evident. These energy modes exhibit resonance response.

The underlying bio-electrical intercellular mechanism triggers the rebound effect of the energy modes followed by interaction with typical wrist pulse beat pattern. This causes radial reflection of varied pulse beat intensities and results in collision of energy modes with typical arterial pulse beat pattern. This rebound effects often camouflage the weak energy modes and often mistaken as typical pulse beat driven by cardiac output.

Hence, this study proposes rebound of three energy modes indicated as three radial pulse-beat types as the working physiological principle of *Nadipariksha.* The combinations or inter-conversion of three different energy mode profiles tend to traverse with different velocities that could lead to single or dual dominant energy modes. The measurement of three energy modes may be possible through three vital bioelectrical components such as bio-impedance, bio-reactance and phase angle. This has been elaborately described in the proposed bio-electrical model.

Proposed Bio-Electrical Model of *Nadipariksha*

The bio-electrical model, proposed to explain the relation between cell energy profile and whole body bio-electrical activity to understand *PEP* or *Nadipariksha,* is as shown in the diagram.



ATP = Adenosine Tri Phosphate, ADP = Adenosine Di Phosphate

a) Bio-impedance = Bio-resistance = Bio-reactance = Phase angle (≅6⁰).

b) Bio-impedance and Bio-resistance greater than Bio-reactance with decreased phase angle (>5<6⁰)

c) Bio-reactance greater than Bio-resistance lesser than Bio-impedance, excess phase angle 7⁰-12⁰.

The quantification of energy modes or *PBER* in the energy pathway or *Nadi* relates to cellular or system level. Its origin is a result of complex interaction of cellular bio-electrical response with the radial artery pulsation activity. This interaction leads to rebound effect eliciting different *PBER or Pulsating Energy Profile* (*PEP*) akin to three distinct effects of *Nadipariksha. PEP* could be similar to *Doshas* explained as bio-energy variable [36,18]. The possible transmission of *PBER* or energy mode, through energy pathway or *Nadi,* is the underlying principle of *Nadipariksha* that can be referred to as *Energy Pulsating Pathway (EPP).*

The bio-electrical activity of tissues generates and conducts both endogenous Alternating Current (A.C.) and Direct Current (D.C.). The cell also opposes the external A.C. in terms of impedance and reactance by exhibiting pulsating waveform behavior. It is akin to the proposed *PEP* function of *Nadipariksha.* Hence, the measure of bio-electrical parameters such as bio-impedance (Z), bio-reactance (Xc) and response voltage phase angle (θ) evaluated by bio-electrical principle [40,41,42] can be the appropriate variable to assess pulsating energy profile in *Nadipariksha*. The quantification and measurement of bio-energy down to ionic level

on the basis of Krebs' cycle or glycolytic pathway correlates with bio-electrical activity [43].This could support the *EPP* examination or *Nadipariksha* on pulsating energy status in terms of energy input-output and energy storage function [8].

The pulsating energy or *PBER* might be proposed as the generation and expenditure of bio-electrical energy, indicated by the three components, namely Z, X_c and θ of bio-electrical activity in different combination. The Xc represents extent of energy storage capacity in terms of capacitance property of net ionic charge of cell membrane. Several studies on whole body bio-electrical impedance [44] in different body regions [45] and varying impedance ranging from 500 ohms to 13 ohms [46,47] infer variation in energy expenditure and storage, as well as, its measure through Xc and Z ratio or phase angle (θ) measures. The θ also reflects the extent of energy storage, expenditure [47,48,49,50] and energy balance [51]. Therefore, it can be proposed that bio-electrical measurement may represent varied energy profile of *Nadipariksha*.

DISCUSSION & CONCLUSION

The proposed model indicates that the logical relation among bio-impedance, bio-reactance and phase angle infers the modulation of *PEP* within *EPP,* which is the very basis of examining *Nadipariksha*. The model suggests that above mentioned bio- electrical variables could be suitable parameters to assess *Tridosha* in terms of different energy modes with specific functions such as bio-energy expenditure, distribution and storage capacity.

Nadipariksha may prove to be a valid & reliable method of examining the whole body bio-electrical activity so as to assess bio-energetics of pulsating energy profile with respect to optimal psycho-physiological functions of the body.

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