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 viewpoint, 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 [16,15], 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 [9]. 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 PPVs 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], noradrenalin [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 isostonic 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 [10]. 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 ($\approx 6^\circ$).

b) Bio-impedance and Bio-resistance greater than Bio-reactance with decreased phase angle ($>5<6^\circ$)

c) Bio-reactance greater than Bio-resistance lesser than Bio-impedance, excess phase angle $7^\circ$-$12^\circ$.

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 $^{[36,10]}$. 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 ($\theta$) 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, Xc 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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