

CONCEPT OF MEASURING PULSE RATE VARIABILITY AS A TOOL FOR DETERMINATION OF STRESS IN HEALTHY INDIVIDUALS

Arun Kumar M¹

¹Assistant Professor, Department of Physiology, M. S. Ramaiah Medical College.

ABSTRACT

BACKGROUND

Stress is the major factor which alters the physiology in the human beings. Stress can be dangerous if it is acute and severe as in life threatening situation, trauma, and several other conditions. Even the milder stress can be harmful if persists for longer duration. Such chronic mild stress if not managed regularly it can cause several morbidities. What is preventing people from managing stress is the question of debate. In most of the patients, the lack of awareness is the major culprit.⁽¹⁾ There is a growing concern about the increasing cost and prevalence of stress-related disorders; especially in relation to workplace. In General, human tendency is to avoid stress and also other conditions which might lead to long term problems or misery or ill health. The challenge is how to make people realise that they are under stress and this is problematic.

KEYWORDS

Stress, Pulse Rate Variability, Medical Device.

HOW TO CITE THIS ARTICLE: Kumar AM. Concept of measuring pulse rate variability as a tool for determination of stress in healthy individuals. Journal of Evolution of Research in Human Physiology 2016; Vol. 2, Issue 2, July-December 2016; Page:15-16.

BACKGROUND

Understanding the physiology of stress gives us light on how to cope up stress. Several biological parameters vary with stress. The physiological variations are change in blood pressure, pulse rate, respiratory rate. The biochemical changes are increase in cortisol, adrenaline and other hormones. All these bodily changes help the human to fight against the stressful situations. These changes are collectively called as general adaptation syndrome.^(2,3)

During this the physiological changes occur to produce the extra energy that is required to manage stressful events or also called stress response. It is good to start with stress response as it helps in experiencing something different and later a person starts learning better. But if there is continuous warrant of stress response the body gets fatigued and organ damage may start. Intervention at the stage wherein stress response is controlled at beginning helps us in fighting against the harmful effects of stress. Measurement of changes in the above said parameters can be used to understand the stress levels. One such measurement is pulse rate variability which measures the functions of autonomic nervous system (ANS) in the individuals. Since stress elicits the autonomic response, measurement of ANS will give us picture of the stress response in an individual.^(4,5)

Autonomic nervous system has 2 parts, sympathetic (SS) and parasympathetic components (PS). Sympathetic drives the person to struggle to acquire basic needs and parasympathetic system helps in nourishing and utilising the acquired things. The overall effect of the SS is to prepare the body for strenuous physical activity by increasing the flow of blood that is well oxygenated and rich in nutrients to the tissues that need it. The parasympathetic system predominates during quiet, resting conditions.

*Financial or Other, Competing Interest: None.
Submission 13-08-2016, Peer Review 01-12-2016,
Acceptance 08-12-2016, Published 31-12-2016.*

Corresponding Author:

*Dr. Arun Kumar M,
Assistant Professor, Department of Physiology,
M. S. Ramaiah Medical College.
E-mail: drarunkm@gmail.com*



The overall effect of the PS is to conserve and store energy and to regulate basic body functions such as digestion and urination.^(1,6,7) For example, in animals hunting for food there is a huge sympathetic stimulation whereas eating, digesting the food and taking rest following that is taken care by PS. In human beings the SS and PS has to work to reach balance for maintaining optimum conditions of livelihood. The problem starts occurring when either of SS and/or PS is overactive, and especially if the sympathetic drive increases. Prolonged SS without balanced by PNS can lead several disease conditions. This is evidenced by the fact that people who have high SS activity is prone to develop cardiovascular diseases, like hypertension.⁽⁸⁾

Autonomic responses and thus stress levels can be measured using pulse rate variability (PRV).⁽⁹⁾ If sympathetic activity is predominantly persisting in an individual then it can be easily communicated to an individual by appropriate methods. As a result of bringing such awareness, it becomes easy for motivating the individual for maintaining SS-PS balance. This can be achieved either by reducing the sympathetic activity and increasing the parasympathetic activity. This will definitely help in preventing several long term complications. This is aptly called as biofeedback of stress response. Such biofeedback mechanism has gained importance in primordial prevention of non-communicable diseases like hypertension, stroke.⁽¹⁰⁾

PRV gives several parameters, when measured. It has measurement similar to heart rate variability which is measured by using ECG. There are three groups of parameters: Time domain, frequency domain and non-linear analysis methods. Among time domain parameters, SDNN and RMSSD is mostly done to check the capacity of the heart to respond to stress. Better the values better the response. SDNN more than 50 is considered to be normal stress, and values less than 50 considered to be abnormal stress. RMSSD less than 10 normal and more than 10 abnormal or stress.^(11,12) Among frequency domain parameters say whether the person has autonomic balance. In stress, there is imbalance with sympathetic predominance. Nonlinear analysis parameter considered is SD2 and value more than 64 is seen in stressed individuals.⁽¹³⁾

To measure pulse rate variability, a novel device can be designed and assembled using standard sensors and amplifiers available in the market. As the technology has advanced, the basic components for making such devices are very cost effective and feasible. Assembling of such device and utilising them can be done with the help of hardware engineers and software engineers.

Advantage of such devices is getting the real time stress levels for an individual on time to time basis, monitoring stress in apparently normal people over a long period of time and training them to prevent distress, a tool to follow up the benefits of stress relaxation or biofeedback mechanisms. Early intervention can help an individual to prevent disease progression.

In summary, a working team which consists of bioengineers and doctors coordinating each other can translate several practical scientific concepts into medically useful products for the benefit of common people. The quality health care delivery by professionals also improves.

REFERENCES

1. Salleh MR. Life event, stress and illness. *Malays J Med Sci* 2008;15(4):9-18.
2. Selye H. Stress and the general adaptation syndrome. *Br Med J* 1950;1(4667):1383-92.
3. Ganong WF. The stress response--a dynamic overview. *Hosp Pract Off Ed* 1988;23(6):155-8, 161-2, 167.
4. Assenmacher I, Barbanel G, Gaillet S, et al. Central regulation of ACTH release in stress. *Ann N Y Acad Sci* 1995;771:41-54.
5. Stress, endocrine physiology and pathophysiology-endotext. NCBI Bookshelf. [cited 2016 Aug 12]. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK278995/>
6. Almeida-Santos MA, Barreto-Filho JA, Oliveira JL, et al. Aging, heart rate variability and patterns of autonomic regulation of the heart. *Arch Gerontol Geriatr* 2016;63:1-8.
7. McCorry LK. Physiology of the autonomic nervous system. *Am J Pharm Educ* 2007;71(4):78.
8. Zhou Y, Xie G, Wang J, et al. Cardiovascular risk factors significantly correlate with autonomic nervous system activity in children. *Can J Cardiol* 2012;28(4):477-82.
9. Chen X, Huang Y-Y, Yun F, et al. Effect of changes in sympathovagal balance on the accuracy of heart rate variability obtained from photoplethysmography. *Exp Ther Med* 2015;10(6):2311-8.
10. Dillon A, Kelly M, Robertson IH, et al. Smartphone applications utilizing biofeedback can aid stress reduction. *Front Psychol* 2016;7:832.
11. Tharion E, Parthasarathy S, Neelakantan N. Short-term heart rate variability measures in students during examinations. *Natl Med J India* 2009;22(2):63-6.
12. Matsumoto Y, Mori N, Mitajiri R, et al. Study of mental stress evaluation based on analysis of heart rate variability. *Journal of Life Support Engineering* 2010;22(3):105-11.
13. Melillo P, Bracale M, Pecchia L. Nonlinear heart rate variability features for real-life stress detection. Case study: students under stress due to university examination. *BioMedical Engineering OnLine* 2011;10:96.