Systematic Review of Hridaya in Kriya Sharir with Special Reference to Autonomic Regulation and Heart Rate Variability

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***Abstract*—The concept of Hridaya occupies a central position in Kriya Sharir and is considered essential for the maintenance of life, consciousness, circulation, and mental equilibrium. Ayurvedic classics describe Hridaya not only as a structural organ but also as the seat of Chetana, Prana, and Ojas. Contemporary physiology explains cardiac regulation through the autonomic nervous system, which maintains cardiovascular homeostasis via sympathetic and parasympathetic pathways. Heart Rate Variability (HRV) is a non-invasive marker reflecting autonomic modulation of cardiac activity and has emerged as an important tool for assessing stress, adaptability, and cardiovascular health. The present systematic review aims to analyze the classical concept of Hridaya in Kriya Sharir and explore its correlation with autonomic regulation and HRV. Relevant Ayurvedic references from Charaka Samhita, Sushruta Samhita, and Ashtanga Hridaya were reviewed along with contemporary scientific literature related to autonomic physiology and HRV. The review highlights the functional association of Prana Vayu, Vyana Vayu, and Sadhaka Pitta with neuro-cardiac regulation. It also explores the possibility of interpreting HRV as an objective physiological indicator of autonomic balance described in Aureate integrative understanding of Hridaya and HRV may provide a scientific basis for Ayurvedic concepts related to cardiovascular and psychological health. This review emphasizes the need for interdisciplinary research to establish evidence-based correlations between Ayurvedic physiology and modern biomedical parameters.**

***Index Terms*—Hridaya, Kriya Sharir, Heart Rate Variability, Prana Vayu, Autonomic Regulation, Sadhaka Pitta**

I. INTRODUCTION

Hridaya is regarded as one of the most vital organs described in Ayurvedic literature and occupies a central place in Kriya Sharir. Ayurveda considers Hridaya not merely as a structural organ responsible for circulation but also as the seat of Chetana, Prana, Ojas, Mana, and emotional activities. Classical texts such as Charaka Samhita, Sushruta Samhita, and Ashtanga Hridaya have elaborately explained the anatomical, physiological, and psychological significance of Hridaya. It is considered the Moola Sthana of Pranavaha Srotasa and Rasavaha Srotasa, emphasizing its importance in maintaining vitality and systemic coordination. The continuous functioning of Hridaya is essential for sustaining life and maintaining equilibrium within the body. [1]According to Ayurvedic physiology, the proper functioning of Hridaya is governed by various physiological entities including Prana Vayu, Vyana Vayu, and Sadhaka Pitta. Prana Vayu is responsible for higher neurological and vital functions, whereas Vyana Vayu regulates circulation and rhythmic cardiac activity throughout the body. Sadhaka Pitta is associated with intellect, emotional stability, enthusiasm, and mental coordination. Together, these components maintain the integrity of cardiovascular and neuropsychological functions. Thus, the Ayurvedic understanding of Hridaya extends beyond mechanical circulation and includes dynamic regulation of both body and mind.[2]Modern physiology explains cardiac regulation through the autonomic nervous system (ANS), which consists of sympathetic and parasympathetic divisions. These two components work in coordination to regulate heart rate, blood pressure, cardiac output, and vascular tone according

to physiological demands. Sympathetic stimulation increases heart rate and myocardial contractility, whereas parasympathetic activity predominantly reduces heart rate and promotes cardiac relaxation. Balanced autonomic regulation is therefore essential for cardiovascular adaptability and homeostasis. Dysregulation of autonomic function is associated with stress, anxiety, hypertension, arrhythmias, and various cardiovascular disorders. [3]Heart Rate Variability (HRV) is a non-invasive physiological marker that reflects the variation in time intervals between consecutive heartbeats and represents autonomic modulation of cardiac activity. HRV has gained considerable importance in modern clinical and research settings for evaluating autonomic balance, stress response, emotional regulation, and cardiovascular fitness. Reduced HRV is often associated with impaired autonomic adaptability and increased risk of cardiovascular morbidity. Recent interdisciplinary research has shown increasing interest in correlating HRV with traditional medical systems, particularly Ayurveda, to establish objective physiological parameters for assessing systemic balance and health status.[4]The Ayurvedic concept of Hridaya shares several functional similarities with modern concepts of neuro-cardiac regulation and autonomic modulation. Functions attributed to Prana Vayu, Vyana Vayu, and Sadhaka Pitta appear closely related to neural control of cardiovascular and emotional activities. Despite this conceptual similarity, systematic scientific reviews integrating Ayurvedic descriptions of Hridaya with HRV and autonomic regulation remain limited. Therefore, there is a need for comprehensive exploration of classical Ayurvedic concepts in the light of contemporary physiological understanding. The present systematic review is undertaken to analyze the concept of Hridaya in Kriya Sharir and evaluate its possible correlation with autonomic regulation and Heart Rate Variability. Such integrative understanding may help establish scientific interpretations of Ayurvedic physiology and promote interdisciplinary research in the field of cardiovascular health and neurophysiology. [6]

II. AIM

To systematically review the concept of Hridaya in Kriya Sharir with special reference to autonomic regulation and Heart Rate Variability.

Objectives

1. To study the concept of Hridaya described in Ayurvedic classics.
2. To analyze the physiological role of Hridaya in Kriya Sharir.
3. To review the role of Prana Vayu, Vyana Vayu, and Sadhaka Pitta in cardiac regulation.
4. To study the modern concept of autonomic nervous system regulation of the heart.
5. To review the physiological basis and clinical significance of Heart Rate Variability.
6. To establish a conceptual correlation between Ayurvedic principles and Heart Rate Variability.

III. REVIEW OF LITERATURE

Concept of Hridaya in Ayurveda

The term Hridaya is derived from the Sanskrit roots “Hri,” “Da,” and “Ya,” which collectively denote the functions of receiving, giving, and continuous movement. Ayurveda describes Hridaya as one of the most essential organs responsible for sustaining life and coordinating various physiological activities. Classical Ayurvedic texts consider Hridaya as the seat of Chetana, Ojas, Mana, and Prana. In addition to its circulatory role, Hridaya is believed to regulate emotional, psychological, and cognitive functions. The dynamic nature of Hridaya indicates its role in maintaining systemic harmony and physiological balance throughout the body. The significance of Hridaya is therefore multidimensional, involving structural, functional, and psychosomatic aspects of health. [7]

Ayurvedic classics describe Hridaya as the Moola Sthana of Pranavaha Srotasa and Rasavaha Srotasa, emphasizing its role in respiration, circulation, and nourishment. Charaka Samhita explains that injury or dysfunction of Hridaya may severely affect consciousness and vitality. The circulation of Rasa and Rakta throughout the body is regulated by Vyana Vayu, which is functionally associated with Hridaya. The coordinated functioning of Prana Vayu and Vyana Vayu maintains rhythmic physiological activities essential for survival. This concept demonstrates the sophisticated understanding of cardiovascular regulation present in Ayurvedic physiology. The interrelationship of these physiological principles reflects the holistic approach of Ayurveda toward maintenance of health and prevention of disease. [8]

Hridaya According to Charaka Samhita

In Charaka Samhita, Hridaya is considered one of the vital organs and the principal seat of Chetana. It is described as the location where Mana, Buddhi, sensory perception, and emotional responses are coordinated. Charaka also emphasizes the importance of Hridaya in maintaining the integrity of Ojas, which is regarded as the essence responsible for immunity, vitality, and strength. Disturbance in Hridaya is believed to produce severe systemic and psychological manifestations. The text further explains that proper circulation and physiological coordination depend upon the healthy functioning of Hridaya. Such descriptions indicate that Ayurveda viewed the heart as both a physiological and neuropsychological regulatory center. [9]

Hridaya According to Sushruta Samhita

Sushruta Samhita provides detailed descriptions regarding the anatomical and physiological importance of Hridaya. Sushruta considered Hridaya as one among the vital organs whose injury may lead to immediate fatality. The text also highlights its role in the transportation of nutrients and maintenance of life processes. According to Sushruta, the channels connected with Hridaya distribute nourishment throughout the body, thereby supporting tissue integrity and vitality. The close relationship between Hridaya, circulation, and consciousness reflects the advanced physiological understanding present in classical Ayurvedic literature. These descriptions show notable conceptual similarities with modern cardiovascular physiology. [10]

Role of Prana Vayu, Vyana Vayu, and Sadhaka Pitta

Among the five subdivisions of Vata Dosha, Prana Vayu and Vyana Vayu have major functional association with Hridaya. Prana Vayu governs higher neurological activities, respiration, sensory integration, and maintenance of consciousness, whereas Vyana Vayu regulates circulation and rhythmic cardiac activity. Sadhaka Pitta, situated in Hridaya, is associated with intellect, memory, courage, emotional balance, and psychological coordination. These entities collectively maintain physiological adaptability and psychosomatic equilibrium. The functional attributes of these Ayurvedic principles demonstrate similarities with autonomic regulation and neuro-cardiac integration described in modern physiology. Therefore, Ayurvedic physiology presents a multidimensional interpretation of cardiac regulation that extends beyond mere mechanical circulation. [11]

IV. MODERN CONCEPT OF AUTONOMIC REGULATION

The autonomic nervous system (ANS) is an important regulatory component of the peripheral nervous system that maintains involuntary physiological activities of the body, including cardiovascular, respiratory, gastrointestinal, and glandular functions. The ANS primarily consists of sympathetic and parasympathetic divisions that work in coordinated opposition to maintain homeostasis. Cardiac activity is continuously modulated through neural impulses originating from autonomic centers located in the brainstem and hypothalamus. The sympathetic nervous system increases heart rate, myocardial contractility, and conduction velocity during physical activity or stress, whereas parasympathetic stimulation predominantly decreases heart rate and promotes relaxation. Balanced autonomic regulation is therefore essential for maintaining cardiovascular adaptability and physiological equilibrium. [12]

The sympathetic nervous system exerts its effects on the heart mainly through norepinephrine released from postganglionic fibers, resulting in increased cardiac output and enhanced tissue perfusion. Conversely, parasympathetic regulation is mediated through the vagus nerve, which slows sinoatrial node activity and conserves energy during resting conditions. The interaction between these two systems determines moment-to-moment variations in cardiac rhythm and vascular tone. Disturbance in autonomic balance may contribute to hypertension, arrhythmias, anxiety disorders, metabolic syndrome, and cardiovascular diseases. Modern research has increasingly emphasized the role of autonomic dysfunction in stress-related disorders and psychosomatic illnesses. [13]

Neuro-cardiac regulation involves continuous communication between the central nervous system and the cardiovascular system through neural, hormonal, and biochemical pathways. Emotional states, psychological stress, sleep patterns, and environmental stimuli significantly influence autonomic activity and cardiac performance. Chronic stress may lead to excessive sympathetic activation and reduced parasympathetic activity, thereby

impairing cardiovascular adaptability. Such alterations are associated with increased morbidity and reduced quality of life. Contemporary physiological studies therefore consider autonomic balance an important determinant of overall physical and psychological health. [14]

V. HEART RATE VARIABILITY

Heart Rate Variability (HRV) refers to the physiological variation in time intervals between successive heartbeats and is considered a reliable indicator of autonomic nervous system activity. HRV reflects the dynamic interaction between sympathetic and parasympathetic influences on the sinoatrial node of the heart. Greater variability generally indicates healthy autonomic adaptability and efficient physiological regulation, whereas reduced HRV is associated with stress, fatigue, cardiovascular disease, and impaired autonomic responsiveness. HRV analysis has become an important non-invasive method for assessing cardiac autonomic function in both clinical and research settings. [15]HRV can be assessed using time-domain, frequency-domain, and non-linear analytical methods. Time-domain parameters include SDNN, RMSSD, and pNN50, which evaluate beat-to-beat variability over time. Frequency-domain analysis measures high-frequency (HF), low-frequency (LF), and LF/HF ratio components that reflect parasympathetic and sympathetic modulation. Non-linear methods analyze the complexity and adaptability of cardiac rhythm patterns. These parameters provide valuable information regarding autonomic balance, emotional regulation, and cardiovascular adaptability under various physiological and pathological conditions. [16]Recent scientific studies have shown that HRV is strongly associated with stress physiology, emotional health, physical fitness, and neuro-cardiac regulation. Reduced HRV is commonly observed in individuals with chronic stress, anxiety, depression, hypertension, diabetes mellitus, and ischemic heart disease. Conversely, practices such as meditation, yoga, controlled breathing, and relaxation therapies are reported to improve parasympathetic activity and HRV indices. These findings have generated significant interest in integrating HRV assessment with traditional healthcare systems, including Ayurveda, for evaluating systemic balance and holistic health status. [17]

VI. CORRELATION OF AYURVEDIC CONCEPTS WITH HEART RATE VARIABILITY

The Ayurvedic concept of Prana Vayu demonstrates significant functional similarity with parasympathetic regulation described in modern physiology. Prana Vayu is primarily responsible for respiration, maintenance of consciousness, sensory perception, and regulation of higher neurological activities. Its normal functioning supports calmness, mental stability, and physiological coordination. In modern science, parasympathetic activity mediated mainly through the vagus nerve maintains resting cardiac activity and promotes relaxation responses. Increased vagal tone is generally associated with improved Heart Rate Variability and better adaptability to stress. Therefore, the functions attributed to Prana Vayu may be correlated with parasympathetic modulation and neuro-cardiac regulation. [18]Vyana Vayu plays a crucial role in circulation, rhythmic movement, and distribution of nutrients throughout the body. Ayurvedic texts describe its function in maintaining the continuous movement of Rasa and Rakta through coordinated cardiac activity. Modern physiology explains cardiac rhythm regulation through autonomic influences acting upon the sinoatrial node and conduction pathways of the heart. Variations in heart rhythm generated by sympathetic and parasympathetic interaction are reflected through HRV parameters. The circulatory and rhythmic functions of Vyana Vayu therefore show conceptual similarity with autonomic cardiac modulation and cardiovascular adaptability. This correlation supports the possibility of interpreting certain Ayurvedic physiological principles through measurable cardiovascular parameters. [19]Sadhaka Pitta is considered responsible for emotional stability, intelligence, memory, enthusiasm, courage, and psychological coordination. It is situated in Hridaya and is believed to influence both mental and physiological activities. Contemporary neurophysiology recognizes a strong interaction between emotional processing centers of the brain and autonomic regulation of the cardiovascular system. Emotional stress, anxiety, depression, and psychological disturbances are often associated with reduced HRV and impaired autonomic adaptability.

The psychosomatic functions attributed to Sadhaka Pitta therefore appear closely associated with emotional-autonomic regulation described in modern medicine. This indicates that Ayurvedic concepts may possess substantial relevance in understanding neuropsychological and cardiovascular integration. [20]Heart Rate Variability may serve as an objective physiological marker for evaluating autonomic balance and psychosomatic adaptability described in Ayurveda. Higher HRV reflects efficient autonomic flexibility, emotional stability, and better cardiovascular regulation, whereas reduced HRV is associated with stress, autonomic dysfunction, and impaired health status. From an Ayurvedic perspective, balanced functioning of Prana Vayu, Vyana Vayu, and Sadhaka Pitta may contribute to optimal physiological adaptability and systemic harmony. Conversely, disturbances in these regulatory entities may lead to psychosomatic imbalance and cardiovascular dysfunction. Thus, HRV analysis may provide a scientific approach for assessing certain functional principles described in Ayurvedic physiology. [21]

The integrative interpretation of Ayurveda and modern physiology opens new possibilities for interdisciplinary research in Kriya Sharir. Correlating classical concepts of Hridaya with autonomic regulation and HRV may help establish measurable scientific parameters for evaluating holistic health. Such approaches can strengthen evidence-based understanding of Ayurveda and facilitate integration of traditional concepts with contemporary biomedical science. Future experimental and clinical studies are required to further validate these conceptual correlations and their practical applications in preventive and therapeutic healthcare. [22]

VII. DISCUSSION

The present review highlights the multidimensional concept of Hridaya described in Ayurveda and its possible correlation with autonomic regulation and Heart Rate Variability. In Ayurvedic literature, Hridaya is considered not only a circulatory organ but also a center of consciousness, emotional stability, and physiological coordination. The functions of Prana Vayu, Vyana Vayu, and Sadhaka Pitta collectively maintain cardiovascular and psychological balance, which appears comparable to neuro-cardiac regulation described in modern physiology. Modern science recognizes the autonomic nervous system as the major regulator of cardiac activity and physiological adaptability. Heart Rate Variability has emerged as an important non-invasive marker for assessing autonomic balance and stress response. Increased HRV reflects better cardiovascular adaptability and parasympathetic dominance, whereas reduced HRV is associated with stress, anxiety, and cardiovascular dysfunction. The functions attributed to Prana Vayu show similarity with parasympathetic regulation due to its role in respiration and maintenance of vital activities. Vyana Vayu may be correlated with cardiac rhythmicity and circulation, while Sadhaka Pitta appears related to emotional and psychological regulation. Thus, the Ayurvedic concept of Hridaya may be interpreted as a functional neuro-cardiac center integrating both physiological and psychosomatic aspects of health. The review also suggests that HRV may serve as an objective parameter for evaluating autonomic balance in Ayurveda. Yogic practices, meditation, and breathing exercises described in Ayurveda are known to improve autonomic function and HRV indices. However, scientific studies directly correlating Ayurvedic physiological principles with HRV are still limited. Further interdisciplinary research is required to establish stronger evidence-based correlations between Ayurveda and modern biomedical science.

VIII. CONCLUSION

The present review demonstrates that the concept of Hridaya in Kriya Sharir extends beyond a mere anatomical organ and represents an important center of circulatory, psychological, and autonomic regulation. Ayurvedic principles involving Prana Vayu, Vyana Vayu, and Sadhaka Pitta show notable conceptual similarities with modern neuro-cardiac and autonomic mechanisms governing cardiovascular function and emotional balance. Heart Rate Variability serves as an important non-invasive indicator of autonomic adaptability and may provide an objective scientific parameter for understanding physiological balance described in Ayurveda. The integrative interpretation of Ayurvedic concepts with modern cardiovascular physiology supports the relevance of Ayurveda in contemporary healthcare and psychosomatic medicine.

The review also highlights the need for further interdisciplinary and evidence-based research to establish stronger correlations between Ayurvedic physiology and measurable biomedical parameters. Such studies may contribute to the development of integrative approaches for preventive cardiology, stress management, and holistic healthcare.

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