

## EFFICACY OF AMALAKI RASAYANA AS A PREVENTIVE AND CURATIVE ROLE IN AGE RELATED CARDIOVASCULAR DISEASES

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Received on: 14/07/2019

Revised on: 04/08/2019

Accepted on: 25/08/2019

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### ABSTRACT

Aging is a well-recognized risk factor in the development of cardiovascular disease, which is the primary cause of death and disability in the elderly population. With 50% of all heart failure diagnoses and 90% of all heart failure deaths occurring in the segment of the population over age 70, heart failure is largely a disease of the elderly. The age-related changes likely act as both a catalyst and accelerator in the development of cardiovascular disease. Since the aging population is one of the fastest growing segments of the population, it is of vital importance that we have a thorough understanding of the physiological changes that occur with aging that contribute to the high incidence of cardiovascular disease in this population. This insight will allow for the development of more targeted therapies that can prevent and treat these conditions. Hridroga is the broad spectrum which deals with all the abnormalities of Hrudaya covering all the cardiovascular diseases under this umbrella. Hence To prevent age related CVD Rasayana plays important role. The rasayana therapy enhance the qualities of Rasaadi dhatus, enriches it with nutrients so one can attain longevity, freedom from disorder. Amalaki rasayana having amla pradhana pancha rasa and having hrudya and vayasthapana properties helps in prevention and cure of age-related cardiac diseases. Hence this article aims in understanding the age-related changes in the cardiovascular system and role of Amalaki rasayana in preventive and cure of age-related Cardiovascular diseases.

**KEYWORDS:** Cardiovascular diseases, Rasayana, Amalaki Rasayana, Hrudya, Vayasthapana.

### INTRODUCTION

CVDs are the number one cause of death globally. An estimated 17.9 million people died from CVDs in 2016, representing 31% of all global deaths.<sup>[1]</sup> Currently, there is an increase in annual cases of CVDs such as heart fibrosis, hypertrophy, atherosclerosis, ischemic injury, hypertension, myocardial infarction, and stroke which, put together, account for approximately 39.6% of age-related diseases. Aging is characterized by functional decline in homeostatic regulation and vital cellular events, thereby promoting an increase in tissue damage, rate of morbidity, and mortality. Aging involves changes in the complex regulatory interplay among cells, organs, and systems. Cardiac and smooth muscle cells participate in involuntary control of heart and vascular functions. The integrity, excitability, conductivity, contractility, and elasticity of these cells are important to cardiovascular control. Progressive loss of physiological function of cardiomyocytes and vascular smooth muscle cells have been associated with cellular aging. Cardiovascular aging most likely affects pathophysiological pathways implicated in the development of cardiovascular disease.<sup>[2]</sup> Hence insight should be gained about the processes involved in cardiac aging for prevention and

management of age-related cardiac diseases. In Ayurveda perspective Hridaya is seat of Rasavaha Strotas.<sup>[3]</sup> & it is also one of the trimarma.<sup>[4]</sup> and Dashpranayatan.<sup>[5]</sup> All the diseases pertaining to heart considered under the broad classification of Hridroga. Hridroga is among those diseases mentioned in Ayurveda where in the description is quite brief. As vata is predominant dosha during vriddhavastha.<sup>[6]</sup> age related CVD can be considered as vata pradhana tridoshaja hridroga. Rasayana<sup>7</sup> is one of the branches of Ayurveda which deals with the rejuvenation, regeneration, immunomodulation and healthy ageing. It prevents ill health, block geriatric symptoms hence rasayana will be useful in age related diseases. Amalaki Rasayana,<sup>[8]</sup> having vayasthapana and hrudya properties thus helps in both prevention and curation of CVD.

### Physiology of cardiovascular system

The cardiovascular system is the body's main transport system. The cardiovascular system consists of the heart, blood vessels. It is an organ system that permits blood to circulate and transport nutrients (such as amino acids and electrolytes), oxygen, carbon dioxide, hormones, and blood cells to and from the cells in the body to provide nourishment and help in fighting diseases, stabilize

temperature and pH, and maintain homeostasis.<sup>[9]</sup> An efficient cardiovascular system is essential for health and longevity, but its efficiency reduces with age, which has a negative impact on all other organ systems.

### Impact of Aging on the Heart and Vasculature

By delivering oxygenated blood to all tissues in the body, the health of the cardiovascular system is vital for health of every tissue and longevity of the organism as a whole. Aging has a remarkable effect on the heart and arterial system, leading to an increase in CVD including atherosclerosis, hypertension, myocardial infarction, and stroke.<sup>[10]</sup> The four different levels of human cardiac aging are: functional, structural, cellular and molecular.<sup>[11]</sup>

### Functional changes of the aging heart

#### Diastolic function

Diastole involves two phases-early passive filling and active filling in late diastole phase. With aging the rate of filling declines during diastole because of abnormal diastolic function, development of heart failure is hastened.

#### Systolic function

With advancing age systolic function of heart worsens. The left ventricular ejection fraction is preserved during aging but worsening systolic function is responsible for reduction in cardiac reserve during exercise. This leads to gradual heart failure.

#### Electrical function

Aging also disturbs cardiac conduction system because of reduction in number of pacemaker cells in sinoatrial node. Elderly persons suffer from sinus dysfunction. Sinus dysfunction manifests as palpitation, dizziness, syncope with persistent fatigue and confusion.

### Structural changes of the aging heart

**Ventricular structure:** Left ventricular wall thickness increases with advancing age. The increased thickness of ventricles may contribute to development of fibrosis, irregular rhythms, progressive heart muscle deterioration and end stage heart failure.

**Atrial structure:** In elderly persons atrial contraction plays a major role in left ventricular filling during diastole than in young age. As there is atrial hypertrophy and dilation it results in irregular heart rhythms.

### Cellular changes of the aging heart

**Fibrosis:** With age the cellular level remodelling of heart results in loss of cardiomyocytes and SA node pacemaker cells. Overall aging associated cellular changes lead to fibrosis of heart muscle.

**Amyloid deposition:** In elderly amyloid deposition occurs in myocardium. Amyloid is abnormal fibrous extracellular proteinaceous deposits. Amyloid deposition

affects heart contractility and conduction which enhances chances of atrial fibrillation.

### Molecular changes of the aging heart

**Mitochondrial function:** Cardiac function requires an enormous amount of energy which is provided by heart mitochondria by ATP production. Disturbed mitochondrial function is not able to provide energy required for the heart function. Excessive free radicals, mitochondrial dysfunction cause heart failure.

**Calcium signalling:** Calcium is critical regulator of heart muscle function. Disturbed calcium signalling is responsible for atrial fibrillation.

**Neurohormonal signalling:** Neurohormonal signaling is chronically activated in the elderly person. Hyperactivated neurohormonal signalling causes cardiac hypertrophy, fibrosis and diastolic dysfunction.

### Ayurvedic view

According to Ayurveda "HRIDAYA" is one among trimarma and pranayatana. It is also moolsthana of Rasa and Rakta vaha srotas. The heart muscle myocardium can be correlated with mamsa dhatu and the rhythmic contractions of hridaya are due to vayu.

"HRU"- means Harati (to receive from).

"DA"- means Dadati (to give).

"YA"- means Yaati (to control).<sup>[12]</sup>

All these functions are due to Vayu, Specially Prana and Vyana vayu.<sup>[13]</sup> Also, hridaya is sthana of sadhak pitta,<sup>[14]</sup> avalambak kapha.<sup>[15]</sup> and oja.<sup>[16]</sup> Charaka describes that "Vyana Vayu" a component of Vayu, continuously ejects the blood out of the heart and distributes it all over the body.<sup>[17]</sup> Vagbhata, further clearly stated that the "Prana Vayu,<sup>[18]</sup>" located in the head, controls the activities of the heart. In this context, Vyana Vayu and Prana Vayu denote the nervous control of circulation because Vayu, in general, represents all neural mechanisms. Sushruta explains that, after the complete digestion of food, the absorbed material known as Rasa reaches the heart and, thereafter, is distributed to all other parts of the body with the initiating act of Vyana Vayu.<sup>[19]</sup> Bhela was the first individual who described the process of circulation for the first time. He said that "The blood [Rasa] is first ejected out of the heart, it is then distributed to all parts of the body, and thereafter, it returns back to the heart through the blood vessels known as 'Sirah'.<sup>[20]</sup> Any derangement in these (either structure or function) causes hridroga. Aging is one such factor which affects both. It is considered as Swabhavabalapravrittha vyadhi – disease due to natural aging.<sup>[21]</sup> Impairment of the cardiac function in old age is mainly brought about by derangement of vata as vata is dominant dosha during vriddhavastha, especially the vyana vayu as it is responsible for circulation. As heart is the root of rasavaha srotas and is the organ responsible for rasa-samvahan (circulation), vitiation of rasa-vaha srotas and rasa dhatu by morbid doshas leads to heart

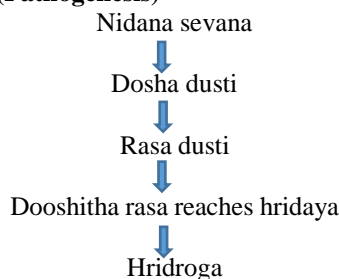
disease. There are tendencies of gradual diminution of all *dhatu*s during ageing because in old age *vata* predominates and its fundamental properties precipitate the *śosana* and *kshaya* of different *dhatu*s which are responsible for the most of the manifestations of ageing. Similar changes are noticed in heart. Hence it can be considered as *vata* *pradhana* *tridoshaja* *hridroga* based on Lakshanas.

The detailed description of *Hridroga* is available in *Bruhatrayees*.<sup>[22]</sup>

#### Nidana

- 1) Aaharaja -Usna, Guru, Kashaya, Tikta sevana, Adhyashana
- 2) Viharaja- Shrama, Vegadharana, Abhigata, Ativirechana
- 3) Manasika -Cinta, Bhaya, Trasa, Mada

#### Samprapti (Pathogenesis)



#### Bheda – Lakshna (Classification and Symptomatology)

Five type of *Hridroga*s viz. *Vataja*, *Pittaja*, *Kaphaja*, *Sannipataka* and *Krimija*

#### Samanya lakshana

Vaivarnya (Discoloration of skin), Murcha (fainting), Jwara (fever), Kasa (cough), Hikka (hiccup), Swasa (dyspnea), aasya vairasya (bad taste in mouth) Trisha (morbid thirst), pramoha (unconsciousness) Chardhi (vomiting), Kaphotklesha (nausea), Ruja (pain), aruchi (Anorexia), vividhasthaanye (such other ailments)

#### Vataja hridroga lakshana

Uttamaruja (excruciating pain) Vepathu (trembling), vestana (cramps), sthamba (stiffness), severe pain after digestion of food, hritshoonyabhava (feeling of emptiness in the heart region), drava (tachycardia), shosha (atrophy of cardiac muscles), bhedha (pricking pain), samoha (unconsciousness)

#### Pittaja hridroga lakshana

Hruddaha (burning sensation), tikthata vaktre (bitter taste in mouth), tikthamlodgirana (bitter and sour eructations), klama (exhaustion), trushna (thirst), moorcha (unconsciousness) bhrama (giddiness), sweda (perspiration), santrasa (feeling of distress), jwara (fever) peethabhava (yellowish discoloration)

#### Kaphaja hridroga lakshna

Supta/sthabdha (bradycardia), sthimita (stiffness), bharika (heaviness), tandra (drowsiness), praseka (excess salivation), jwara (fever) kasa (cough) aruchi (anorexia), ashmavruttham yathaa (pt feels as if stone kept over heart)

**Sannipataja hridroga:** Sarvalingam-all the signs and symptoms described above are manifested together

**Krimija hridroga:** Teervarthi (acute pain), toda (pricking pain), kandu (itching)

#### Role of Amalaki Rasayana in Hridroga

Amalaki has amla *pradhana* pancha rasa, sheetha virya and madhura vipaka. It is also having vayasthapana, tridoshahara and rasayana properties.<sup>[23]</sup> The major chemical constituents in amla are vitamin C, tannins, alkaloids, phenolic compounds and flavonoids. *Amalaki* is also having antioxidant properties by virtue of its antioxidants present in it which include Vitamin C, bioflavonoids, flavones, polyphenols, and carotenoids. *Amalaki Rasayana* enhance the telomerase activity in aged individuals hence promote quality of health.<sup>[24]</sup> *Amalaki* have shown a beneficial role in heart diseases, diabetes, liver and various other disorders. It is also used for lowering blood cholesterol levels.<sup>[25]</sup> *Amalaki Rasayana* increases the expression of antioxidant defense and  $\beta_{1/2}$  – adrenergic receptor genes in the heart, mitochondrial Oxidative Phosphorylation, fatty acid oxidation and autophagy which contribute to improvement in cardiac function. Metabolites such as gallic acid, ellagic acid, vitamin A, 1 $\alpha$  24R,25-trihydroxyvitamin D<sub>3</sub>, 13'-carboxy- $\alpha$ -tocotrienol (Vitamin E), sulfate derivative of norepinephrine and putative arachidonic acid derived anti-inflammatory metabolites in *Amalaki Rasayana* help in the regulation of myocardial bioenergetics, contractile, myocardial inefficiency and dysfunctional excitation-contraction coupling and hemodynamic function and thereby contribute to improvement in cardiac function. Gallic acid, ellagic acid and vitamin E are known to increase the antioxidants status in the body lead to increase in the antioxidant enzymes SOD1 or 2 as well as Gpx and decrease in NF- $\kappa$ B expression contributed to decrease in degrees of hypertrophy and fibrosis or increase in anti-hypertrophy markers (SERCA2, TroponinT, Myh11). Arachidonic acid metabolite (5(S) 6(S) -epoxy-15(S)-hydroxy-7E, 9E, 11Z, 13E-eicosatetraenoic acid), play important roles in optimal metabolism and in reducing heart disease risk. The synergistic effects of these components help in cardioprotection. *Amalaki Rasayana* rich in Oxidative Phosphorylation, fatty acid oxidation, mitochondrion regulatory proteins up regulate expression of OXPHOS complexes such as Succinate dehydrogenase, COXIV, and ATP5a1 in cardiac tissues contribute to mitochondrial function of heart. AR reduces the Expression of nuclear factor kappa-light-chain-enhancer of activated B cells which improves the antioxidant defense in aged heart. The

increased expression of autophagy markers LC3 and beclin-1 as well as decrease in the expression of p62 (marker for autophagy induction) in heart suggests the effect of Amalaki Rasayana on a healthy cellular or tissue aging process. Amalaki Rasayana improve the muscle contractility in the aged heart due to increased expression of SERCA2 (sarco/endoplasmic reticulum  $Ca^{2+}$ -ATPase), Calm3, Troponin T, Myh11 and decreased expression of PLN genes in the hearts. The effects of Amalaki Rasayana seem to have similarities to the drugs such as digitalis and nor-adrenaline and adjunctive agents such as L-carnitine and Coenzyme Q.<sup>[26]</sup> Administration of tannoid principle of *Emlica officinalis* prevents ischemia-reperfusion-induced oxidative stress in heart.<sup>[27]</sup>

Numerous preclinical studies with laboratory animals have shown that amla does possess cardioprotective and anticoagulant effects and is useful in delaying/preventing/reducing experimentally induced cardiotoxicity, atherosclerosis, myocardial infarction, hypertension and reducing ischemic-reperfusion injury. The pleiotropic effect of amla is believed to be due to the presence of various phytochemicals and studies have shown that the tannoids (emblicanin-A and -B), gallic acid, ellagic acid and corilagin also possess cardioprotective properties. Additionally, clinical studies have also shown that the regular intake of amla was effective in reducing the cholesterol levels and the effect to be similar to that of the conventionally used HMG CoA reductase inhibitor, simvastatin. Recent studies have also shown that amla improves endothelial function and reduced biomarkers of oxidative stress and systemic inflammation.<sup>[28]</sup>

## DISCUSSION

Aging is a natural phenomenon which affects various systems in the body, one among which is cardiovascular. Now a days early ageing is seen due to unhealthy lifestyle. Due to complexity of symptoms and vata dosha being predominant during vriddhavastha it can be considered as vata pradhana tridoshaja Hridroga. General symptomatology of Hridrogas has been mentioned only by Charakacharya. Five type of Hridrogas viz. Vataja, Pittaja, Kaphaja, Sannipataka and Krimija have been described by charaka and vagbhata. Susrutacharya has not explained Tridoshaja variety. Chikitsa of hridroga has been explained in all bruhatrayees. Vriddhavastha is a state of diminution of all dhatus and rasa being aadhya dhatu and important dooshya in hridroga, rasayana plays a important role in both prevention and curatation of age related ailments. In old age there is functional, structural cellular and molecular changes in heart therefore rasayana chikitsa plays a very crucial role in the preservation and promotion of heart health. *Amalaki Rasayana* being best *Vayasthapana rasayana* promote longevity, and it prevent ill health, block geriatric symptoms which suggests life supporting activities of *Amalaki Rasayana*. As it is having amla pradhana pancha rasa, sheetha virya and madhura vipaka it attributes to *tridoshahara, Rochana, Dipana,*

and *Anulomana* properties of *Amalaki*. Again because of having properties such as *Hridya, Tridoshahara,* and *Madhura Vipaka, Amalaki Rasayana* does nourishment of *Rasa Dhatu* which further nourishes all the *Dhatus*. Being amla rasa pradhana it has *hrudya property* hence considered as best cardio tonic. The vitamin C, tannins, alkaloids, phenolic compounds and flavonoids present in *amla* possess immunomodulatory, antioxidant and anticancer activities. All these properties of *Amalaki rasayana* help in prevention and curing of cardiovascular diseases.

## CONCLUSION

Old age is the most common cause which increases the risk of Left ventricular Hypertrophy, coronary heart disease, congestive heart failure, stroke, and sudden death. Understanding the mechanism of hypertrophy in aging and pressure-overload hearts will assist the development of strategies to prevent or ameliorate cardiac hypertrophy and failure, or even to delay cardiac aging changes. This can be understood under the purview of umbrella term hridroga. Although various clinical trials to attenuate the progression of CVDs have been tried in modern medicine the results were disappointing. Here rasayana plays an important role. Thus, *Amalaki rasayana* having *Tridoshahara, Vayasthapana, Hrudya* properties helps in prevention and curing of cardiovascular disorders.

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