

CARDIOVASCULAR HEALTH AND RASADHATU

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ABSTRACT

Cardiovascular diseases and other chronic diseases present a great burden for society as they are the most common cause of death in the world. The role of diet and nutrition as determinants of chronic non communicable diseases is well established. Chronic diseases are largely preventable through a healthy lifestyle involving a balanced diet and regular physical activity. *Ayurveda*, being the science of life, recommends a holistic approach in the prevention of such conditions. The paper makes a review on the role of *Rasadhatu* and the *Ayurvedic* prevention strategy in such nutrition related chronic diseases.

Key words - Cardiovascular diseases, *Ayurveda*, *Rasadhatu*

INTRODUCTION

Cardiovascular disease (CVD) is a broad term for a range of diseases affecting the heart and blood vessels, often as a consequence of atherosclerosis and/or high blood pressure, leading to life-threatening events¹. In the coronary arteries this leads to coronary artery disease, in the carotid arteries it leads to stroke, in the femoral arteries peripheral artery disease and in the renal arteries kidney failure. It is estimated that 90% of CVD is preventable. Among the modifiable or preventable risk factors, smoking, diet and physical activity are crucial in the development and prevention of CVD. These risk factors are common to many of the chronic non communicable diseases now named as life style disorders.

Many studies have proven the fact that diet low in carbohydrate, fat and calories and regular physical activity reduces the risk for such conditions. Thus, from the *Dwividhopakrama* perspective of *Chikitsa*,

the common line of management for these conditions is *Apatarpana*. In short, we can say that the life style disorders are *Santarpnotha vyadhis*. *Atipurana* or excess energy intake along with *avyayama* or sedentary life style leads to deranged metabolism of the macronutrients; mainly carbohydrate and fat. Nutritional researches are now targeting towards the dietary impacts in the primary as well as secondary prevention of CVD. The report of the joint WHO/FAO expert consultation has come up with guidelines² to reduce the burden of nutrition related chronic diseases like obesity, diabetes, and cardiovascular disease. Being the *Dhatu* concerned with nutrition, it becomes logical to assume the pathologic state of *Rasadhatu* in the development of cardiovascular diseases.

RASADHATWAGNI: The function of *Rasadhatu* is *tushti* and *preenana* which in turn means nurturing, maintaining and revitalizing. *Rasa* is a *soumyadhatu*³. It is the

first *dhatu* that receives the internalized nutrients from the exterior and transmit them to each and every *dhatu* represented by various tissues and organs⁴. It is an ever changing fluid part of the human body which receives the essence of digestion and maintains constant supply of nutrition to all the tissue and organ. The *Dhatwagni* of *Rasa* is said to function properly when the biochemical state of *Rasa* is maintained in such a way as to provide its basic functions of *tushti* and *preenana*. Carbohydrates, protein, fat, vitamins, minerals and water are the basic nutrients essential for human body. These nutrients have to be distributed continuously to other *dhatu*s at times of physiologic demands of exercise, fast etc. Thus the entire regulatory mechanism that ensures the constant availability of these nutrients in the serum in accordance with the demand can be considered as the function of *Rasadhatwagni*.

The function of an array of enzymes and hormones and the liver that regulate the metabolism of these nutrients are the representatives of *Rasadhatwagni*. The liver plays a central role in metabolic homeostasis and is a major site for synthesis, metabolism, storage and redistribution of carbohydrates, proteins and lipids. Products of carbohydrate and amino acid catabolism are directed towards fatty acid synthesis and storage of energy when the supply of fuel is in abundance. A diet high in sucrose is associated with an elevation of plasma triglyceride concentrations. This increase happens due to increased hepatic secretion and impaired clearance of very-low-density lipoprotein. When the physiological demand of energy is more as in exercise, glucose can be formed from amino acids and the glycerol portion of fat by the process of gluconeogenesis. Thus the *Rasadhatwagni* constantly modifies its func-

tion closely in accordance with the supply and demand of energy.

RASAVAHA SROTAS: Incessant circulation of *Rasa* is maintained by the *Hridaya* through the *Dasamoolasiras* and their branches; hence *Hridaya* is considered as the *moolasthan* of *Rasavahasrotas*³. This is, in fact, the circulatory system; mainly the arterial system. The vascular tree is not merely an inert channel for the circulation of blood and nutrients but a microenvironment consisting of the endothelium and other cells of the vessel wall. Although only a simple monolayer, the healthy endothelium is able to respond to physical and chemical signals by production of a wide range of factors that regulate vascular tone, cellular adhesion, thrombo resistance, smooth muscle cell proliferation, and vessel wall inflammation⁵.

The onset of atherosclerosis is believed to be due to discrete areas of chronic inflammation in large and medium sized arteries due to infiltration and retention of LDL particles inside the blood vessel wall. A cascade of events follows that ultimately lead to the recruitment of monocytes that differentiates into macrophages which internalize lipoproteins and are transformed into lipid-loaded foam cells – the archetypical cell in atherosclerosis^{6,7}

RASAVAHA SROTOVAIGUNYA AND ENDOTHELIAL DYSFUNCTION:

Prolonged and/or repeated exposure to cardiovascular risk factors can ultimately exhaust the protective effect of endogenous anti inflammatory systems within endothelial cells. As a consequence, the endothelium not only becomes dysfunctional, but endothelial cells can also lose integrity, progress to senescence, and detach into the circulation⁵. This leads to increased expression of adhesion molecules and pro-inflammatory cytokines. These initial events can be considered as the *Srotovai-*

gunya, which may progress to the further development of atherosclerosis.

Lipoprotein transport into the artery wall and its entrapment within the endothelium and the extracellular matrix is a concentration-dependent process. The cells of the artery wall secrete oxidative products from multiple pathways and initiate lipid oxidation. At the same time, artery wall cells produce microenvironments that could exclude the water-soluble antioxidants of plasma. Lysophosphatidylcholine, a product of LDL oxidation, has been shown to be a chemoattractant for monocytes and T-lymphocytes, to induce the adhesion molecules and to increase levels of PDGF and heparin-binding epidermal growth factor in endothelial cells and smooth muscle cells. The lesion grows by the migration of new mononuclear cells that enter at the shoulder regions of the lesion and the proliferation of both monocyte, macrophages and smooth muscle cells⁸. This shows that the interaction between *Kapha dushta Rasa* and *Rasvaha srotas* is the central event in the development of *Dhamanipratichaya* or atherogenesis.

Several hypotheses have been proposed to explain the initiating events in atherogenesis. The oxidation hypothesis emphasizes the importance of oxidative modification in the atherosclerotic process, because compared with native LDL, oxidized LDL is preferentially taken up in the arterial wall. This hypothesis makes a role of diet and lifestyle in atherogenesis, because LDL can be oxidized by smoking, for example, and oxidation can be prevented by dietary antioxidants, eg, vitamins and polyphenols⁹. Exercise has also shown to improve endothelial function and nitric oxide (NO) bioavailability and also promote endothelial progenitor cell mobilization from the bone marrow that can

differentiate into mature cells with endothelial characteristics as a repair process at sites of endothelial detachment⁵. In short, the complex interactions of diet, lifestyle, and with lipoprotein metabolism and endothelial function help in establishing *Sthanasamsraya* (progression into *Srotorodha*) or regression of the *vaigunya* at these areas of *Rasavaha srotas*.

VYANAVATA AND VASAMOTOR FUNCTION: The function of *Rasa* and *Vyanavata* is totally interdependent¹⁰. *Vyanavata* effects the circulation of *Rasa* by maintaining the pumping action of heart and also the vasomotor functions of blood vessels. Normalcy of one is essential for the proper functioning of the other. The endothelium modulates vasomotion, by release of vasodilator substances like nitric oxide (NO), prostacyclin and vasoconstrictors like endothelin and vasoconstrictor prostanoids.

Early lesions appear to develop at sites of predilection that are related to hemodynamic and mechanical factors⁸. Studies also show that for any given lipoprotein concentration in the plasma, lipoprotein retention in the artery wall was more important than the rate of transport into the artery wall¹¹. Clinical evidence demonstrates that postprandial triglyceride level adversely affect the endothelium by mediating changes in vascular tone. After consumption of a high-fat meal, a reduction in flow-induced dilation of the brachial artery correlated with postprandial plasma TG concentration in healthy subjects. It has been proposed that the effects of triglyceride on endothelial tone are mediated in part by reduced nitric oxide production, either because of the TG particles themselves or due to oxidized LDL associated with the postprandial period¹². Thus the composition of *Rasa* affects its circulation in the *Rasavahasrotas* by interfering

with the vasomotor activity which can be attributed to the function of *Vyanavata*.

AGNI AND GENES: Latest studies on nutrition research are centered on the observation that gene - environment interactions modulate plasma lipid concentrations and potentially CVD risk. The homeostasis of lipid metabolism is the result of interactions between multiple genes mainly in liver and endothelium with environmental (nongenetic) factors. It has to be correlated to the *Ayurvedic* concept that the *Agni* (a generic term representing the digestion and metabolism in human body) is influenced by diet and environmental factors¹³. It is proposed that the environmental and specific metabolic states induce mutation in specific gene loci, resulting in impairments in binding capacity, in post-translational processing, or in recycling of various proteins. Researchers are currently trying to understand why omega-3 fatty acids suppress or decrease the mRNA of interleukin, which is elevated in atherosclerosis, arthritis and other autoimmune diseases, whereas the omega-6 fatty acids do not¹⁴. These facts are proving that *Agni* is very much dependent on diet and other daily regimen (*vihara*), climate and even mental states. Thus continued interaction of unhealthy habits bring about irreversible changes in metabolism at the gene expression level leading to pathological events culminating in conditions like obesity, insulin resistance, CVD etc.

CONCEPT OF SUDDHARASA: Among the *dhatwagnis*, it is *Rasadhatwagni* that responds immediately to diet, physical activity and mental state¹⁵; as it is the first one to metabolise the *Ahararasa*, the product of *Jadharagnipaka*. Persistent exposure to unhealthy life style lead to altered function of *Rasadhatwagni* resulting in derangements in the *Rasadhatu* which further derange the microenvironment of

Rasavahasrotas. As per *Ayurvedic* classics, *Apatarpana* is the line of approach in *Rasapradoshaja vyadhis*. Such modalities might act at a multitude of planes of metabolism like reduce the enteric uptake of dietary as well as biliary lipids (from the intestine), remove hepatic fat deposition and thereby reduce insulin resistance in hepatocytes, improve the expression of LDL receptor of liver, provide antioxidants that reduce the oxidation of LDL in circulation, improve endothelial function and NO bioavailability, promote endothelial progenitor cell mobilization from the bone marrow and so on resulting in regression of atherosclerotic plaque.

Selecting the suitable combination of *Apatarpana / samana chikitsa* along with measures to alleviate *Vata* should be adopted; as *Langhana* in long run will vitiate both *Vata* and *Rasadhatwagni*. Controlled and judicious use of *Snehana* would maintain the normalcy of *Vata* and consistent function of *Jadharagni* and the *Dhatwagnis*¹⁶. This might provide the free fatty acids essential for the energy production in the muscles during the regular exercise and also improve the level of the HDL and the antioxidants that act as anti-atherogenic agents. Correction of *Rasadhatudushti* by the combination of these measures enabling these multidimensional benefits can be, in short, named as *Rasasuddhi*.

AYURVEDIC PREVENTION STRATEGY: *Hridroga* is told in *Ayurveda* as a disease produced by deranged state of *Rasadhatu*. *Rasasuddhi* should be the first and foremost aim while planning *Ayurvedic* management in the primary prevention of cardiovascular diseases. It is the *Hetuvipareeta chikitsa*. Dietary restrictions like low calories and fat diet, low salt intake, increase the intake dietary fibers etc can be supplemented with the *Ahara niyamas*

recommended by *Ayurveda* like avoiding overeating, in between eating, late night meals etc. The extent of physical activity can be customized by the concept of *Ardhasakti* and they have to be advised not to completely cut down fat intake¹⁷. Mental stress can be relieved by resorting to individualized *yoga* techniques. Simple drugs like *Dhanyaka*, *Sunti*, *Triphala*, *Trikatu*, *Panchakola*, *Vaiswanara churna* etc can be recommended for regular but limited period of use followed by controlled use of *Abhyantara sneha*; preferably medicated ghee. *Virechana* at suitable *Ritusandhi* would be a feasible type of *Sodhana*.

In overt manifestations of CV D, priority has to be given to (add) *Vyadhivipareeta chikitsa* Secondary prevention has to be carefully modified by adopting *Hridrogahara*, *Medohara*, *Pramehahara*, *Sophahara* or *Vatavyadhihara* measures, according to the disease and complications. Along with these, diet and regimen ensuring *Rasasudhi* need to be advised so as to avoid recurrence of the same condition or manifestation of a new clinical event of CVD.

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Source of support: Nil
Conflict of interest: None Declared