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Review Article

CONCEPT OF HYPERLIPIDEMIA IN AYURVEDA

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ABSTRACT

Hyperlipidemia is a clinical terminology represents excessive tiers of fat or lipids in the blood, which consist of cholesterol and triglycerides. Hyperlipidemia can be inherited due sedentary life lead. As opposed to the excessive cholesterol hyperlipidemia consists of hypertriglyceridemia and high rise of triglyceride and cholesterol indicates mixed hyperlipidemia. *Meda* is a very crucial component included in the category of *Dhatu*. It may be correlated with fats or lipids in modern medical parameters. *Meda Dhatu* has an extensive role for various metabolic disorders like obesity, Diabetes Mellitus in phrases of *Sthaulya*, *Prameha* due to excessive deposition of *Meda*. **Aims & Objective:** Etiology, pathophysiology and principle management of hyperlipidemia with correlation to *Meda Roga*. It also highlights the role Ayurveda fraternity for the sake of early diagnosis and correct management of diagnosed case of hyperlipidemia or *Meda Roga* through *Ayurveda*. **Materials & Method:** The literal review carried out by collecting the literature and research finding from various classical and modern text book, online reports and online research articles in Google Search and PubMed Database. **Results:** Hyperlipidemia or *Meda Roga* is a burning issue with underlying critical pathology correlated to *Medabaha Sroto Dusti*, lead to serious illnesses and ultimately death. **Conclusion:** Hyperlipidemia and *Meda Roga* in *Ayurveda* may be correlated. Hyperlipidemia stands for cardiovascular issues given that last decades as a result of lifestyle modification. Present study attempts to correlate the relation among lipids and *Meda Dhatu*.

INTRODUCTION

Hyperlipidemia incorporates several genetic and acquired troubles that describe advanced lipid tiers inside the body. Hyperlipidemia is rather common, especially in the Western hemisphere, however additionally throughout the world. [1] The clinical circumstance has been introduced in the context of *Asta Ninditiya Purusha* where *Atisthaulya* is crucial attention as genetic in addition to inherited condition with the high rise of lipids in terms of *Meda*.[2] Lipids typically encompass cholesterol levels, lipoproteins, chylomicrons, VLDL, LDL, Apo lipoproteins, and HDL.[3]

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Lipid is found in our body in the shape of *Meda Dhatu* or *Medadhara Kala* or adipose tissue included in *Saptabidha Kala*. Presence of *Meda* is inside the stomach in addition to inside the cartilage. The fats gift inside the large bones is called *Majja* or bone marrow. The marrow is discovered in the large bone, while a substance comparable in appearance and observed interior another boney shape can be taken into account as *Meda* which blended with blood. The fat present in basically muscular shape may be considered as *Vasa* or muscle fats.[4] Hyperlipidemia includes the high rise of cholesterol and triglyceride or both. Cholesterol is a fatty substance that travels thru the bloodstream on proteins called lipoproteins. High cholesterol in the blood, increase at the partitions of blood vessels, and form plaque. Over the years, plaque deposits develop largely and start to clog up arteries. Heart ailment, peripheral artery disorder, which may result in limb ischemia or gangrene, is demonstrated as a result of high cholesterol. There are two types of cholesterol one is LDL, and another is HDL.[5] Due to the

predominance of *Prithivi* and *Apa Mahabhutas* in *Meda Dhatu*, it produces liquidity and smoothness. Perhaps HDL or "proper" cholesterol cleans up excess "bad" cholesterol and cleans up the arteries; ultimately back to the liver by the manner of *Bhutagnipaka*. It takes vicinity within the *Adhoamasaya* and is continued and finished inside the *Yakrit* or liver. *Sara Bhaga* and *Kitta Bhaga* could be separated after the completion of *Bhtagnipaka*. LDL ("bad") cholesterol congests the artery partitions, making them tough and narrow. Ayurveda classifies the *Meda Roga* simplest by way of *Meda Dosha*.[6] In the modern-day clinical system, it is categorized into major classes, familial and acquired. Received hyperlipidemia is most customarily the result of lifestyle factors. It may additionally result from medications taken or underlying fitness situations. Lifestyle elements can increase "bad" cholesterol levels and lower "correct" levels of cholesterol. the principal lifestyle alternatives that raise your chances of developing high levels of cholesterol encompass an unbalanced food plan, insufficient workout, smoking or regular exposure to secondhand smoke, obese or obesity, heavy alcohol use (even though ingesting mild amounts of red wine. health situations may also results to high cholesterol levels, such as kidney ailment, diabetes, polycystic ovarian syndrome (PCOS), an underactive thyroid, liver ailment [5] as an association with *Santarpana Janya Nidan Sevan* resulting *Amaprodoshaja Vikara*. Different inherited situations or *Bija Dosha* and pregnancy may lead to excessive cholesterol. Inherited hyperlipidemia or mixed hyperlipidemia is cause of both cholesterol and triglyceride in excessive tiers. [7]

MATERIALS AND METHOD

The literal review carried out by collecting the literature and research about hyperlipidemia, *Meda Roga*, *Medabaha Sroto Dusti*, obesity finding from various classical and modern text book, online reports and online research articles in Google Search and PubMed Database.

Concept of Lipid in Ayurveda

Meda is described as the only one which performs the characteristic of *Sneha*. It provides selected kind of *Dhatu* originated from *Mamsa Dhatu*. The *Sthana* of *Medo Dhatu* is *Vapavahan* and the site of accumulation of *Meda Dhatu* in the abdominal cavity, which is likewise called *Tailavartika*. [8] In other phrase *Vasa* are the fats content material of the *Mamsa Dhatu* and which are qualitatively much like *Medodhatu*, so it is understood that compositions of *Medo Dhatu* are *Prithvi* and *Apa Malabutas*. So *Medo Dhatu* is *Atisnigdha*, *Guru, Picchila*, *Mridu*, *Sandra* and *Sheeta*.[9] The total quantity of *Medo Dhatu* is two *Anjali* and that of *Vasa* is three *Anjali* respectively.[10]

Nidan or causative factors:

Absence of physical activity, sleeping during day time and intake of food which increases the *Kapha*, intake of *Baruni* type of wine make the end product of digestion to become abnormally *Madhura* which in turn causes increases the *Meda* or lipid level in blood stream which causes the *Medaroga* or Hyperlipidemia.[11] Hyperlipidemia is associated with the imbalanced cholesterol level caused by caused by a combination of having too much LDL cholesterol and not enough HDL cholesterol to clear it up. As a result the *Medabaha Srota* (channels carrying adipose tissue) get vitiated.[12] There are two fundamental cause of hyperlipidemia as familial and acquired.[5]

Table-I: Etiological factors of Hyperlipidemia according to Ayurveda: [13]

Aharaja Nidan	*Viharaj Nidan*	*Manashik Nidan*	*Oupasargika Nidan*
Adhyashana (taking food after lunch or dinner)	*Avyayama* (less exercise)	*Harshanityatva* (happiness)	*Amaprodosha* (indigestion)
Atisampurna (binge eating)	*Avyavaya* (no sexual activities)	*Atichintana* (no worries)	*Snighda, Madhura Basti Sevena* (enema which contain oily and sweet drugs)
Guru Ahara Sevana (taking food which is heavy to digest)	*Sukha Shayya* (very comfortable bedding)	*Priyadarshana*	*Snigdha Udvartana* (powder massage with oily drugs)
Madhura Ahara sevana (excessive use of sweets)	*Atisnana Sevana* (excessive bathing)		*Vijaswabhaba* (heredity)
Shleshmala Ahara Sevana (food which will increase *Kapha*)			

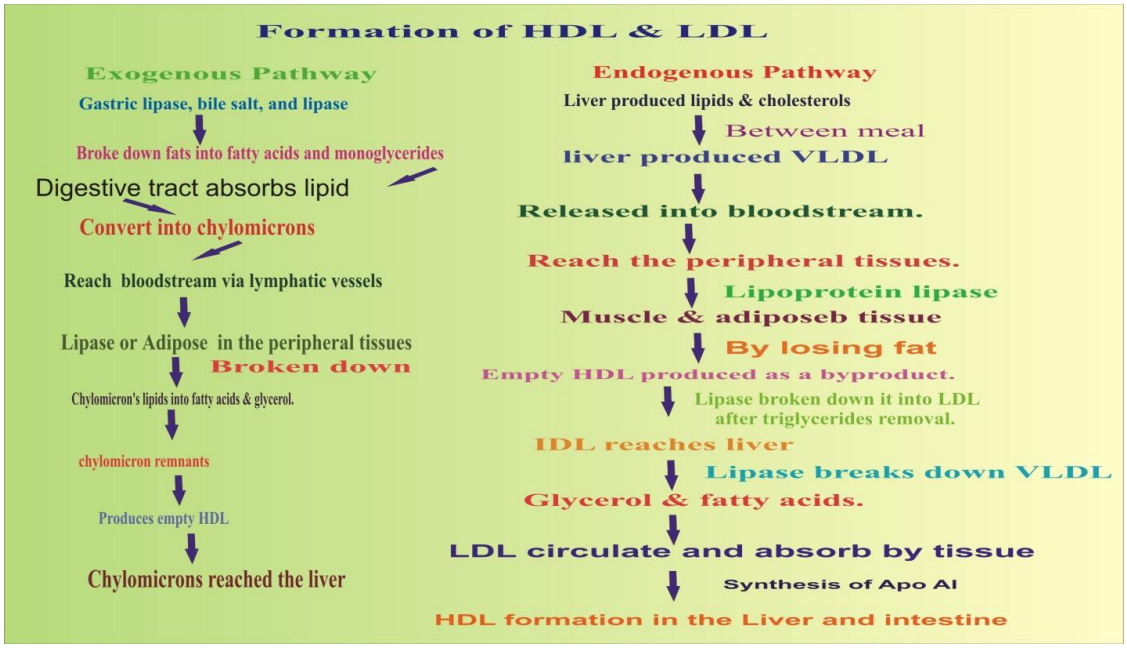
Table – II: Etiological factors of Hyperlipidemia According to Modern Science[5]

Acquired Hyperlipidemia		
Lifestyle	**Health Conditions**	**Medications**
An unbalanced diet	Kidney disease	Birth control pills
Insufficient exercise	Diabetes	Diuretics
Smoking or Regular exposure to second hand Smoke	Polycystic Ovary Syndrome (PCOS)	Corticosteroids
Overweight or obesity	Underactive thyroid	Antiretrovirals used for HIV treatment
Heavy alcohol use (though drinking moderate amounts of red wine	Liver disease	Beta-Blockers
Familiar or inherited hyperlipidemia		
Familial combined hyperlipidemia or mixed hyperlipidemia. It causes both high cholesterol and triglyceride levels		

Pathophysiology

Hyperlipidemia is polygenic in inheritance that is manifested with the aid of the issues appreciably encouraged through elements which includes imperative obesity, saturated fats intake, and the cholesterol content within the eating regimen.[14] Partaken meals undergoes within the manner of digestion by consecutive three stages of Avasthapaka.[15] Throughout the initial segment of digestion or Madura Paka, cells on the tongue produce a form of lipase known as lingual lipase. Lingual lipase is that starts evolved to interrupt triglycerides down. This enzyme is strong in acidic environments and keeps to work because the lipids pass to the stomach for further digestion. This stage of digestion takes location by way of the effect of Kapha Dosha. Within the second section of digestion or Amla Paka, the enzyme gastric lipase is produced utilizing cells in the belly by way of the movement of Pitta Dosha that continues to interrupt down the lipids. Contents from the stomach then input the small intestine. This degree helps the lipid make into larger droplets. These droplets input the small intestine for further process. Inside the third stage of digestion, named Katu Paka to approach the segment of absorption of fatty acids and glycerol from the intestine. Bile is a digestive fluid made by way of the liver and stored within the gallbladder. That is launched into the primary section of the small intestine known as the duodenum and aids in the digestion of lipids. Bile salts attract each water and fats, allowing them to act as an emulsifier of lipids. Smaller droplets grow the surface location of the lipids, making them more accessible for enzymes to work on. The pancreas secretes pancreatic lipases, which smash the fat (triglycerides) into free fatty acids and monoglycerides so they can flow into the body. This degree of digestion takes place with the impact of Vata *Dosha*. The lipid is predominated by *Apa* and *Prithivi Mahabhuta*. *Jatharagni* also activates *Bhutagnis* by way of providing them with the well-fashioned substrate which constitutes the second stage of digestion. The *Bhutagni Paka* takes place within the *Adhoamasaya* and is sustained and completed in *Yakrit* or liver. *Jatharagni Paka* of the *Ahar Dravya* was immediately observed via *Bhutagni Paka* resulting separation of *Sara* and *Kitta* part. [17] Proper digestion of lipid calls for emulsification which centers the incensement of lipase activity. The bile salt disperses fats into smaller particles with the assistance of bile acid, cholesterol, and lecithin. Cholesterol is in general synthesized within the frame (endogenous) manufacturing in the liver from acetyl CoA via the HMG-CoA pathway. Absorbed monoglycerides and fatty acids surpassed through the epithelial cells and shaped into chylomicron. The Chylomicrons are lipoproteins that include triglycerides and other lipids (cholesterol, fats-soluble nutrients, and so forth.). The chylomicrons achieve the bloodstream through the lymphatic vessels. The Apo lipoproteins predominated within the chylomicrons are apoE & apoB-48. Moreover, it includes apoA-I, apo-II, and apo-IV. ApoA-I removes oxidized phospholipids from oxidized LDLs. ApoA-II reduces LDL oxidation. ApoA-IV has anti-oxidant and anti-atherosclerotic elements. ApoA-IV secrets and techniques via the small gut and synthesized inside the gut and inspired by energetic lipid absorption. ApoE has an anti-atherosclerotic interest. Chylomicrons reached the liver and were removed via the apoE-mediated system. Liver-produced lipoprotein very-low-density lipoproteins (VLDL) transport lipids thru the blood circulation. Elements affecting hepatic lipoprotein synthesis can result in improved plasma cholesterol and triglyceride tiers.[18]

Figure-I: Formation of HDL and LDL by Exogenous and Endogenous Pathway[16]



The *Sarabhaga* of *Annarasa* of the ingested meals that is the result of the motion of each *Jatharagni* and *Bhutagni* is absorbed from the *Amashaya* and disbursed in the path of the body using the *Dhamnis*, after the movement of *Bhutagnis*, like this *Medo* that fashioned by the action of *Medagni*. *Asthayi* Dhatu and *Sthayi Dhatu* After the movement of *Dhatwagni* could be produced. *Asthayidhatu* is precursor of the *Sthayidhatu* and is circulated in the body with *Srotas*, *Sthayi Dhatu* of *Medo Dhatu* can be correlated with adipose tissue and it also refers with *Baddha Medas* and *Asthayi Bhaga* of *MedoDhatu* with lipoproteins synthesis within the liver, also refers with *Abaddha Medas*. When *Dhatvagni* function is decreased then quantitative synthesis of *Dhatu* is extended. Whereas its function is growth subsequently it increases by means of its qualitative action [19]. *Abaddha Medas* is the number one purpose for the formation of Atherosclerotic changes in the blood vessel and frequently remains asymptomatic till plaque stenosis reaches 70 to 80% of the vessel's diameter. Endothelial damage appears to stem from the lack of nitric oxide inside the endothelium. This method leads to expanded infection at once across the site of disorder, allowing the accumulation of lipids inside the innermost layer of the endothelial wall. The lipids are then engulfed by using macrophages, leading to the hooked up order of "foam cells." This cholesterol build-up within the "foam cells" reasons next mitochondrial disorder, apoptosis, and, ultimately, necrosis of the underlying tissues.[20]

Pathogenesis

Because of the obstruction of *Medobaha Srota* by using vitiated *Vata* particularly confined to *Kostha* resulting in stimulation of *Agni* and *absorption* of food. Because the food is digested very quickly there could be voracious hunger. Due to impairment of *Prana Vayu* and *Samana Vayu* [21] the discrete vicinity of the hypothalamus which includes the feeding center within the ventrolateral nucleus of the hypothalamus (VLH) and satiety center within the ventromedial hypothalamus (VMH). The cerebral cortex receives high-quality signals from the feeding center that stimulate consumption and the satiety center modulates this method with the aid of sending inhibitory impulses to the feeding center. [22] The *Pachak Agni* and *Saman Vayu* and *Apana Vayu* [23] are the two toughest factors in the case of *Meda Roga*. In *Medaroga* the adipose tissue mass very swiftly improved employing the involvement of adipose tissue lipoprotein lipase (ATLPL). This enzyme is synthesized within adipocytes, secreted into the extracellular space, and attaches to the luminal surface of close endothelial cells. At this region, ATLPL hydrolyzes fatty acids from the triglycerides of circulating triglyceride-rich lipoproteins. The launched fatty acids are taken up through adipocytes, converted of triglycerides, and saved.[22] Within the event of disproportionate growth of fats than the other *Dhatus* cause the excess deposition in buttock, stomach, and breast.[24]

Figure II: Pathogenesis of *Meda Roga*

Clinical Manifestation[24]

Reduced Life Span *or Ayushrasha*: *Purva Dhatu* is accountable for nourishment of *Uttar Dhatu*. In *Meda Roga* due to *Srotoaborodha* only *Meda Dhatu* gets nourished and other *Dhatu* can't nourish properly results in *Ayushrasha*. Untreated hyperlipidemia are greater prone to expand coronary artery ailment (CAD) as those with levels of cholesterol within the normal range. This can lead to clogged arteries, that could trigger heart attack, stroke, or different critical problems for that reason lifestyles span is much less.[25]

Early Sign of Senility or *Javoparodha*: Malformation of *Dhatus*, because of their *Shaithilya* (flabbiness), *Sukumarya* (delicacy) and *Guruta* (heaviness) and by the impairment feature of *Vayu* results in impair of the characteristic of hypothalamus ensuing Hypo-gonadrotrophic hypogonadism or Froehlich's syndrome develops in obesity. This consists of the visible impairment and mental retardation [22] thus early sign of senility develops.

Difficulty in Sexual Intercourse or *Kriccha Vyabayata*: Due to malfunctioning of *Dhatus* nourishment of *Indriya* hampers ensuing in loss of sexual desire. *Vrishan* (testis) the primary site of *Shukravaha Srotas* is fashioned from *Medha* and *Kapha*, vitiation of *Medha* and *Kapha* leads to vitiation of testis and *Shukra* formation. The production of the male sexual hormone testosterone is related to the levels of cholesterol. In obese men, the level of cholesterol is usually excessive consequences low levels of testosterone. Obesity may additionally motive erectile disorder due to the lack of enough testosterone with the intention to lessen the blood flow to the penis.[26] Adipokines are cytokines predominantly secreted by means of adipocytes. To some extent adipokines are leptin, adiponectin, resistin, visfatin, omentin, and ghrelin. The insulin resistance and leptin tiers are prolonged and hyperandrogenemia happens in obese ladies. Similarly, anovulation, changes in adipokine levels and the HPG axis, and steroidogenesis in overweight women impacts the reproductive system. [27]

Fatigueless or *Daurbalya*: *Rasa Dhatu's* main function of *Preenan* i.e., providing nourishment to the other *Dhatus*, is affected which leads to *Daurbalya.* Insulin resistance is due to a combination of receptor and post receptor defects in insulin action. The enlarge adipocyte decrease the insulin receptors and lose the capacity to metabolize glucose properly, thus fatigueless develops. [22]

Foul Body odour *or Daurgandhya*: Due to excessive *Sweda* that's *Mala* of *Meda* leads to *Daurgandha*. This awful odour is found in mouth, body elements, urine, feces, sweat etc. skin folds create areas with decreased airflow and expanded sweat. When this sweat mixes with smell-causing bacteria, an unpleasant smell results.[28] Thyroid glands regulate many bodily features, consisting of our sweat response and the kidneys and liver assist disposal of toxins from our bodies. When they cannot feature well, toxins can increase in the blood and digestive tract, developing an odor. Kidney disorder can cause urea to make your sweat tackle an ammonia smell. The associated manifestation of hyperlipidemia like hyperthyroidism, grave's disease and chronic kidney disease also results into foul body smell.[29]

Excessive perspiration *or Swedabadha*: Due to *Kapha, Sansarga* of *Meda*, *Vishyanditva* (liquidification) of *Meda*, *Guruttva* of *Meda, Vyayama Asahattva* (unable to do exercise) is resulting and lead to *Swedabadh*. The associated manifestation of hyperlipidemia like

hyperthyroidism, grave's disease and chronic kidney disease also results into foul body smell excessive perspiration. [29]

Increase in Hunger or *Atikshudha*: Immoderate accumulation of *Meda* reasons obstruction within the way of *Vata* results in *Agnisandhukshan* in *Koshtha*. This *Tivra Agni* digests the food rapid and for that reason excessive hunger is visible in *Meda Roga*. Because of extended cortisol secretion, the extreme digestive strength and hyperactive *Koshtha*, *Vata* result in immoderate urge for food & hunger. This is because of excess tissue desires of nutrition. Due to impairment of *Prana Vayu* and *Samana Vayu* [23] the discrete region of the hypothalamus which incorporates the feeding middle inside the ventrolateral nucleus of the hypothalamus (VLH) and satiety center inside the ventromedial hypothalamus (VMH). The cerebral cortex receives signals from the feeding center that stimulate intake and the satiety middle modulates this technique with the resource of sending inhibitory impulses to the feeding center. [22]

Increase in Thirst *or Atitrishna*: excessive thirst is said to be due to *Tikshnagni* and aggravated *Vayu* to be the principle purpose. The *Tikshna* Agni and *Ruksha Guna* of *Vayu* cause *Talushosha*. Ang II acts on seven transmembrane domain peptide receptors, AT1 and AT2. Operating through the AT1 receptor Ang II stimulates thirst (the act of looking for and drinking fluids, especially water), an appetite for sodium, the release of anti-diuretic hormone (ADH or vasopressin) to preserve water through the kidneys, and vasoconstriction (retaining perfusion strain to all organs and cells). The primary physiological sign for a growth in plasma Ang II is extracellular dehydration (hypervolemia). The responses listed above enable the fast return of plasma quantity to regular degrees, therefore decreasing the sign for Ang II generation. Thus increase in thirst develops.[30]

DISCUSSION

Hyperlipidemia or *Medo Roga* has been entitled as raised cholesterol level caused by a combination of high LDL cholesterol and less HDL cholesterol to clear it up. Hyperlipidemia includes familial and acquired impact. Familial hyperlipidemia or *Bijaswavhava Meda Roga* is due to mutation within the gene for the LDL cholesterol receptor, which is concerned with passing LDL from the body. Mutations in different genes also can reason inherited excessive cholesterol which includes the PCSK9 gene and the gene for Apo lipoprotein B.[31] Acquired type is the result of underlying health conditions, medications you take, lifestyle modification. For the all kinds of *Meda Roga* it is estimated that high intake of fatty food results into the ultimate manifestation. Maximum nutritional fat is provided in the shape of triacylglycerols which must be hydrolyzed to fatty acids and monoacylglycerols before they may be absorbed. Fat digestion is efficient and is almost finished in the small gut. The stomach is part of the method of fats digestion due to its churning action which helps to create an emulsion. Fats coming into the intestine are blended with bile and are further emulsified. The emulsion is then acted upon by way of lipases secreted through the pancreas. Pancreatic lipase catalyzes the hydrolysis of fatty acids from positions 1 and three to yield 2-monoacylglycerols. The unfastened fatty acids and monoglycerides are absorbed by using the enterocytes of the intestinal wall Fatty acids are transported within the blood as complexes with albumin or as esterified lipids in lipoproteins. Very-low density lipoproteins (VLDL) are massive triacylglycerol- wealthy debris produced within the liver from endogenous fat, instead of chylomicrons which deliver exogenous fats. VLDL is the principle factors of triacylglycerols which are additionally processed by using lipoprotein lipase and deliver fatty acids to adipose and muscle mass. Low-density lipoproteins (LDL) are the cease products of VLDL metabolism.[32] In Ayurvedic view of digestion, metabolism is typically controlled by the action of Agni. The *Kayagni* or digestive activity present within the body and subsequently converting its name through the determination of site. Every time its site being in the *Kostha* its miles known as *Kosthagni*, being within the *Jathar* is called *Jatharagni*. As it attended to the feature of *Ahara Paka*, it is known as *Pachakagni*. Whilst appearing over the *Dhatu* is called *Dhtwagni* and by using performing over *Panchmahabhuta* it is known as *Bhutagni*. All of the types of *Agni* accountable for the digestion, metabolism and absorption of partaken meals. *Agni* is responsible for the formation of *Ama* to accumulate inside the *Dhatus* leading on to *Dhatuvriddhi* and *Dhatu Kshaya*. Both the process is abnormal and provide rise to sickness like *Meda Roga* and others. The *Dosha* that is vitiated turns out to be unusual undergoing either *Vriddhi* or *Kshaya* cause vitiation of the *Rasa* and other *Dhatus* next, both of them together vitiate the *Mala* which in flip vitiate the *Malayanas*.[33] It is often that there is a combination of genetic and environmental factors at play that ultimately contribute to develop hyperlipidemia and cardiovascular disease and many systemic diseases, which stimulate an inflammatory sub-layer with clinical manifestation. Ailment including *Granthi*, *Vriddhi*, *Galaganda*, *Arbuda*, and *Ostha Prokopa* are due to the movement of deranged fat. *Madumeha*, *Meda Roga* and abnormal diaphoresis, and so forth should be regarded as having their beginning in the humor deranged fats of the body. [34] Psoriasis, Crohn disease, Inflammatory bowel disease, chronic obstructive

pulmonary disease, depression, chronic pain, pediatric alopecia aerate, Chronic kidney disease are also included as clinical or subclinical values of dyslipidemia and atherosclerotic problems.[1] Regarding the management of hyperlipidemia Ayurvedic classic describe the principle of treatment as consumption of *Guru* (heavy) but *Apatarpana* (non-nourishing) diet in prescribe from. Diets and drinks alleviate *Vata* and *Kapha* and which reduce fat. *Vasti Karma* (enema) should be given with *Rukshya* and *Tikshana Dravya* and *Udvartana* should be administered with *Rukshya* drugs.[35]

CONCLUSION

Ahita Ahara and *Vihar*, indulges of *Prajyaparadha* and no longer following the scheduled prescribed in *Dinaccharrya* and *Ritucharrya* is the basic aspect for lifestyle modification. All the elements are absolutely accountable for the manifestation of *Meda Roga* which can also correlate with hyperlipidemia. Within the present study causative factor, pathophysiology, pathogenesis and clinical manifestation of hyperlipidemia are attempted to correlate within the Ayurvedic context of *Medobahasroto Dusti Nidan*, *Samprapti* and manifestation of *Meda Roga*. Lifestyle changes often key to managing hyperlipidemia or *Meda Roga*. Even hyperlipidemia is inherited way of life modifications are still a critical a part of treatment. To be able to prevent the manifested disease even un-manifested one the regimens should be observed to get happiness.

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