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Review Article

A COMPREHENSIVE OVERVIEW OF *AGNI* IN DYSLIPIDEMIA

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ABSTRACT

The whole philosophy of Ayurveda is based on achieving, maintaining and promoting positive health. The equilibrium of various structural and functional units of the body named as *Dosha, Dhatu, Mala, Agni* and more important the mind results in health and disequilibrium causes disease. This era is of industrialization, stress during the work, dietary habits, lack of exercise and various varieties among the daily diet results into the disturbance of *Agni* or metabolism and ultimately leads to clinical entity known as Dyslipidemia. Dyslipidemia is not a single but a range of disorders with a variety of genetic and environmental determinants. It is a condition in which the levels of lipoproteins; that is; cholesterol, triglycerides or both are altered in plasma. A cluster of other metabolic risk factors are found with the dyslipidemia including obesity, glucose intolerance, insulin resistance and hypertension. *Agni* is responsible for all the metabolic activities of body. As per modern medicine the dyslipidemia is mainly because of the disturbances in the metabolism. *Agni* is involved in the metabolism at macro and micro circulation of body on the some way or the other.

Many theories have been put forward with many new hypotheses describing this disorder in Ayurveda as well as in modern science; still there is enough scope to work out on its aetiopathology and management aspects; as in modern science its management aspect remains symptomatic with troublesome side effects. Until pathology is clear, treatment part remains difficult. Hence the management of this disease is merely insufficient in other systems of medicine and patients are continuously looking with a hope towards Ayurveda to overcome this challenge.

INTRODUCTION

Cholesterol in our body is generally obtained from dietary (animal) sources or synthesized in the liver. All cells rely on cholesterol as building blocks to create the multiple membranes. Fat (Lipid) is insoluble in plasma and hence cannot be transported directly through the blood. It is now recognized that lipids in their various forms are transported by lipoproteins. Lipoproteins are a group of heterogeneous substances, metabolically active, constantly circulating through the vasculature and existing in a state of dynamic equilibrium between tissues and liver.

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Lipids constitute a heterogeneous group of compounds, which are relatively insoluble in water, but freely soluble in non-polar organic solvents like benzene, chloroform, ether, acetone etc. They are of great importance to the body as the chief concentrated storage forms of energy, besides their role in cellular structure and various other biochemical functions [1]. It is a disorder of lipoprotein metabolism, which can include over production or deficiency of lipoproteins or both. The disorder can manifest as an elevation of plasma cholesterol, triglycerides, or both or a low high density lipoprotein level or all three together that contributes to the development of atherosclerosis. Moreover, lipid levels vary with age, sex and nutritional status. Values are lower at birth with a relatively rapid upsurge during the first year of life and further slow rise until 6 years of age. Adolescence causes more change in males than in females. Levels of

plasma lipids tend to rise from the third up to seventh decade, particularly in affluent societies.

The WHO (Fredrickson) classification is a biochemical phenotypic classification based on raised lipoprotein.

Primary Hyperlipidaemia is classified into – type I, IIa, IIb, III, IV, & V. They may be only hypercholesterolemia (type IIa) or only hypertriglyceridaemia (type I, IV & V) or both (combined form) (type IIb & III). Their details are mentioned in the Table 1.

Frederickson's Classification of Hyperlipidaemia [1]

Table 1: Showing Frederickson's Classification of Hyperlipidaemia

Type	Lipoprotein Fraction elevated	CHL Level	TGL level	Appearance of plasma After 24 hours	Metabolic Defect	Features
I.	Chylomicron	N	↑↑	Creamy layer over Clear plasma	Lipo protein lipase deficiency (Familial)	Eruptive Xanthoma, Hepatomegaly Pain abdomen
IIa	LDL	↑↑	N	Clear	LDL receptor Defect (Familial)	Atherosclerosis CAD Tuberous Xanthoma
IIb	LDL & VLDL	↑↑	↑	Slightly Cloudy	Excess of Apo B (Polygenic)	Corneal arcus
III	IDL & VLDL	↑ ↑↑	↑	Cloudy	Abnormal Apo E (familial)	Palmar xanthoma, High incidence of vascular diseases
IV	VLDL	N or ↑	↑	Cloudy or milky	Overproduction of VLDL(familial)	Associated with DM, IHD & Obesity
V	VLDL & Chylomicrons	N	↑	Creamy layer over milky plasma	Secondary to other causes (familial)	IHD

Elevated levels of fasting plasma total cholesterol in the presence of normal levels of triglycerides. It is almost always associated with increased concentrations of plasma LDL cholesterol (type IIa). A rare individual with markedly elevated HDL cholesterol may also have increased plasma total cholesterol levels.

Metabolism and dyslipidemia are closely related, even though, dyslipidemia is one of the disorders in Metabolic Syndrome[2]. The exact mechanisms of the complex pathways are still not known. Most people affected by the condition who are older, obese, have sedentary life and have a degree of insulin resistance. Stress can also be a contributing factor. The most important risk factors are diet (particularly sugar sweetened beverage consumption)[3], genetics[4], aging, sedentary behaviour[5] or low physical activity, disrupted sleep, mood disorders and excessive alcohol use.

There is debate regarding whether obesity or insulin resistance is the cause of the metabolic syndrome or if they are consequences of a more far-reaching metabolic derangement. A number of markers of systemic inflammation, including C-reactive protein, are often increased, as are fibrinogen, interleukin 6, tumour necrosis factor-alpha (TNF-α), and others. Some have pointed to a variety of causes, including increased uric acid levels caused by dietary fructose. [6-8]

Research shows that Western diet habits are a factor in development of metabolic syndrome, with high consumption of food that is not biochemically suited to humans[9]. Weight gain is associated with metabolic syndrome. Rather than total adiposity, the core clinical component of the syndrome is visceral and/or ectopic fat (i.e., fat in organs not designed for fat storage) whereas the principal metabolic abnormality is insulin resistance [10]. The continuous provision of energy via dietary carbohydrate, lipid, and protein fuels, unmatched by physical activity/energy demand creates a backlog of the products of mitochondrial oxidation, a process associated with progressive mitochondrial dysfunction and insulin resistance.

After viewing the magnitude of the disease; a comprehensive and complete analysis of all the important literature of both modern and Ayurveda was done and online sources are searched to find out probable etiopathogenesis of the disease on Ayurvedic perspective. In this review study, many aspects of basic concepts of Ayurveda were analysed to find out the probable aetiology and pathogenesis of Dyslipidemia

with probable correlation with *Agni dushti* in Ayurvedic literature.

Samprapti of *Agnimandya*

Types of *Agni*

Description of the number of *Agni* varies in various classical Ayurvedic texts as follows –

1. *Acharya Charaka* has mentioned about 13 *Agnis*. *Jatharagni* - 1, *Bhutagni* - 5, *Dhatvagni* - 7. (Cha. Chi. 15/38) [11]
2. According to *Acharya Sushruta*, five types of *Agnis* are illustrated viz; *Pachakagni, Alochakagni, Sadhakagni, Ranjakagni* and *Bhrajakagni*. (Su. Su. 21/10) [12]
3. *Vagbhata* has described different types of *Agni* viz. *Bhutagni* - 5, *Dhatvagni* - 7, *Doshagni* - 3 and *Malagni* - 3. [13]
4. *Sharangdhara* has recognised five *pittas* only (Pachaka*, Bhrajaka, Ranjaka, Alochaka* and *Sadhaka*) sha.s. pu. Kha. 5/32 [14]
5. *Bhavmishra* has followed *Acharya Charaka* and *Vagbhata*. (Bha.pu.kha. 3/169,180) [15]

Role of *Agni*

Agni is responsible for various metabolic activities. It is responsible for any amount of increase or decrease of *Dosha, Dhatu* or *Mala*. If this *Agni* gets vitiated then it has an impact on health at microcirculatory level depending upon the *Agni* involved. When *Agni* is decreased, (*Mandata*) then various metabolic products at various levels get produced and it produces *Ama*; (undigested or partially digested molecules). Due to this, many *Vijatiya dravyas* are formed at various levels. Agni further can't convert the *Vijatiya* (non-assimilating) *Dravyas* into *Sajatiya* (assimilating) ones and end products cannot be assimilated by the *Dhatus*. Such products will be dangerous to the body and can cause signs and symptoms according to their presence at various physiological levels (*Dhatugatatva*).

If *Agnimandya* is present at the level of *Jatharagni,* then *Ahara Rasa* produced will not be of good quality. In turn the nutrient supply for further *Dhatu* maintenance would get hampered. There will be no production of proper *Dhatu* and the result will be obviously *Dhatu kshaya*.

If *Agnimandya* is present at *Bhutagni*, then *Ama* would be restricted to *Ahara rasa* that is the productive juice of food and this *Ahara Rasa* which is not properly formed; cannot be assimilated by *Dhatus* and results in *Dhatudushti*. It should be noted that *Ama* will be in circulation. This *Ama* can be accumulated in any parts of the body leading to various disorders. Also it is important to note that which among the 5 types of *Bhutagni* is involved. If one *Bhutagni* is involved, it leads to impairment in nourishment of that particular *Dhatu* which is having predominance of that particular *Mahabhuta*.

If *Agnimandya* is present at the level of *Dhatvagni*, then at that level a particular *Dhatu* would not be able to assimilate nutrients present in the circulating *Ahara rasa* (productive juice) or circulating *Poshaka dhatu*. So such *Poshaka dhatus* will be accumulated in *Ahara rasa* in abnormal quantities and they may further get accumulated at abnormal sites. This process of accumulation is termed as *Leenatwa* (deep seated) of *Ama* (especially in *Dhatus)*. Such *Leenatwa* can cause a number of disorders.

When *Jatharagni* is impaired the *Bhutagni* and *Dhatwagni* are also supposed to be impaired. Hence during the treatment of any kind of *Agnimandya* or *Ama* conditions, all these three levels should be taken into consideration.

The above mentioned pathologies can occur with this disorder also. Especially when *Medo dhatwagni* is vitiated; then homologues nutrients present in *Poshaka medo dhatu* will be in excess in circulation and this can cause a situation like Dyslipidemia. This is because the *Poshaka medo dhatu* cannot be assimilated into *Sthayi medo dhatu* by *Medo dhatwagni*. The cause for excess *Poshaka medo dhatu* in circulation is not only the *Medo dhatwagnimandya* but there may be decrease in other *Agni* also. Any reason which can lead to *Kapha vridhhi, Pitta kshaya* or *Vata prakopa* can cause this condition.

The consequences of such increase in *Poshaka medo dhatu* may be *Dhamani pratichaya*. The excess *Poshaka medo dhatu* may accumulate on the walls of vessels and may cause serious complications related to circulation. *Dhamani pratichaya* is considered as one of the *Nanatmaja kaphaj rogas*.

Agni plays an important role in the physiology as well as pathology too.

While considering physiology- Acharya Charaka says "The life span, complexion, vitality, good health, enthusiasm, plumpness, glow, vital essence, lustre, heat and the life breaths are derived from the thermogenic process."

But as we are talking about "Dyslipidemia" one should think about its deformity in the lipid metabolism. The action of *Agni* on lipids occurs at three different levels. Any food item cannot be assimilated at elementary level without proper digestion. This process is to be performed by three types of *Agnis* viz., *Jatharagni, Dhatwagni* and *Bhutagni.*

Out of these, *Jatharagni* is responsible for conversion of heterogeneous form is converted into homogeneous form. Then the *Dhatwagni* and later on *Bhutagni* take part in ultimate formation of *Dhatu*. *Agni* digests the four types of food and provides energy for sustaining life. It protects body from wear and tear. Hence *Agni* performs the functions of digestion and metabolism both.

Application of *Nyaya*'s for understanding the Mechanism of *Dhatuposhana*

The *Ahara-rasa* is a precursor of the body (*Shareera dhatu)*. Its transformation into the *Dhatu* is carried out by the fraction of *Jatharagni* and *Dhatvagni* as well as *Bhutagni*. The *Sneha* after digestion goes through same chain. This internal assimilation process is explained in old classics as *Dhatvagni* and *Bhutagni Vyapara*. To explain this digestion process and formation of *Dhatu,* the commentators of various *Samhitas* on the basis of the guidelines given by Acharyas has put forward three Mechanisms of *Dhatuposhana* which are called as *Dhatu Poshana Nyayas*. Going through commentaries of *Chakrapani, Dalhana* and *Arundatta*, it is noted that -

- *Chakrapani* himself was not very assertive, regarding the acceptance of *Poshana Nyayas*.[16]
- *Arundatta* clearly supported *Ksheeradadhi Nyaya* by dividing *Dhatu* as *Poshya* and *Poshaka*.[17]
- Similarly *Dalhana* had the same view which was further produced by *Arundatta* with a conclusion that - *Rasat Raktam Tato Mamsam* etc. This mechanism of *Dhatu Poshana* can be explained only with the help of *Ksheera Dadhi Nyaya.[18]*

The *Sneha Pachana* requires the assimilation in the *Dhatu* - where the *Sneha* has to perform the function of *Dosha-Shamana* or *Shodhana* accordingly. *Ghrita* (ghee) is one of the food ingredients. So according to '*Rasapradhanam Aharadravyam, Veeryapradhanam Aushadham'*, it will follow the same path of assimilation and will go *Dhatu* to another *Dhatu* but exception is there in the following two cases:

1. If it is processed with some other Medicinal properties i.e., *Siddha* or *Samskarita Sneha Kalpana*, it will be delivered directly to the target accomplished to the Specific *Veerya* - *Karmukata* of the drugs i.e., Targeted Drug Delivery (TDD)
2. If *Sneha poshakams* has are more than the threshold in *Rasa dhatu*, this extra quantity will directly reach to the deeper *Dhatu* like *Meda, Majja* etc. The *Sneha* along with nutrient fluid i.e. *Rasa* is circulated continuously in the entire body at the same time, by the *Vyana vayu* by virtue of its physiological function of circulation. E.g. From the ghee like foods along with the other nutrient; fluids or *Ahara rasa* are produced and nourish the *Rasa, Rakta, Mamsa, Meda, Majja* and *Shukra*; thus for the *Shodhana* a *Sneha Ksheera Dadhi Nyaya* (*Dhatu Sneha Parampara*) and *Kedari Kulya Nyaya* (*Yugapat Sarvato Ajasram*) are acceptable. In case of *Khale Kapota Nyaya*, the *Dhatu* pick up only its *Poshakamsha* (nutrient content). *Dhatu* are *Poshya* and *Poshaka* which is site of action rendered to *Sneha*. The *Poshaka Dhatu* in *Srotas*, when acted upon by respective *Dhatvagni* and *Bhutagni*, then only it will play supportive or nutritive role for *Poshya Dhatu*. The *Khale Kapota Nyaya* is suitable in *Bija Dosha* patients of *Medovridhi*. In this condition whatever diet is taken; it is directly converted into *Meda Dhatu* due to specific affinity to *Meda Dhatu.* and *Dalhana* clearly explains that by passing two *Dhatus* i.e. *Rakta and Rasa*, only *Meda Dhatu* is excessively formed in the patients of *Medoroga (Sthaulya)*.

In *Medovridhhi,* due to the excessive supply of *Snigdha, Madhura*, *Guru* etc. types of *Ahara*, the *Ahararasa* contains excessive nutrition homologous to *Medas*. Due to persistent overload, the *Medo agni* is diminished leading to excessive accumulation of *Sneha* in *Ama* form and thus causing *Rasa raktagat medovriddhi.*[19]

Metabolism and Dyslipidemia

The insulin resistance/metabolic syndrome (MetS) is characterized by the variable coexistence of hyperinsulinaemia, obesity, dyslipidaemia, and hypertension.[20-21] Other features of the syndrome include the pro-inflammatory states, micro-albuminuria, and hypercoagulability [22-23]. The abnormalities may be the consequence of global metabolic effect of insulin resistance; although the underlying mechanism for this pattern is not fully understood.

Lipid metabolism is controlled by a variety of cellular regulators that include several transcription factors involved in their synthesis and secretion. Transcription factors play an important role in regulating both synthesis and secretion of lipids and studies have shown that insulin may decrease lipoprotein secretion by attenuating the activity of the transcription factor. Liver X receptor alpha is other transcription factor that plays an important role in modulating fatty acid and lipoprotein metabolism by regulating lipogenesis through enhanced expression of the lipogenic genes [24-25]. During metabolic syndrome, chylomicrons, which contribute to the large triglyceride-rich lipoproteins in the post prandial state, can accumulate in the circulation thereby influencing overall lipid and lipoprotein turnover [26-27]. Dietary fatty acids, after entering the circulation through chylomicrons, are taken up by the liver as chylomicron remnants [28]. Accumulation of these chylomicron remnants leads to impaired glucose and lipid metabolism [29]. The overall contribution of dietary fatty acids to hepatic triglycerides is determined by the dietary fat content.

Dyslipidemia and *Medodushti*

There is similarity in the aetiological factors, clinical features, treatment and even in the complication of dyslipidemia and *Medoroga*. It is mentioned in the in the Table 2.

Table 2: Showing comparison between Dyslipidemia and *Medoroga*

Sr. No.	Feature	*Medoroga*	Dyslipidemia (Lipid and Associated Disorders)
1.	Aetiological Factors	*Medyanam Atisevanat* *Avyayam* *Divaswap* and *Achinta* *Bija- Swabhavat*	Intake of high fat diet Lack of exercise Sedentary lifestyle Excessive intake of alcohol Genetic predisposition
2.	Clinical Features	*Kshudra shwas* *Ati Sweda* *Daurbalya* *Ati Nidra*	Excessive thirst Exertional dyspnoea Excessive perspiration General weakness
3.	Complications	*Dhamani Pratichay*	Atherosclerosis, Cardio and cerebro vascular manifestations
4.	Management	*Deepan, Pachan, Medohar Dravya, Kaphapaham, Vyayama*	Low fat diet, Hypolipidemic drug, Exercise

Pathogenesis of Dislipidaemia According to Ayurveda

Dyslipidemia is a *Dushya* dominant disorder. *Agni; Dhatwagni* along with *Jatharagni*; is responsible for all metabolic activities of the body. *Ahara Rasa* is responsible for all the nourishment of further *Dhatus* made from it [30]. *Ahara Rasa* qualities depend upon the quality of diet a person takes. If the diet is *Madhur*, *Guru, Snigdha, Sheeta* in nature the *Ahara Rasa* which is going to form will also be *Madhur*, *Guru, Snigdha* and *Sheeta* in nature. So further *Rasa Dhatu*; which will form from it will also be more of *Madhur, Guru, Snigdha* and *Sheeta*. So the *Mala* of *Rasa* that is; *Kapha* also becomes of the same quality.

The *Ahara* get digested with the help of *Jatharagni*, and gets converted to *Rasa*. This *Rasa* as its name suggests enters into microcirculation and then with the help of *Vyan vayu* enters into the heart and circulates through whole body.[31]

After entering into the circulation[32] this *Rasa* does the *Karma* of *Tarpana, Vardhana, Dharana, Yapan, Snehana* and *Avasthambhan*. It also does the *Poshana* of *Doshas*, *Dhatus, Upadhatus* and *Mala*. "*Hruday*" is the *Moola sthana* of *Rasa*. From the heart it gets circulated giving nourishment to all the *Dhatu* as it is *Poshak* in nature (with the help of *Kedar Kulya Nyay*). It nourishes the *Dhatus* and again returns to heart [33]. So thus it is continuously gets circulated so it is called Rasa; the continuously flowing element in the body [34].

When the *Madhur, Snigdha, Sheeta guna* of this *Rasa* increase, then it becomes more sticky (*Pichhil*) in nature. So there is disturbance in its normal flow due to abnormal consistency. The *Rakta* which is in company with the *Rasa* also loses its normal *Sara Guna* (normal flow). *Rakta dhatu* also gets nourishment from Rasa so the qualities possessed by Rasa are ultimately acquired by *Rakta dhatu. Rakta dhatu* becomes more *Madhur, Snigdha, Guru* which then causes *Rasa* and *Rakta* to be sticky.

The pathology further continues to increase the *Pichhil Guna* (stickiness) of *Rasa Dhatu* so it makes it *Styan* (adherent). The *Pichchil guna* has property of *Upalepan* [35] (to form a layer over the surface). The *Sara guna* of *Rasa-Rakta* has already decreased; increase in *Stanatva* deranges the flow from arteries and thus abnormal fatty substance increases in it; causing *Medovridhhi*. The *Upalepan* then causes slowly and steadily *Dhamani Pratichay* which is nothing but atherosclerotic changes.

Management of dyslipidemia with Ayurvedic principles

The root cause of dyslipidemia is *Agni vikruti*. The *Agni vikruti* then leads to the *Vikruti* in *Dhatvagni* and then this causes disturbance in *Chay-Apachay* that is; metabolism of body; which leads to *Medovriddhi*. So the drugs should act in the following manner:

1. *Jatharagni (Sthool Agni) Sandhukshan* (enhancing the digestive power) drugs like *Marich, Chitrak, Vidang, Shunthi. Katu Rasa* is having *Teekshna*, *Ushna Guna* which is similar to the properties of *Agni*. The Ayurvedic Principle of "*Samanen Saman Vruddhi*" supports the above action.
2. *Dhatwagni Sandhukshan* (transformative power) like *Musta, Pimpali, Chitrak, Shunthi, Marich, Guduchi, Bhringaraj, Kutki*. According to *Charaka,* these *Tikta* drugs posses the *Lekhana, Karshana, Rasa, Meda, Kleda, Upashoshana* properties. These properties helped in *Dhatwagni Deepan*, thus curing the various symptoms of *Medovridhhi. Medovriddhi* is a metabolic type of disease *Dhatvagni Mandhyajanita Vyadhi*. This metabolic nature of disease demands "*Agnivriddhi*" therapy particular at the level of *Rasa dhatvagni and Jatharagni* (digestive fire). When any of these fires

is not proper, *Dhatus* are not properly produced. Improper function of *Agni* is the root cause for all disease, most of the *Deepana* and *Pachana* drugs are *Katu* and *Ushna Virya* properties and they act on the *Jatharagni* and *Dhatvagni* level.

3. *Strotas Shodhan* (clearing the channels) drugs like *Haritaki, Bibhitaki, Amlaki, Shilajit, Guggulu, Vidang, Chitrak, Bhringaraj, Apamarg, Saptaparna, Shigru, Karanj. Katu* and *Tikta* expel the vitiated material from the *Srotas* (channels); so the obstructive *Styan Rasa and Rakta* have been cleared out from the *Srotasa.* So the *Strotas Shodhan* then helps in normal manufacturing of the *Dhatus*. In *Bhav Prakash Samhita, Shigru* has been included in the *Medohar Dravyas.*
4. Drugs acting on the specific organ; that is; here working on *Dhamani* and *Sira*. (specifically on receptor level) like *Arjun, Sariva, Gokshur, Punarnava. Punarnava, Gokshur, Sariva* are *Madhur* in nature. They act on the organ that is they improve the endothelial dysfunctioning of arteries; giving strength to them. A combined effect of drugs like *Arjun, Punarnava, Brahmi, Shankhapushpi, Jatamansi* showed increased HDL-C level. Increased level of HDL-C shows it is preventing atherosclerosis. The drug which can increase the level of HDL-C may be considered as Cardio protective component. The hypocholesterolaemic property of *Arjuna* has also been reported by investigators. It is not the only drug effect, but combined effect of above drugs.
5. Drugs acting on the Stress like *Brahmi, Jatamansi, Shankhapushpi.* The pharmacological studies showed that *Shankhapushpi* enhances neuropeptide synthesis in the brain. Moreover, it reduces the level of acetylcholine and catecholamine in the brain tissue, which are elevated because of disturbed psychological factors. Thus it provides psycho stimulant and psycho-tranquilizer effects in animal experiments. In clinical studies also it showed significant anxiety relieving results.

CONCLUSION

Dyslipidemia is a metabolic disorder occurring due to the disturbances in metabolism. Every cell in the body is working due to its continuous metabolism. The management of biochemical reactions with enzymes is an important part of cellular maintenance. Enzymatic activity allows a cell to respond to changing environment demands and regulate its metabolic pathways, both of which are essential to cell survival.

Ayurveda has elaborated an important factor of digestion and metabolism in our body as *Agni.* Ingested food is digested, absorbed and assimilated by *Agni* according to Ayurveda. The term "*Agni*" is used in the sense of digestion of food and metabolic products. The vitiation in it causes different disorders. Dyslipidemia is also one of them.

So far we have considered the gross classification of 13 *Agni* explained in the classics but it is important to recall here that this is just a broad classification. Each cell has its own *Agni* and at every site of body where the transformation of any metabolite is taking place, it happens because of the *Agni* present there. Therefore, *Agni* in number are considered infinite also. So even if one cell or one tissue or one organ is affected due to its *Agni*; the treatment principle resides in treating *Agni* and nothing more to it.

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