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RESEARCH ARTICLE

LOCATION OF PHYSIOLOGICAL ACTIVITIES OF DHATWAGNI AND BHAUTIKAGNI

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ABSTRACT

The physiological activities of Dhatwagni and Bhautikagni can be understood after the action of Jatharagni in gastrointestinal track. The Jathragni i.e. enzymes of bile, pancreatic juice, intestinal juice and local hormones are secreted at the time of digestion in duodenum. Simultaneously immediately after the digestion of complex food , the simplified food is further catalyzed into Guna of Panchabhautik dravya to increase their own property as Parthiva, Apya, Agneya, Vayaviya and Nabhas in the whole body with the help of their own Bhautikagni. These are similar to enzymes which are end with 'ases' like Oxidases, Kinases, Dehydrogenases, AT Pases, Anhydrases which can be categorized according to the types of chemical reactions they catalyze at cellular level. All tissues in the human body are classified in the seven types of Dhatu. The growth and development of our body tissues is dependent upon the food available, genetic makeup i. e. Prakriti and the metabolic rate i.e. Dhatupakakal. The specific Dhatwagni as catalysts acts on only saatmya or specifically same and induced fit substrates at active site of the same tissue. Maumsadhatwagni acts on Maumsadhatu poshak aumsha only after the integrated activity of Vayavyagni, Jaliyagi and Raktagni which are controlled by Vatadosha as Nervous mechanism and Antarushma as Hormones. Dhatupaka and Bhutagnipaka is the metabolic set of chemical reactions in a cell. Bhautikagni paka is catabolic activity which breaks large molecules into smaller ones; usually releases energy and Dhatu sneha parampara is anabolic activity which builds large molecules from smaller ones; usually consumes energy. Hypothetically location of Dhatwagni is especially in their respective tissues and Bhautikagni is present in every tissue. Mitochondria are the activity site of most of the agnis in a cell. The Dhatu poshana activity at cellular level is as Anabolism and urja/mala production by Bhutagnipaka is as Catabolism.

INTRODUCTION

Prameha (DI, DM) like *dhatugat vyadhies* (metabolic disorders) are on rise. Disturbance in *Bhautikagni* and *Dhawagni* paka (Metabolic path) may be located to correct their activities by Ayurvedic therapy at cellular or tissue level. The study of metabolic phases helps in clinical manifestation of various *dhatu*. Thus the need is to locate physiological activities of *Dhatwagni* and *Bautikagni*.

Bhautikagni

Main importance is given to *Jathragni*[1]. Complex food is simplified and further catalyzed into cellular building blocks of *panchabhautik* elements as *parthiva , apya , agneya , vayaviya* and *nabhas*[2] .They increase their own basic *guna* (property) to form macromolecule homogenous to bodily components in the whole body (*Deha)*, with the help of their own *ushma* or *agni.*

These *panchabhauitkagni* are active till the *Gandhadi guna* from *parthivadi dravyas* are catalyzed and transported[3].

The ingested food (*dravya*) from the site of enzyme secretion (*nabhi -agni sthana*) by the digestion *(Vipaka)* and circulation through heart (*stanamadhya - Rasavaha srotas)* to tissue (dhatu) by internal metabolic activities like glycolysis till generation of neurotransmitters like Acetyl CoA (Indriya dravya – *vilakshan guna).*

Most of the catabolic activities take place in liver

1. Anaerobic glycolysis in presence of one or two enzymes could be taken as *akashiyagni*.
2. Dehydrodenase- H ion formation and transport (electron transport)-could be taken as *Vayaviyagni.*
3. Coenzyme hydrogen acceptor (NAD or NADP or flavin) does O_2 transmission could be taken as *Taijasiyagni*.

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4. 4) Chain of enzymes (enzymes required are flavo-proteins, cytochromes and cytochrome oxidase) with prosthetic groups reoxidized with hydrogen load then react with oxygen to give water- could be taken as *jaliyaviyagni*?; NAD + ½ O_2 Many steps NDA+ H_2O
5. Complete oxidation of acids gives CO_2 and H_2O by group of enzymes could be taken as *Parthivagni.*

Dhatwagni

All tissues in the human body are classified in the seven types. The growth and development of our body tissues is dependent upon the food available, genetic makeup i.e. *prakruti* (*beejabhoot*) and the metabolic rate i.e. *dhatupaka kala*.

The stimulation or inhibition of the portions of jatheragni[4]; local enzymes, growth factors, co-enzymes, vitamin derivatives, and whole enzymes decide the formation of particular tissue in proportion.

Integration of dhatwagni and bhautikagni paka

There is an integration of *dhatwagni* and *bhautikagni paka* (metabolism of different pathways). In fed states inter conversion of foodstuffs (exogenous metabolism-*dhatuplawana*) is first due to *bhautikagnipaka* and then *dhatwagnipaka* by *dhatu sneha parampara* or by *asthayee poshakansha* in *tridha parinamana*[5] (Biosynthesis or Metabolic synthesis) as per trividh nyaya. (Glycolysis in mitochondria, triacarboxylic cycle and gluconeogenesis in circulation).In starved states sthayee or poshya dhatu anu becomes their own fuel (proteins, ketone bodies and fatty acids); which are utilized by various dhatus (tissues) for the maintenance, again first due to *bhautikagnipaka* and then due to *dhatwagnipaka* (endogenous metabolism of tissue).

Rasagni[6]

Ahara rasa (Chile) is converted into *rasa dhatu* (composed of all nutrients) in the presence of *Rasagni* (by the process of glycogenesis, gluconeogenesis) in ***rasavaha srotasa*** **(in circulation by heart and vessels)** Formation of *madhur rasa* is indicated in this sukshma *pachana* i.e. Metabolism as of glucose, all fructose and glactose to glucose depends upon the energy needs (*bala, urja, ushma*) of the body cells.

Sthayee or *poshya rasadhadu* is catabolized by *bhautikagni* and used in post absorptive (fasting) phase for energy (in the form of ATP production) and *asthayee poshak rasa dhatu* is used to synthesis other dhatu (synthesis of amino acids, triglycerides).
In the case of *rasavaha srotodushti*; the activity of local *Agni* (enzyme) becomes more speedy or slow as to lead *sthulya* (obesity) *karshya* (mall nutrition) and affect activity of *jathragni* latter on.

Raktagni[7]

Asthayee rasa dhatu or *poshaka rasa dhatu* is converted into *rakta dhatu* in presence of *raktagni*, the process of formation of *shweta, kapota, harita, padmakinshuk alktaka varna* of *shonita* serially from *rasa dhatu* this is influenced by *ranjak pitta* or *ranjakagni* and *pittoshma* from ***amashaya, yakrut,*** **and** ***pleeha***

in *raktavaha strotas*.

The pure *rakta* is red and basically a liquid with a *visra gandha*. *Panchbhoutika guna* of *rakta dhatu* are like properties of flowing blood in vessels in living organism.

Cellular level organization transform into the tissue level of organization through blood. Blood is a fluid connective tissue. Metaplasia of these i.e. the transformation of one type of cell into another may be in the form of sira, kandara.

Maumsagni[8]

Asthayee raktadhatu or *poshak rakta dhatu* is converted into *maumsadhatu* in presense of *maumsagni*. The process of formation of *sthir dhatu* from *Drava dhatu* is influenced by *vayawagni* and *jaliyagni* with *raktagni*.

The study of metabolic phases helps in clinical manifestation of *mansa kshaya, mansavrudhi* and *mansavaha strotas dushti lakskhane*. Fibromyalgia, muscular dystrophy, myasthenia grevis, gangrene, myoma, myomalacia, myopathies, are diseases of muscles.

Medogni[9]

Asthayee maumsa dhatu or *poshak maumsa dhatu* is converted into *medodhatu* in presence of *medogni. Medodhatu* formation takes place in ***medodharakala*** **and** ***medovahstrotas***. *Meda poshakansha* present in *rasa samvahana* (in circulation or in common metabolic pool) is utilized and stored as *sthayee meda* in different organs of *Medovahasrotas* and *medodharakala* (below the skin), *anu asthi* (in small bones), ***vrikka*** **and** ***wapavahan*** **(kidneys and omentum),** etc.

The study of fat metabolism is essential to understand the clinical manifestation of *medodushti* like *granthi, vruddhi, galaganda, arbuda, madhumeha, atisthoulya, atisweda pravrutti*, etc.

Asthyagni[10]

Asthi dhatu is a *vidur dhatu* (formed very late in embryonic stage). The theory described for *vidur dhatu poshan is khale-kapot*. That indicates the long way and period for its formation from *ahara rasa* through ***asthidhara kala in Asthivaha srotas***. *Asthi dhatu* holds body structures and protect them formation of *updhatu-danta* (teeth), *kesha* (hair) and *nakha* (nails) as *mala* (keratin or waste) from *sthayee asthi dhatu* takes place in this process.

Deficiency in *asthidhatu* (**bone matrix**); results in *danta nakha bhanga* (brittle, cracked teeth or nails), *keshapatan* (hair fall), and pain as in severe osteopenia. Excess *asthi dhatu* forms *adhyasthi* (calcaneal spur), *adhidanta* (extra tooth), long hair and nails.

Thyroid hormone, IGF-1, Vita-D, GH are required for the growth of the bone, the ossification or osteogenesis. The local enzymes in this process can be treated as '*asthagni*'.

Asthi saushirya is a detoriated physiology of bone due to vata prokopa as in a senile osteoporosis. Osteogenic, paget's disease (excessive bone remodeling may result in soft bone formation), osteoarthritis, osteoylitis, osteopenia are the common disorders of bone calcium metabolism. Disorders related to *kesha, nakha, roma* are described in asthi prsdoshaja roga. This is a special area for research in Ayurveda.

Mjjagni[11]

It is described in Ayurvedic texts that *asthayee poshaka asthi* is coverted into *majja dhatu* in presence of *majjagni* at the site of ***majjavahasrotas and majjadharakala*** i.e. **at the internal big spaces of bones.** No description found about formation of *upadhatu* of *majja dhadtu. Akshi skhweda* is *majjamala.*

Disturbance in growth and development of *majjadhatu* may lead to *parvasandhi shool, bhrama, moorchha, tamodarshana, arushaa, sthoola, parva mula, daurbalya, laghuta, sarvanga netra gauravam.*

Degeneration, vertigo, transient ischemic attack, lethargy, neuralgia, swelling following viral infection in syndrome like Reye syndrome and mental retardation etc. are the diseased conditions.

Shukragni[12]

Shukra dhatu is a precious *dhatu and* a *shuddha dhatu* formed from *majjaposhakaunsha* in the presence of *shukragni* at the site of ***shukradhara kala*** **(germinal epithelium) and *shukravaha srotas* (testis or ovary and mammary gland).**

Shukragni of whole body (metabolic enzymes for production of proteins and energy) and *antarushma* (hormones EGF-Epidermal GF) from the whole body controls the *kritsna dehasthita shukra* as well.

Activity of Bhautikagni and dhatwagni at cellular level

1. Endoplasmic reticulum- Rough-synthesis of protein (*dhatwagni kriya*)
2. Smooth- synthesis of lipids and steroids, storage and metabolism of calcium (*dhatwagni kriya*), catabolism and detoxification of toxic substances (*bhautikagni kriya*).
3. Golgi apparatus-processing, packaging, labeling and delivering of proteins and lipids (*bhautikagni kriya*)
4. Lysosome- degradation of macromolecules (garbage system), autophagy, removal of excess secretary products activity by lysosome enzymes like hydroxylases, protease, lipase, amylase, nucleases (*bhutagni kriya*).
5. Peroxisomes- Large number of peroxisomes present in liver. These micro bodies contains some oxidative enzymes such as catalase, urate oxidase and D-amino oxidase which does breakdown of fatty acids, detoxification of metabolic products(bhutagni kriya)., oxygen utilization, accelerate gluconeogenesis from fats, degrade purine to uric acid, formation of myelin, formation of bile acids(*dhatwagni kriya*).
6. Mitochondrion- This organelle is concerned with production of energy. It contains enzymes such as acetyl-CoA synthase and glcerophophate acetyltransferase, succinic dehydrogenase, cytochrome oxidase, cytochrome C, ATP synthase. It is responsible for many enzymatic activities. Oxidative enzymes in cristae does oxidation of digested food like proteins, carbohydrates, lipids, water, CO_2 and energy is stored in mitochondrion which is used later for synthesis of ATP (*bhautikagni kriya*).
7. Ribosome- These are responsible for the synthesis of proteins of hemoglobin, preoxisome and mitochondria (*dhatwagni kriya*).

Hypothetically

- Location of *Dhatwagni* is especially in their respective tissues of particular *srotasa* (system).
- Correlation of *Dhatwagni* activity at cellular level is as catalyst of *dhatu sneha parampara* (Anabolism).
- Location of *Bhautikagni* is in liver and in the whole body at cellular level.
- Correlation of *Bhautikagni* activity at digestion as breaking complex food in building blocks and at cellular level is as *dhatuskhalan* with *urja/bala* production by *bhautikagnipaka* (Catabolism).

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