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A CRITICAL ANALYSIS OF *MEDO DHATU* : AN APPROACH TO EXPLORE THE PHYSIOLOGICAL ENTITY

[1]Mandal Nisith Kumar,[2]Kundu Suman, [3]JanaDipanjan, [4]Maity Gouranga, [5]Tripathi Joydip
[1]Assistant Professor,Dept. Of Kriya Sharir,RaghunathAyurvedMahavidyalaya& Hospital Contai, PurbaMedinipur,West Bengal-721403
[2]Assistant Professor, Dept. Of Kayachikitsa
[3]Assistant Professor, Dept. Of Panchakarma
[4]Assistant Professor, Dept. Of SariraRachanaa
[5]Assistant Professor, Dept. Of Kaumarbhritya

ABSTRACT

Ayurveda is a well documented science on human health. All the basic segments of medical sciences including anatomy, physiology, pathology, pharmacology are well described in *Ayurvedic* literatures as per *Ayurvedic* parlance. According to *Ayurveda*, *Dhatu* are considered as one of the basic functional as well as structural component of human body. There are seven basic *Dhatu* are present in human physiology as per *Ayurvedic* parlance.*Medo Dhatu* is a *Dhatu* which bear a resemblance with adipose tissue in both structural and functional aspect. This review aims at scanning of scientific articles to provide a comprehensive knowledge about the conventional entity of *Medo-dhatu*.

Keywords: *Dhatu*, *Medo-dhatu*, Adipose tissue

INTRODUCTION: *Ayurveda* is known as one of the most ancient medical literature in India as well as world. It deals both preventive and therapeutic aspect of health. The basic tributaries of medical science like anatomy, physiology, pathology, pharmacology etc are also available in *Ayurvedic* literatures. According to *Ayurvedic* compendia, physiological concept of human body are based on *Dosha, Dhatu* and *Mala*.[1]Concept of *Dhatu* is a unique speculation in *Ayurveda*. According to *Ayurvedic* point of view, the *Dhatu* is a component of human body which is associated with structural as well as functional support to human body.[2]Both physiologically and pathologically *Dhatu* bears an immense importance. An infirmity in *Dhatu*, makes it susceptible to vitiated *Doshas* which is termed as *Dosa-dushyasammurchana*. Thereafter a disease is manifested. According to affected *Dhatu* and causative *Dosha* there are a number of diseases in *Ayurveda*. Human body are composed of seven *Dhatus* , which are [3,4,5] *Rasa,Rakta,Mamsa,Meda,Asthi,Majja,Sukra*

Medadhatu is 4[th]*Dhatu* among all.

CRITICAL ANALYSIS OF *MEDO DHATU*

Acharya Madhavkar mentioned that '*Snehatmedojanayati*' that means *Medo* is derived from *Sneha or fatty food intake*.[6] The *Medosara* chiefly presents in *Udara* as well as in different forms in different sites such as[7]

- Inside *Anu-asthi* (small bones) – Known as *Saraktamedas*
- In *Sthula-asthi* (large bones) – Known as *Majja*
- In *Mamsa* – Known as *Vasa*.

Medodhatu is considered as *Sneha* dominant *Dravadhatu* which is having *Snigdha* properties and dominance of *Ambumahabhoota.*[8]

Medovaha Shrotas

Every *dhatu* have two distinct entity[9] –

- *Poshakadhatu*– It is immobile in nature and acts as storage.
- *Poshyadhatu* – It is the mobile in nature and takes part in biochemical reactions.

In *Ayurveda, Shrota* is considered as a path through which the *Poshyadhatu* pass to and from the *Poshaka Dhatu*.[10]Every

Dhatu has its own *Shrota* including *Medo Dhatu*.

Two different state of *Medo-Dhatu* also has been described in *Ayurveda*[11]

- *Baddhameda*(Stored in a particular site)
- *Abaddhameda* (Circulating in nature)

The *Medovaha-Shrotomoola* refers to the organs which may be closely related to *Medo Dhatu* functions or which are important sites of storage related to beginning or ending of the channels of *Medovaha-Shrota*.

According to *Brihatrayee* the *Medovaha Shrotamula* are as following

- *Charaka–Vrikka*(Kidney) and *Vapavaha* (Omentum)[12]
- *Shusruta–Vrikka*(Kidney) and *Kati (Waist region)*[13]
- *Vagbhatta–Vrikka*(Kidney) and *Mamsa*[14]

Function of *Medo Dhatu*

Snehana(Mobilization of lipid for physiological purpose) is the premier function of *Medo Dhatu* as well as others function of *Medo Dhatu* includes[15,16]

- *Sweda*(Sweat and sebum mediated excretion via skin)
- *Dardya*(Integrity)
- *Asthipusthi* (Metabolic support to bone)

DISCUSSION

Concept of *Meda Dhatu* Genesis vis-a-vis Lipid Metabolism in Normal Human Subject

Concept of *dhatu* in *Ayurveda*, bear a resemblance with tissue. The English word "tissue" has been derived from the French tissue, meaning something that is woven. In conventional system, tissue is considered as a basic *anatomical* and physiological component of the living organism.It is defined as an aggregation of morphologically similar cells and associated intercellular matter acting together to perform specific functions in the body.

Acharya Madhavkar has mentioned that '*Snehatmedojanayati'* that means *MedoDhatu* is derived from *Sneha* or fatty food intake.

Dietary fats are hydrolysed by the various lipolytic enzymes present in the GI tract. Triacylglycerides (TAG) molecule results in the release of 2-monoacylglycerol (2-MAG) and free fatty acids (FFAs).[17]Lipolysis of phospholipids compounds produce FFAs and lysophosphatidylcholine.[18]Most dietary cholesterol exists in the form of the free sterol, with only 10–15% existing as the cholesteryl ester. The latter must be hydrolyzed by cholesterol esterase to release free cholesterol for absorption.[19]

Digested lipids are taken up by enterocytes and packaged as chylomicrons for export into the lymphatic system. Chylomicrons are primarily very large, spherical TAG-rich particles that also contain PLs, cholesterol, vitamin E, vitamin A, and protein.

In the circulation, the triglycerides carried in chylomicrons are metabolized in muscle and adipose tissue by lipoprotein lipase and free fatty acids are released, which are subsequently metabolized by muscle and adipose tissue, and chylomicron remnants are produced. Chylomicron remnants are then occupied by the liver.

In the liver VLDL are formed via endogenous lipoprotein pathway. The triglycerides carried in VLDL are metabolized in muscle and adipose tissue by lipoprotein lipase releasing free fatty acids and IDL are formed. The IDL are further metabolized to LDL, which are taken up by via the LDL receptor in numerous tissues including liver. Reverse cholesterol transport are mediated via HDL. Cholesterol and phospholipids that are effluxes from cell, are carried by HDL towards liver.[20]

Storage and release of lipids are major functions of adipocytes. Hence adipose tissue is considered as lipid storage compartment.[21]

Synthesis and storage of TAG in adipose tissue occur in periods of energy excess, and hydrolysis of TAG occurs in adipose

tissue to generate fatty acids for use by other organs during periods of energy deprivation.[22]

Hence it may be inferred that in respect to origination, the concept of *Medo Dhatu* correlates with the adipose tissue which is considered as the principle site of lipid storage.

Chief Sites of *Medo Dhatu* vis-a-vis Adiposity

According to various *Ayurvedic* literatures, the potential storage of *Medo Dhatu* includes -

- *Sphik*(Buttocks)
- *Udara*(Abdomen)
- *Vapavahana*(Omentum)
- *Vrikka* (Kidney)
- *Asthis*(Bones)

Adipose tissue plays an essential role in regulating energy balance through its metabolic, cellular and endocrine functions.Adipose tissue has been historically classified into two types based on their metabolic activity[23]

- Anabolic white adipose tissue (WAT)
- Catabolic brown adipose tissue. (BAT)

BAT is be biologically active in neonates and young children to maintain normal body temperature generating heat. BAT regressed with aging by transforming into white adipose tissue WAT.[24]

Fat distribution in adult human body, two distinct types of white adipose tissue are found

- Subcutaneous areas (SCAT)
- Visceral adipose tissue (VAT)

VAT is present mainly in the mesentery and omentum and drains directly through the portal circulation to the liver. VAT adipocytes are more metabolically active, more sensitive to lipolysis and contains a larger number of inflammatory and immune cells.[25]

Adipose tissue distribution around the kidney have two distinct location

- Perirenal fat –An accumulation of adipose tissue between renal capsule and renal fascia
- Pararenal fat - Adipose tissue superficial to renal fascia

Brown adipose tissue developmentally found in interscapular and perirenal regions.[26]

Bone marrow adipose (BMAT) tissue develops postnatally and accounts for 50–70% of bone marrow volume in healthy adult humans. BMAT development is a normal physiological process. BMAT further accumulates with aging and in diverse clinical conditions.[27]

All the chief sites of *Medo Dhatu* as mentioned in *Ayurvedic* compendia, are found to be linked with adiposity.

Function of *Medo Dhatu* in Conventional Parlance

Sweda(Sweat and sebum mediated excretion via skin) :

The skin also acts as an excretory organ. Water-soluble exogenous and endogenous toxic/bioactive substances, such as metals, drugs, cytokines, and steroids can be eliminated in the sweat.

Sebum secretionpathway plays an important role in lipid and cholesterol homeostasis. An enhanced sebum secretion results in elimination of excessive circulating lipids and fat-soluble substances from circulation. The major component of human sebum is triglycerides and fatty acids (57%).Hence an increased circulating lipid leads to enhanced production of sebum.[28]

Dardya(Integrity)

A phospholipid bilayer with associated proteins that surrounds the cell is termed as plasma membrane. Plasma membrane are consist of phospholipid bilayer and membrane proteins. Lipids are the fundamental structural elements of membranes and proteins are responsible for carrying out specific membrane functions.[29]Lipids function as essential structural components of cell membranes and maintain cellular integrity. So the *Dardya* function of *Medo Dhatu*, may corresponds to function of plasma membrane lipid.

Asthipusthi (Metabolic support to bone)

It has been recently suggested that BMAT directly regulates bone metabolism. In the last decade, bone has emerged as a highly metabolic organ that contributes to the regulation of whole-body metabolism. BMAT also has been shown to be responsive to parathyroid hormone and to secrete receptor activator of nuclear factor kappa-B ligand (RANKL), a key regulator of osteoclast differentiation and activation. This suggests that BMAT exhibits unique osteo-resorptive characteristics.[30]

Snehan(Mobilization of lipid content)

Adipose tissue act as a lipid storage compartment in human body. Two primary metabolic activities of white adipose tissue includes lipogenesis and lipolysis.In response to changes in nutritional state, lipolysis rates are precisely regulated through hormonal and biochemical signals.[31]

Adipose tissue liberates glycerol and nonesterified fatty acids into systemic circulation via lipolytic pathway from triacylglycerol stores inside adipocytes.

Net cholesterol mobilization from adipose tissue also occurred after acute starvation.[32]Adipose tissue plays the central role in regulation of lipid mobilization and metabolism.

CONCLUSION

Both anatomical as well as physiological aspect of *Medo Dhatu* conventionally correlates with adipose tissue. Role of adipose tissue in human physiology are recently in the prime area of interest. Adipose tissue plays an important role in various metabolic disorder like metabolic syndrome, diabetes mellitus etc. Ancient classical texts of *Ayurveda* also descried various metabolic disorders such as *Atisthoulya, Madhumeha* etc associated with altered physiology of *Medo-Dhatu*.

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Corresponding Author: Dr.Nisith Kumar Mandal,Assistant Professor,Dept. Of Kriya Sharir,RaghunathAyurvedMahavidyalaya & Hospital Contai, PurbaMedinipur,West Bengal-721403
Email: mandalnisith09@gmail.com.

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