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### Differences And Relations Between *Meda*, *Majja* And *Vasa* With Their Modern Aspects.

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#### ABSTRACT: -

*Ayurveda* is a practical and reliable ocean of knowledge and every word written in ancient texts of *Ayurveda* is totally right. Adipose tissue was earlier known only as depot of fat but different researches proved it much more than just a fat store. But *Acharyas* in their texts wrote this earlier before the modern science proved it. According to anatomical positions, and compositions, *Acharyas* divided them into *Meda* (fat), *Majja* (bone marrow) and *Vasa* Adipose tissue). Now a days *Meda* (fat) can be called as visceral fat, *Majja* as bone marrow and *Vasa* as intramuscular fat. These three are having effect on other tissues of body like *Meda* is responsible for formation and nutrition of *Asthi dhatu* (bone) and *Majja* is responsible for formation of *Shukra dhatu* (semen). And hence this shows functional interdependence of between different tissues of body. The *praman* (evidence) of these tissues is also given and disturbances caused due to their increased or decreased level is also given. This shows importance of different tissues in maintaining equilibrium of the body. This review article is an attempt to explore the physiological aspects of *Meda* (fat), *Majja* (bone marrow) and *Vasa* (Adipose tissue). Differences and relations between these three are described in this article. Different researches in modern science are also mentioned here to show how the views of *Acharyas* are accepted globally.

**Keywords-** *Majja*, *Vasa*, *Meda*, adipose tissue, bone marrow, *Dhatu* etc.



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## INTRODUCTION

Adipose tissue is earlier known only for depots or source of extra energy for the body or as a stored energy but modern researchers proved that there is homeostatic function of adipose tissue in the body. Adipose tissues are having number of different functions based on their location in the body. Adipose tissue is having its important role in different physiological processes like bone metabolism, immune mechanism, reproductive functions etc. all these functions are done by adiposities via adipokines. Adipose tissues are basically loose connective tissue. They are mainly comprised of adipocytes which include nerve tissue, stromovascular cells and immune cells which are present in different places of the body.<sup>1</sup>

In *Ayurvedic* literatures, ancient *Acharyas* mentioned the *Meda* (fat) distribution in the body at different places by different names. For example, when it is present in small bones and abdomen (around viscera) it is called *Meda* (fat) i.e., visceral fat, when present in long bones is known as *Majja* (bone marrow) i.e. bone marrow and if it is present in intermuscular fat, it is known as *Vasa* i.e. musclefat.<sup>2</sup>

*Acharyas* also mentioned the role of these in maintenance of physiological status of body and also in manifestation of disease. *Acharyas* mentioned *Meda* (fat) and *Majja* as *dhatu* which is tissue as per modern aspects and *Vasa* is called *upadhatu* or subsidiary tissue<sup>3</sup>. *Acharyas* while explaining about these, explained every aspect like their compositional

differences, quantity and functions, their role in manifestation of disease and their use in treatment. Even There is less explanation given of anatomical and physiological aspects of these but *Acharyas* given a vast detail of applied physiology under the therapeutic use of these in different disorders according to involvement of *Dosha* and season etc. as *Acharya charak* said that disturbances in *Dosha*, *Dhatu* (body tissue) and *Mala* (waste) leads to *Vyadhiutpatti* (pathology)<sup>4</sup>. For maintenance of equilibrium of body (homeostasis), treatment is described according to *Samanya* and *Vishesh siddhant* (homologue and analogue principle)<sup>5</sup>. Use of substances which increases *Meda dhatu* in *Medakshaya*<sup>6</sup> is an example shows deep knowledge of ancient *Acharyas*. *Acharya* has given perfect explanation of each and every aspect of adipose tissue. This review article is an attempt to details the physiological aspects of *Meda* (fat), *Majja* (bone marrow) and *Vasa* (Adipose tissue) and differences between them based on their location or functions.

## MATERIAL AND METHOD

Detailed study of all the references given by different *Acharyas* at different places about *Meda* (fat), *Majja* (bone marrow) and *Vasa* (Adipose tissue) is done with recent researches in adipose tissue including material provided on internet like pub med, science direct, etc.

### **Composition of Vasa (Adipose tissue), Majja (bone marrow) and Meda (fat)<sup>7</sup>-**

When discussing about the *Panchbhautic* composition of *Meda* (fat), *Majja* (bone marrow) and *Vasa* (Adipose tissue), *Acharyas* explained that *Meda dhatu* (fat) is made up of *Jala* (water) and *Prithvi Mahabhuta*, while *Majja* (bone marrow) is made up of *only Jala mahabhuta*. There is no description of *Panchbhautic Sangathan of Vasa*.

### **Sites of Meda (fat), Majja (bone marrow) and Vasa (Adipose tissue)<sup>8</sup>-**

*Meda dhatu* (fat) is present in cavity of small bones, abdomen (*udara*), and red bone marrow (*sarakta Meda*). *Majja dhatu* is present in cavities of long bones and skull bones (*mastakgata Majja*). *Vasa* is present as *sneha* or unctuousness of *mansa dhatu*.

According to modern point of view, *Meda* (fat) can be correlated with visceral white adipose tissue (VWAT) which is present around the omentum, intestines and perirenal areas which accounts for total 10% of total adiposities of the body and brown adipose tissue (BAT) which is present in cervical, axillary, and inter-scapular and supraclavicular regions.

Talking about *Majja*, *Majja* (bone marrow) can be understood by bone marrow adipose tissue which is situated in ribs, sternum, vertebrae and medullary canal of long bones (tibia, femur and humerus). *Rakta Majja* is red bone marrow or regulated marrow adipose tissue (rMAT). It is present withing active sites of hematopoietic sites such as mild to proximal tibia, femur and lumbar vertebrae. *Peeta Majja* is yellow bone marrow or constitutive marrow adipose tissue (cMAT). It is situated at distal tibia and caudate vertebrae of the tail.

*Vasa* can be understood by subcutaneous white adipose tissue (SWAT) and its sites are buttocks, thighs and abdomen. And it is 85% of total adipocytes of the body.

### **Types of Meda (fat), Majja (bone marrow) and Vasa (Adipose tissue)-**

*Meda* (fat) can be divided as *baddha* and *abaddha Meda*<sup>9</sup>. *Baddha Meda* is deposited fat while circulating lipids are *abadhha Meda*. *Majja* is having subtypes of *rakta* and *peeta Majja* (red and yellow bone marrow). It is also divided as bone marrow (*asthigata Majja*) and brain marrow (*mastulunga Majja*)<sup>10</sup>. *Vasa* have no divisions.

### **Quantity of Meda (fat), Majja (bone marrow) and Vasa (Adipose tissue)<sup>11</sup>-**

*Meda* – 2 *anjali*

*Majja*- 1 *anjali*.

*Mastulunga gata Majja*- ½ *anjali*.

*Vasa*- 3 *anjali*

### **Response of Meda (fat), Majja (bone marrow) and Vasa (Adipose tissue) to various factors-**

*Ayurvedic Acharyas* described about the factors which vitiated *Medovah srotas* and *Majjavaha srotas* separately. Lack of exercise, excessive day sleep, excessive Intake of fatty things, and alcohol (*varuni*) are causes of *Medovah srotas* vitiation. While causes of vitiation of *Majjavaha srotas* are crushing, injury and compression of bone marrow<sup>12</sup>. Visceral white adipose tissues (VWAT) and subcutaneous white adipose tissues (SWAT) secretes adipokines which are mainly responsible for distinguished metabolic consequences. Chronic low grade inflammation is manifested by visceral adipose tissue via lower amount of beneficial adiponectin and higher amount level of pro-inflammatory factors secreted by them. This is the reason why they are called as bad adipose tissues. Metabolically they are more active and show increased lipolysis in response to catecholamines diminished lipolysis in response to insulin and  $\alpha 2$  adrenergic agonist activity. (Ma X et al., 2015; Bruun JM et al., 2005; Wellen KE and Hotamisligil GS, 2005) All these adipose tissue have different

responses to various factors like excessive cortisol increases central fat, subcutaneous fat is reduced by growth hormones, brown fat adipogenesis is increased by thyroid and estradiol, brown fat differentiation is reduced by cortisol.

#### **Nourishment of Meda (fat), Majja (bone marrow) and Vasa (Adipose tissue)-**

*Acharyas* explaining about nourishment stated that nourishment of *dhatu* (body tissue) is done by *Ahara rasa* (digestive juice) and *Rasa dhatu* (Plasma) and previous *dhatu* are the factors which affects qualitative and quantitative status of nourishment of *dhatu* (body tissue).

*Meda dhatu* and *Vasa* is nourished by *Mansa dhatu* while *Majja* is nourished by *Asthi dhatu* (bone)<sup>13</sup>. Support for this statement can be given by using modern researches. There is common progenitor of myocyte and adipocytes. Lateral and paraxial mesoderm's are common precursors of common mesenchymal stem cells. White adipose tissue is derived from lateral mesoderm. On other hand myocytes and brown adipose tissue are derived from paraxial mesoderm<sup>14</sup>. Also the skeletal muscles regulates the fatty acid and glucose metabolism and in case of any abnormality during intrauterine life, in the development of skeletal muscles, it causes disturbances in metabolism of fat which leads the patient being more susceptible for type 2 diabetes mellitus. Muscle contracts and releases myokines which enhances glucose uptake and lipolysis and have beneficial effect on glucose and lipid metabolism. Also they regulates lipid and glucose metabolism by exerting systemic effect on liver and white adipose tissue<sup>15</sup>. This explains the *Ayurvedic* view that normal functional status of *Mansa* and *Mamsa dhatvagni* nourishes *Meda dhatu* (fatty tissue) appropriately but when there is vitiation it leads to disturbance in nourishment of *Meda dhatu* (fatty tissue).

*Ayurveda* says that nourishment of succeeding

*dhatu* depends upon the previous *dhatu* and nourishment of *Majja dhatu* (fatty tissue) depends upon *ashti dhatu* (bone)<sup>16</sup>. It can be understood by a previous study which reported that the adipocytes of bone marrow and osteoblasts have common precursor effects development of each other. Another study also suggested that visceral adipose tissue also having positive effect on bone marrow adipocytes and visceral adipose tissue (*Meda*) are also previous *dhatu* of *Majja* (bone marrow adipocytes).

#### **Functions of Meda (fat) and Majja(bone marrow)-**

*Meda (fat) and Majja (bone marrow)* have many important functions in maintenance of equilibrium of the body. *Meda* provides unctuousness(*sneha*), sweat (*sweda*), stability, and nourishment of bones. And *Majja* provides unctuousness (*sneha*), strength (*bala*), nourishment of reproductive organ (*shukra pushti*), and filling of bones<sup>17</sup>. They have main role in nourishment of bone and reproductive tissue as described by different *Acharyas Ayurveda*. *Acharya Sushruta* In *Sutrasthana* said that imbalance state of *Meda and Majja* i.e. *Meda vridhhi* and *Majja kshaya* disturbs functioning of bone tissue and creates abnormalities<sup>18</sup>. This shows the role of secretions of adipocytes i.e. adiponectin and leptin in bone remodeling and reproductive functions.

Role of adiponectin- Bone growth is inhibited due to increased apoptosis and decreased proliferation in short term while bone formation is increased by adiponectin in long term regulation<sup>19</sup>.

Role of leptin- through local and systemic effect leptin effects bone remodeling. Secretion of neuroendocrine hormones through hypothalamus is affected by leptin which ultimately effects bone metabolism. Bone density and bone turnover is enhanced by this through peripheral effect<sup>20</sup>.

This describes how *Asthi dhatu* (bone) is controlled by *Meda dhatu*.

The functions of *Majja dhatu* are described as *Shukra Utpatti* and fulfillment of *Asthi Dhatu*. Recent study shows that bone marrow adipocytes are having role in regulation of bone homeostasis<sup>21</sup>. In another study, evidences of induced spermatogenesis from bone marrow adipocytes in azoospermia hamster was reported which indicates its function in *shukra dhatu* (semen) formation<sup>22</sup>.

## DISCUSSION

As we can say now that there are many similarities in views of *Ayurvedic* and modern sciences about adipocytes. In *Ayurvedic* texts, the *dhatu* and *upadhatus* are meant to maintain equilibrium of the body as *Majja* and *Meda dhatu* do and in modern sciences also explained it by saying that bone marrow are not only filler of bone but also maintains homeostasis of body and adipocytes are not only store of fat but also have effects on bone metabolism. Both modern and *Ayurvedic* sciences mentioned maximum quantity of *Vasa* (subcutaneous adipocytes) among three.

After all the analysis done above, role of *Meda dhatu* can be defined as maintenance of energy homeostasis and metabolism. *Meda vriddhi* leads to obesity and prodromal symptoms of *prameha* (*prameha purvarupa*) and its *kshaya* (hypo-functional state) results in *kashrya* (emaciation) especially in abdomen and flank region. As *Meda dhatu* is responsibility for *asthi dhatu* nutrition and development, it also effects *Asthi dhatu* (bone) and leads to hypo- functional state of bone (*asthi-kshaya*). Hyper functional state also causes cardiovascular disturbances and excess sweating.

*Majja dhatu* supports the functioning of *Meda* (fat), *rasa* (Plasma), *asthi* (bone), *shukra dhatu*, (semen) and regulates functioning of

*vata* and *kapha* as its hypofunctional state (*Majja-kshaya*) leads to consistent nervous disorders, regulates immunity or *bala* in body respectively.

*Vasa* provide support to visceral organs as it is therapeutically indicated in case of prolapsed.

## CONCLUSION

In *Ayurvedic* literature, there is not much details about *Meda* (fat), *Vasa* (adipose tissue) and *Majja* (bone marrow) but there is detailed description present about clinical physiology of *Meda* (fat), *Vasa* (adipose tissue) and *Majja* (bone marrow). Composition, functions, distribution, quantity, separate vitiating factors for *Meda* and *Majja*, all these descriptions given in *Ayurvedic* texts tells us that *Acharyas* was known to all the functions of *Meda* (fat), *Vasa* (adipose tissue) and *Majja* (bone marrow). Many functions described by *Acharyas* are proved by researches occurred in modern sciences but more scientific studies are required so that more clear explanations can be made in support of our text.

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