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A CRITICAL REVIEW OF MEDOVAHA SROTAS AND STHAULYA IN AYURVEDA IN REFERENCE TO MODERN PERSPECTIVE

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ABSTRACT

Ayurveda is a traditional system of Indian medicine. The main aim of this system is to maintain the health of a healthy person and cure the disease of ailing person. *Ayurveda* describes a systemic biological transport system comprising of gross and minute as well as very subtle channels transporting not only fluids, nutrients and waste products but also energy and impulses in different biological parts of body. These channels are called as *Srotasas*. The *Srotasas* are innumerable, but 13 gross channels are clinically approachable and are affected in different disease states with detailed manifestations. These 13 gross channels comprise of three channels which transfer life-support substances from outside to inside the body which are called *Pranavaha* (carrying vital energy), *Udakavaha* (carrying body fluid) and *Annavaha Srotas* (carrying food nutrients). The living body is a huge unified micro-macro channel system as narrated in Ayurveda– "*स्रोतोमयं हि शरीरम्*". The micro channels of circulation are intra-cellular, inter-cellular and extra-cellular transportation mechanism of human body. A channel is defined as a circulation which incessantly secretes Dhatus & excretes waste products from the human body. The functional anatomy of *Medovaha Srotas* is a matter of discussion as per modern medical science. Very few work has been done on the conceptual or functional anatomy of *Medovaha srotas*. In this article, an attempt has been made to find out the functional anatomy of *Medovaha Srotas* with special reference to modern medical perspective. For this study, the basic material is collected from the Ayurvedic classics with the available commentaries as well as textbooks of contemporary science for a better understanding of the

concept and its evaluation with contemporary science.

KEYWORDS: *Medovaha Srotas*, *Vrikka* (kidney), *Vapavahan* (greater Omentum) *Meda* (fat), *Sthaulya* (obesity), Adipose tissue.

INTRODUCTION

The human body is a cluster of the *Srotasas*. *Srotasas* are defined as the channels which incessantly secrete Dhatus & excrete waste products from the human body. The human body is a conglomeration of *Srotasas as* "अपि चैके स्रोतसामेव *समुदायंपुरुषमिच्छन्ति*".[1] The *Srotas* as are also responsible for transportation of *Doshas i.e. Vata, Pitta and Kapha*. These three *Doshas* function at various levels of the organization such as cellular level, single-system level, and organism level. In *Ayurveda*, a person is said to be healthy whose humours and metabolic state are in the status of equilibrium, whose functional activities of the tissues and excretory products are in a balanced state and the soul, senses and mind are in a state of complete well-being.[2] The knowledge of anatomy and physiology of *Srotas* is very essential as it is responsible for carrying & transformation of tissue elements and there by maintaining the health. These channels carry *Prana*, *Udaka*, *Anna*, *Meda*.[3] *Medovaha Srotas* is also one of these Srotasas. *Its* channels carry the substances which nourish *Meda* & fat-carrying ducts. Acharyas have described that the Moolasthana (origin) of *Medovaha Srotasas* are *Vrikka*, *Vapavahan* and *Kati*.

Table 1: Correlation of structures or entities as per ayurvedic text with modern perspective.

Name of Srotas	**Moolasthana (Origin)**			
	***Charaka Samhita*[4]**	***Sushruta Samhita*[5]**	***Astanga* Sangraha[6]**	**Modern Perspective**
Medovaha Srotas	*Vrikka* and *Vapavahana*	*Vrikka* and *Kati*	*Vrikka* and *Mamsa*	Kidneys, Omentum Waist

Aims and Objects

1. To study the *Medovaha Srotas* as mentioned in *Ayurvedic Samhitas* and their commentaries.
2. To study modern co-relation with modern parameters and applied aspect.

MATERIAL AND METHODS

The material is collected from the available concerned literature in *Ayurveda* and modern

medical science text books.

Literature Review

***Srotas*-** According to *Acharya Chakrapani*, the channels transporting the *Poshaka Dhatu* (the part of *Rasa*, *Rakta* etc. tissues which flow to provide nutrition to the successive tissues) are called *Srotasas*. *Srotasas* have colour similar to those of the Dhatus they carry and are of tubular, large or small, long and tendril type in shape.[7]

***Srotas dushti lakshan*:** *Atipravritti* (increased flow), *Sanga* (obstruction), *Siragranthi* (formation of nodules and flow of bodily fluids) and *Vimarga-gamana* (flowing of contents in the wrong or opposite direction) are the features of morbidity of *Srotas.*[8]

Medovaha srotas

The *Medovaha Srotas* has its root in the *Vrikka* (kidneys), *Vapavahna* (Omentum) and *Kati* as per different Acharyas. The *Medovaha Srotas Moola* means the origin which may be closely of *Medo dhatu* functions or which are the important sites of the origin or termination of the channels of *Medo dhatu*.

***Vrikka* (kidneys):** The kidneys develop from two sources. The excretory tubules or nephrons are derived from the lower part of the nephrogenic cord. This part is the called metanephros, the cells which form the metanephric blastema. The collecting part of the kidneys is derived from a diverticulum called the ureteric bud which arises from the lower part of the mesonephric duct[9] According to the modern science kidneys are surrounded by fat. These have following coverings -

1. **The fibrous capsule:**- A thin membrane which closely invests the kidney and lines the renal sinus.
2. **Perirenal or perinephric fat:**- It is a layer of adipose tissue lying outside the fibrous capsule.
3. **Renal fascia:-** A layer of connective tissue encapsulating the kidneys and the adrenal glands made up of two separate layers: the anterior renal fascia, also called as Gerota fascia and the posterior renal fascia, also called as Zuckerkandl fascia.
4. **Pararenal or paranephric body/fat:-** It consists of a variable amount of fat lying outside the renal fascia and towards the lower pole of the kidney which fills up the para-vertebral channel and forms a cushion for the kidney.

The renal capsule is a tough fibrous layer encompassing the kidney and is covered in a layer of peri-renal fat known as the adipose capsule of kidney. The adipose capsule is sometimes comprised in the structure of the renal capsule. It provides protection to kidney from trauma and damage. The renal capsule is surrounded by the renal fascia. Overlying the renal fascia and between this fascia & the transverse facia there is a region of para-renal fat. Therefore *Vrikka* (kidneys) is *Moolasthana* (origin) of *Medovaha Srotas*. The *Vrikka* is known as kidney. In *Kati* region (waist) there is abundant amount of fat. Therefore it is considered as *Moolasthana* (origin) of *Medovaha Srotas.*

Vapavahan:- The *Medovaha Srotas* is comprised of capillaries of the perinephric tissue and omentum. According to modern medical science, greater omentum is a large peritoneal fold attached to the stomach like an apron & covers the loops of intestines to a varying extent. It is the store house of fat having varying amounts of adipose tissue. This carries the fat which is absorbed from intestines to all over the body. The functions of the greater omentum are: -.

- **Immune contribution** having milky spots of macrophage assemblies.
- **Infection and wound isolation**; It may physically limit the distribution of intra-peritoneal infections. The greater omentum can often be found wrapped in the infection and trauma.

Therefore *Vapavahan* may be the *Moolasthana* (origin) of *Medovaha Srotas*. It can be correlated with Greater Omentum.[10]

Table 2: Correlation of structures or entities as per modern perspective on basis of its functional anatomy.

	Structures or entities as per *Ayurveda* Text	**Correlation of structures or entities as per Modern Perspective on basis of its functional anatomy**
Utpaptti	*रक्तमेदःप्रसादादवृक्कkSS(सु.शा.4 /30)* *Rakta* and *Meda Matrij* B*hava*	Metanephros Collecting part- Ureteric bud
No. of kidneys	2	2
Situation	*वृक्कोमांसपिण्डंद्वयंएकोवामपार्श्वस्थितः | द्वितीयोदक्षिणपार्श्वस्थितः || (डल्हण-सु.नि.4 /30)* *Vaam* and D*aksin vaam parshsawa*	Epigastric, hypochondriac, lumbar, umbilical regions. At vertebral level of T12 -L3
Type with *Srotas*	*Medovaha Srotas*	Fat
Shape	*वृक्कोकुक्षीगोलको* *Kukshistha golka*	Bean shaped structure
Weight	-	135-150gm.
Diameter	-	11 x 6 x 3cm

Injury to Moolasthana of *Medovaha Srotas*-

- *Sweda Agamanam* (sweating)
- *Sniddha Angata* (oily appearance of body)
- *Taalu Shosha* (dryness of palate)
- *Sthulata* (obesity)
- *Shopha* (oedema)
- *Pipasa* (thirst)

Vitiation of medovaha *srotas*

अव्यायामाद्दिवास्वप्नान्मेद्यानां चातिभक्षणात्|

मेदोवाहीनि दुष्यन्ति वारुण्याश्चातिसेवनात्||

The causes of vitiation of *Medovaha Srotas* are due to lack of physical exercise, sleeping during the day, and excessive intake of fatty food and alcoholic drinks[11]

Formation of *medo dhatu*

Medo dhatu is an important *Dhatu* of body. It is present all over the body especially in abdomen. "*Medasa Snayusmbhava*" means that the metabolic product of *Meda* (Upadhatu) *Snayu* (ligament) is derived from Meda (adipose tissue)[12]

*रसाद्रक्तं ततो मांसं **मांसान्मेदस्ततो**ऽस्थि च |*

स्वतेजोऽम्बुगुणस्निग्धोद्रिक्तं मेदोऽभिजायते |

The nutritive part present in the *Mansa Dhatu* is transformed into *Medo dhatu* by its own *Medo Dhatwagni* and *Jala Mahabhuta* part during Paka process which makes the *Dhatu Snigdha* and *Drava* in nature.[13]

Digestion of various foods through hydrolysis

Hydrolysis of fats:- Almost whole fat portion of the diet consists of triglycerides (neutral fats) which are the combination of three fatty acid molecules condensed with a single glycerol molecule. During condensation, three molecules of water are removed. The fat-digesting enzymes return three molecules of water to the triglyceride molecule and there by split the fatty acid molecules away from the glycerol.

Digestion of fats:- By far the most abundant fats of the diet are the neutral fats which are also known as triglycerides. Each molecule of this is composed of a glycerol nucleus and three fatty acid side chains. The phospholipids and cholesterol molecules encompass fatty acid and therefore from can be considered as fat. Therefore from dietary point of view cholesterol can be considered as fat. A small number of triglycerides is digested in the stomach by linguallipase secreted by lingual glands in the mouth and swallowed with the saliva. This amount of digestion is less than 10% and is generally unimportant. Instead, all fat digestion occurs in the small intestine essentially.

Steps in fat digestion

1. The first step in fat digestion is: to physically breakdown the fat globules into small proportions so that the water-soluble digestive enzymes can act on the globule surfaces. This process is called emulsification of the fat and it starts by the process of agitation in the stomach to mix the fat with the products of stomach digestion.
2. Most of the emulsification then occurs in the duodenum under the influence of bile, which contains large quantities of bile salts as well as the phospholipid lecithin. Both of these substances, especially the lecithin are extremely important for emulsification of the fat.
3. Therefore, the fat-soluble portions of these liver secretions dissolve in the surface of the fat globules, with the polar projections. The polar projections, in turn, are soluble in the adjoining watery fluids, which significantly decrease the interfascial tension of the fat and make it soluble as well.
4. Subsequently, a chief function of the bile salts and lecithin in the bile is to make the fat globules readily fragmentable by agitation with the water in the small bowel. This represents an increase of as much as 1000-fold in total surface area of the fats caused by the emulsification process.
5. The lipase enzymes are water-soluble compounds and can tack the fat globules only on their surface. Triglycerides are digested by pancreatic lipase, present in enormous quantities in pancreatic juice, enough to digest all triglycerides within 1 minute that it can reach.
6. Most of the triglycerides of the diet are split by the pancreatic lipase into free fatty acids and 2-monoglycerides.
7. Bile Salts form micelles that accelerate fat digestion. The hydrolysis of triglycerides is a highly reversible process; therefore, accretion of monoglycerides and free fatty acids in

the vicinity of digesting fats rapidly block further digestion.

8. When bile salts are of enough concentration in water, they have the propensity to form micelles which are small spherical, cylindrical globules 3-6 nm in diameter composed of 20-40 molecules of bile salt.
9. The bile salt micelles also act as a transport medium to transport the monoglycerides and free fatty acids, both of which would otherwise be comparatively insoluble to the brush borders of the intestinal epithelial cells where these are absorbed into the blood.

Absorption in the small intestine:- When fats are digested to form monoglycerides and free fatty acids, both of these digestive end products first become dissolved in the central lipid portions of bile micelles. This process leaves the bile micelles still in the chyme, where they function again and again to absorb more monoglycerides and fatty acids. In the presence of abundant of bile micelles i.e. about 97% of the fat is absorbed; in the absence of the bile micelles only 40-50% can be absorbed. These are primarily used to form new triglycerides which are subsequently released in the form of chylomicrons through the base of the epithelial cells to flow upward via the thoracic lymph duct and empty into the main stream circulation of blood.

Direct absorption of fatty acids into the portal blood circulation:- The Small quantities of short and medium chain fatty acids, such as those from butterfat, are absorbed directly into the portal blood rather than being converted into triglycerides and absorbed by way of the lymphatics. This phenomenon consents direct diffusion of these short-chain fatty acids from the intestinal epithelial cells directly into the capillary blood of the intestinal villi.

Fat metabolism:- Although most cells of the body metabolize fat, certain aspects of fat metabolism occur chiefly in the liver. Specific functions of the liver in fat metabolism are as follows:

I. Oxidation of fatty acids to supply energy for additional body functions.
II. Synthesis of large quantities of cholesterol, phospholipids and most of the lipoproteins.
III. Synthesis of fat from proteins and carbohydrates.

To originate energy from neutral fats, the fat is first split into glycerol and fatty acids. Then the fatty acids are split by *beta-oxidation* into two-carbon acetyl radicals that form *acetyl coenzyme A* (acetyl-CoA). This can enter the citric acid cycle and be oxidized to liberate tremendous amounts of energy. Thus, the liver is responsible for a major part of the metabolism of fats.

About 80 per cent of the cholesterol synthesized in the liver is converted into bile salts which are secreted into the bile; the remaining 20% is transported in the form of lipoproteins and carried by the blood to the tissue cells everywhere in the body. Almost entirely the fat synthesis in the body from carbohydrates and proteins occurs in the liver. Further it is transported in the form of lipoproteins to the adipose tissue to be stored.

Fat deposits:- The large quantities of fat are stored in two major tissues of the body, the *adipose tissue* and the *liver*. The adipose tissue is generally called *fat deposits.* The major function of adipose tissue is storage of triglycerides until these are needed to provide energy elsewhere in the body. A secondary function is to provide heat insulation for the body. The fat cells (adipocytes) of adipose tissue are modified fibroblasts that store almost pure triglycerides in quantities as great as 80 to 95 per cent of the entire cell volume.

Importance of fat Synthesis and Storage:- Fat synthesis from carbohydrates is especially important for two reasons:

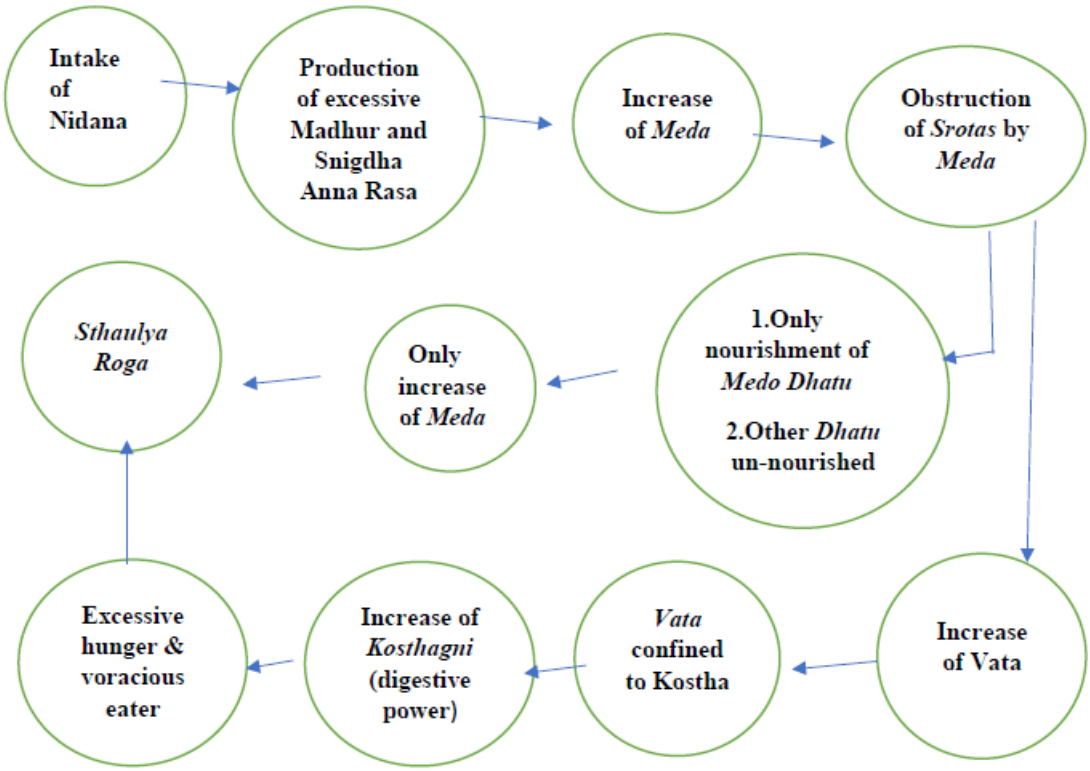
1. The capacity of different cells of body to store carbohydrates in the form of glycogen is generally modest; a maximum of only a few hundred grams of glycogen can be stored in the liver, the skeletal muscles, and different tissues of the body put together.
2. Each gram of fat contains almost two and a half times the calories of energy contained by each gram of glycogen. Therefore, for a given weight gain, a person can store maximum energy in the form of fat than in the form of carbohydrate which is very important when an animal is highly motile to survive.[14]

***Sthaulya* (Obesity):-** *Sthaulya* is a disease which is directly concerned with the *Meda* and *Santarpanjanya Vyadhis.* It occurs due to vitiation of *Medovaha Srotas*.

Nidana:- It is found that dietary factors, lifestyle factors, psychological factors and genetic factors all are responsible for *Sthaulya*. *Nidana* of *Sthaulya* includes *Aharaja Hetu* in the form of food rich in carbohydrate (ghee, oil, newly harvested rice and fresh wine) and *Viharaja Hetu* like lack of exercise (sedentary lifestyle), lack of sexual activity, day sleep, *Chinta shunyata* (lack of mental exercise) and various psychological factors. As per Ayurveda, the maternal genetic factors (*Matrija Bhavas*) are responsible for formation of *Medo Dhatu.* The excessive *Medo Dhatu* is formed by defective genetic material, which is referred as *Bija Svabhava* in *Ayurveda.*[15]

***Samprapti* of *sthaulya* (Pathogenesis):-** Due to the obstruction of body channels by *Meda*, the movement of *Vata* is specifically confined to *Koshtha* (abdominal viscera) resulting in the stimulation of digestive power and absorption of food. Hence, the person digests food quickly and becomes a voracious eater. By not following rules of ingestion of meals at specific times during the day, one is distressed by various dreadful diseases. *Agni* (*Pitta* component responsible for digestion) and *Vata* are the two most troublesome factors from the study point of obesity. These factors blight an obese person just as the wild fire destroys a forest. As the body gains excessive fat, vitiated *Doshas* suddenly cause severe diseases resulting in rapid deterioration of life. The person is considered too obese when there is an extreme increase in fat and muscle tissue in the regions of buttocks, abdomen and breasts which becomes pendulous and suffering from deficient metabolism & energy.[16]

Pathogenesis of *sthaulya* pathway



Dosa-Dushya Vivechan-

- ***Dosha:*** *Kapha* predominant *Tridosha*,
- ***Dushya*:** *Medo Dhatu*,
- ***Srotas:*** *Medovaha Srotas*,
- ***Agni:*** *Jatharagni + Medo Dhatvagni*,

- ***Adhisthan:*** *Sphik, Udara, Stana,*
- ***Srotadusti:*** *Sanga,*
- ***Prognosis:*** *Chirakari Vyadhi.*

Obesity:- Obesity means deposition of excessive fat (adipose tissue) in our body mostly due to dietary disproportion & over nourishment that imparts the health risk. People are generally considered obese when their body mass index (BMI) = weight in kg/ height in m^2 is disproportionate. A BMI between 25 & 29.9kg/m^2 is called over weight and a BMI greater than 30kg/m2 is called obese, which is associated with increased adipose storage in the subcutaneous tissues, skeletal muscles and internal organs such as kidney, omentum, heart and liver. Each 9.3 calories of excess energy stores approximately 1gm of fat.[17]

Obesity increases the probability of various diseases and conditions, mainly cardio-vascular disease, type 2 diabetes, obstructive sleep apnoea, certain types of cancers, osteoarthritis and depression. Obesity is generally caused by a combination of extreme food intake, lack of physical activity and genetic susceptibility. A few cases are caused primarily by genes, endocrine disorders, medications and mental disorders. The opinion that "obese people eat little yet gain weight due to a slow metabolism" is not medically supported. Normally, obese people have a greater energy expenditure than their normal counter parts due to the energy required to maintain an increased body mass.

There are many possible patho-physiological mechanisms involved in the development and maintenance of obesity. Leptin and ghrelin hormones are produced peripherally. These control appetite through their actions on the central nervous system. In certain, these and other appetite-related hormones act on the hypothalamus, a region of the brain which controls the regulation of food intake and energy expenditure.

DISCUSSION

In this literary study we collected various data from the Ayurvedic classics with the available commentaries, as well as text books of modern medical science, various articles for better understanding of the *Medovaha Srotas* and *Sthaulya;* and its comparison with contemporary modern medical science. *Acharya Chakrpani* has described that "*स्रवणादिति रसादेरेव पोष्यस्य स्रवणात्*".

it refers to the macro and micro internal transport system of the body and pathways concerned with the function of accepting, rejecting as well as carrying the vital external support for life from outside viz. *Prana* (air), *Anna* (food) and *Udaka* (water) which are essential to sustain life besides ejecting the excreta viz. *Mala* (feces), *Mutra* (urine) and *Sweda* (sweat) in order to keep the internal environment clean. There are special systemic *Srotasas* for circulating the nutrients and bio-factors through each of the seven *Dhatus*. The *Medovaha Srotas* has its root in the *Vrikka* (kidneys), *Vapavahana* (omentum) and *Kati;* because adipose tissue is stored in renal fascia of kidneys, omentum, liver & subcutaneous tissue of abdomen, flanks etc. The circulation of adipose cells in human body is prevalent in subcutaneous tissue, omentum, kidney and liver. Therefore fat depositions is mainly found in this region due to vitiation of this *Srotas.*

The term '*Sthaulya*' (Obesity) itself indicates the deposition of *Prithvi* and *Aapa Mahabhuta* dominant factors in the body. *Nidana* of *Sthaulya* is divided into four categories *Aharatmaka*, *Viharatmaka*, *Manasa* and others. Besides these *Nidanas*, nowadays it is seen that due to highly refined food with maximum percentage of carbohydrates & habituality of high-tech machineries also makes a person less active & prone to obesity. The risk factors of obesity described by ancient scholars of *Ayurveda* are very much similar to the factors found in modern science. More over mutation of leptin receptors and congenital deficiency of leptin may be the reason behind *Bija Svabhavaj Sthaulyta* (genetic obesity).

CONCLUSION

Our *Acharyas Charaka* and *Sushruta* mentioned that *Vrikka*, *Kati* & *Vapavahan* are the *Moolasthana* of *Medovaha Srotas*. In the above context *Medovaha Srotas* originates from *Vrikka*, *Kati* & *Vapavahan.* Therefore it can be understood that the stores of adipose tissue having important endocrine functions of kidney, omentum, liver & subcutaneous tissue of abdomen & flanks can be compared with *Medovaha Srotasa*. Fat deposition is mainly found in this region due to vitiation of this *Srotas*. *Medovaha Srotodushti* characters may be caused by the injury to the *Moolasthana* of *Medovaha Srotas* and due to disturbance of equilibrium of hormones. Ayurveda correlates the structural and functional integrity of this system to physiological status and impairment of this integrity to pathological status. Unhealthy diet results in building of adipose tissue in the body which results in weight gain and obesity. The risk factors of obesity described by ancient Acharyas of *Ayurveda* are very much similar to the factors found in modern science. Moreover, mutation of leptin receptor and congenital

deficiency of leptin may be the reason behind *Bija Svabhavaj Sthaulyta* (genetic obesity).

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