

Integrating the Concept of *Srotas* with Modern Biomedical Research Challenges and Opportunities

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Abstract- Ayurveda, a traditional Indian system of medicine, describes "*Srotas*" as channels responsible for the transportation and transformation of various substances within the body. *Srotas* are not only responsible for the dispensing of the food to different tissues and cellular systems of the body but also involved in removal of the waste products. While conceptually distinct from modern anatomical structures, *Srotas* share functional similarities with various physiological systems. This article explores the concept of *Srotas*, analyses the challenges in integrating this ancient framework with contemporary biomedical research, and discusses the potential opportunities for advancing our understanding of health and disease.

Index Terms- Ayurveda, Biomedical Research, Integration, *Srotas*.

I. INTRODUCTION

Ayurveda emphasizes the importance of maintaining equilibrium within the body for optimal health. *Srotas*, a fundamental concept in Ayurvedic physiology, are considered the pathways through which nutrients, waste products, and other essential substances circulate. These channels are not merely anatomical structures but also represent functional units responsible for specific physiological processes. Modern biomedical research, with its focus on detailed anatomical and molecular mechanisms, offers a complementary perspective. Integrating these two approaches presents both significant challenges and exciting opportunities for advancing healthcare.

AIM-

To study the concept of *Srotas* from Ayurvedic literature.

OBJECTIVES-

1. To study the challenges in integrating *Srotas* with contemporary biomedical research.
2. To discuss the potential opportunities for advancing understanding of health and disease

II. MATERIALS AND METHODS

Ayurvedic classical texts, Past articles and internet sources were reviewed critically to understand *Srotas*, and to study the Challenges and Opportunities in integration with modern biomedical research.

OBSERVATION:

The term "*Srotas*" originates from the Sanskrit root "*sru*," meaning "to flow." [1] Structures through which the *Sravana* (to ooze, to exude, to filter and to permeate through) of fluids takes place. *Srotas* are the transport system of the body includes blood and lymph vessel, channels, tubes, ducts, canals, passages, meatuses, and, different tracts.[2]

The entire body is made up of *Srotas* which transports all types of materials from one part to another part of the body.

Srotas is the systems which circulate the *Doshas* and *Dhatu* to the various organs. During this process of circulation the *Dhatu* are transformed from the first Rasa to the last layer *Shukra*. "*Srotomayam hi Shariram*" the living body is made up of countless channels that represent the dynamic inner transport system of the physique-psyche and soul organization.

Charaka described the *Srotas* on physiopathological or functional abnormality base where as *Sushruta* mention the *Srotas* on anatomopathological or structural abnormality base. [3]

In physiological view [4]

Srotas is very broad term which starts from external orifices to the very minute invisible ionic channel/gate etc. (*Dosha Dhatu* in *Parmanu Swaroop* as *Dosha-Dhatuvaha Srotas*).

In anatomical view [4]

Srotas is that structure excluding the *Sira* entity means present in pure form i.e. without blood cells (*Rakta Dhatu*). *Srotas* is intra as well as extracellular spaces (*Sravanat srotamsi*).

As per *Charaka* the channels of circulation, carrying the *Dhatu*, undergoing transformation, to their destination are called as *Srotas*. *Srotas* are pathway of *Rasadi Dhatus*.^[5]

As per *Sushruta* channels, which are widely spread in all the spaces of the body, where circulation or Transportation of the fluid occurs irresistibly and continuously are known as *Srotas*. He has clear the *Srotas* as the hollow channel except *Sira* and *Dhamani* which originating from root space spreads in the body and circulate the specific entities.^[6]

As per *Vagbhata* the *Srotas* are the extremely fine passages and pores like present in the lotus stem. He observed that Dhatus separate throughout the body through very fine *Dwar of Srotas* which are scattered extensively in the body.^[7]

Formation of *Srotas* is due to *Ushma* and *Vayu* in *Gharbhaawstha*.^[8] According to *Acharya* *srotas* are the *Akash mahabhata pradhana* hallow structures through which the process of secretion, circulation, transformation of *Dosha, Dhatu, mala* carried out.

Structure of *Srotas* as per *Charaka*, have their colour similar to substance they transport; they may be cylindrical, Gross / Macroscopic or Atomic in Size, Large or Reticulated in shape.

According to *Sushruta*, *Dhamni* have pores in their walls very much like the minute passages present in the stem of a Lotus, through which they supply *Rasa* to all parts of the body.

Vagbhata has followed the view of *Sushruta* and he has compared *Srotas* as fine passages and pores present which are distributed extensively in the

body, very much like the minute channels present in the stem of a Lotus flower^[9]

The number of *srotas* described by different *Acharyas* in Ayurveda is:

- *Charak*: Described 13+1 *srotas*^[10]
- *Sushruta*: Described 11 pairs^[11]
- *Vagbhata*: Classified into *Antarmukh Srotas* (13) and *Bahirmukha Srotas* (9 in males, 12 in females)^[12]

Srotas are not simply passive conduits they are active participants in maintaining homeostasis. Their health is crucial for proper tissue nourishment, waste removal, and overall physiological balance. Impairment of *Srotas* is considered a key factor in the pathogenesis of various diseases in Ayurveda.

A structural or functional defect of the *srotas* or channel is called *strotodushti*. If *Srotas* are in healthy state the formation of *Dosha, Dhatu, and Mala* are good, but when these *Srotas* are vitiated due to any reason then *Dosha, Dhatu and Mala* also become vitiated and body becomes diseased.

The principle of specificity of *Dhatu Vaha Srotas* in Ayurveda is important and a concept similar to that which are seen to emerge from modern scientific research, in the field of physiology and biochemistry, relating to the “mechanism and dynamics of exchange of fluid across capillaries” Like Ayurvedic concept of *Khalekapota Nayaya* modern physiology too has recognized the specificity of the substances, different kinds of tissues need. Thus, recent studies in the metabolism of proteins have shown that “The pattern of Amino Acid mixture supplied to the tissue will determine the suitability of these substances for the synthesis of a specific type of cellular protein”.^[13]

Modern Aspect Of *Srotas*:

TABLE 1

<i>Srotas</i>	Correlation to Modern Biomedics
<i>Pranavaha Srotas</i>	This <i>Srotas</i> , responsible for the flow of <i>Prana</i> (life force), can be correlated with the respiratory system (trachea, lungs) and the cardiovascular system (heart, blood vessels) which transport oxygen throughout the body.

<i>Annavaha Srotas</i>	This <i>Srotas</i> , responsible for the digestion and assimilation of food, can be correlated with the gastrointestinal tract (esophagus, stomach, intestines) and the digestive system as a whole.
<i>Udakavaha Srotas</i>	This <i>Srotas</i> , responsible for the transportation of fluids, can be correlated with the lymphatic system, which helps maintain fluid balance in the body.
<i>Rasavaha Srotas</i>	This <i>Srotas</i> , responsible for the circulation of nutrients, can be correlated with the circulatory system (blood vessels) that transport nutrients to cells.
<i>Raktavaha Srotas:</i>	This <i>Srotas</i> , specifically responsible for the circulation of blood, can be directly correlated with the cardiovascular system (arteries, veins, capillaries).
<i>Mamsavaha Srotas</i>	This <i>Srotas</i> , responsible for the nourishment and maintenance of muscles, can be correlated with the muscular system and its associated blood supply.
<i>Medovaha Srotas</i>	This <i>Srotas</i> , responsible for the metabolism and transportation of fat, can be correlated with the adipose tissue and the endocrine system that regulates fat metabolism.
<i>Asthivaha Srotas</i>	This <i>Srotas</i> , responsible for the nourishment and maintenance of bones, can be correlated with the skeletal system and its associated blood supply and bone marrow.
<i>Majjavaha Srotas</i>	This <i>Srotas</i> , responsible for the formation and transportation of bone marrow and nerve tissue, can be correlated with the nervous system and the hematopoietic system (bone marrow).
<i>Shukravaha Srotas</i>	This <i>Srotas</i> , responsible for the reproductive system, can be correlated with the male and female reproductive systems and their associated hormones.
<i>Mutravaha Srotas</i>	This <i>Srotas</i> , responsible for the formation and excretion of urine, can be correlated with the urinary system (kidneys, ureters, bladder, urethra).
<i>Purishavaha Srotas</i>	This <i>Srotas</i> , responsible for the formation and excretion of feces, can be correlated with the large intestine and the excretory system.
<i>Swedavaha Srotas</i>	This <i>Srotas</i> , responsible for the formation and excretion of sweat, can be correlated with the skin and its sweat glands.
<i>Artavaha Srotas</i>	This <i>Srotas</i> responsible for menstruation and reproductive functions, can be correlated with the female reproductive system (ovaries, fallopian tubes, uterus, and vagina).

Challenges in Integration:

Several challenges hinder the integration of *Srotas* with modern biomedical research^[14]:

Lack of Direct Anatomical Correlation: *Srotas* are described functionally rather than anatomically. This makes it difficult to directly correlate them with specific anatomical structures identified in modern anatomy.

Subjectivity in Assessment: Ayurvedic diagnostic methods for assessing *Srotas* health often rely on clinical observation and pulse diagnosis, which can be subjective and difficult to standardize for research purposes.

Different Terminologies and Conceptual Frameworks: The language and conceptual frameworks of Ayurveda and modern biomedicine differ significantly, making direct translation and comparison challenging.

Limited Empirical Evidence: While Ayurveda has a rich clinical history, there is a relative lack of large-scale, randomized controlled trials using modern scientific methodologies to validate the concept of *Srotas*.

Opportunities for Integration:

Despite these challenges, integrating *Srotas* with modern research offers significant opportunities^[15]:

Functional Insights: The *Srotas* concept can provide valuable insights into the functional organization of physiological systems. By focusing on the flow and transformation of substances, it can complement the structural focus of modern anatomy.

Systems Biology Approach: The holistic nature of *Srotas* aligns well with the systems biology approach, which emphasizes the interconnectedness of biological systems. Studying *Srotas* can contribute to a more comprehensive understanding of physiological regulation.

Microcirculation and Interstitial Fluid Dynamics: The concept of *Srotas*, particularly those related to nutrient transport and waste removal, may offer a valuable framework for studying microcirculation, interstitial fluid dynamics, and lymphatic function.

Personalized Medicine: The Ayurvedic emphasis on individual constitution and the specific involvement of different *Srotas* in disease can contribute to the

development of personalized diagnostic and therapeutic approaches.

New Therapeutic Targets: Understanding the mechanisms underlying *Srotas Dushti* could lead to the identification of novel therapeutic targets for various diseases.

To effectively integrate *Srotas* with modern research, the following steps are crucial^[16]:

Developing Standardized Assessment Methods: Developing objective and quantifiable methods for assessing *Srotas* health is essential for research. This could involve combining traditional Ayurvedic diagnostic techniques with modern imaging and biochemical analysis.

Translational Research: Conducting translational research that bridges the gap between Ayurvedic principles and modern biomedical knowledge is crucial. This could involve investigating the molecular mechanisms underlying *Srotas* function and dysfunction.

Interdisciplinary Collaboration: Fostering collaboration between Ayurvedic practitioners, biomedical researchers, and other relevant experts is essential for successful integration.

Computational Modeling: Using computational modeling techniques to simulate *Srotas* function could provide valuable insights into their role in physiological regulation.

III. RESULT

Srotasa are some channels which are capable to carry something which are involved in the transportation. This transportation can be that much gross as movement of the food in the intestines and can be that much subtle as is –diffusion of some of the nutrients from the extra cellular fluid or even the movement of the nutrients inside a cell.^[17]

Beside this all the cells have their internal circulatory system which is managed by Endoplasmic Reticulum inside the cells. This internal system of cells should also be considered in the same category of the *Srotasa*, if we are considering about the *Poshana Dharma of the Srotasa*.

All the diplomacy above is indicating towards transport system of the body. But the transport system, we are considering is very subtle in nature basically. This system is responsible for the nutritional exchange and transportation and is deeply associated with the tissues. Number of the ducts and transport system cannot be counted because this is incalculable.

There are so many references of *Srotasa* in Ayurvedic texts. After considering these references we can understand that *Srotasa* cannot be correlated to the modern equivalents as there are so many concepts that resemble to *Srotasa*, that create confusion and make it difficult to understand.

CONCLUSION

Srotas is the transportation system of the body which exchange, transport and excretes not only the materials but also massages, impulses, emotions and thought through macro and micro channels. It is must have knowledge to treat the patient as any disease condition is occurs due to *Srotodushiti*.

Integrating the concept of *Srotas* with modern biomedical research presents significant challenges but also offers exciting opportunities for advancing our understanding of health and disease. By addressing the challenges and pursuing the opportunities, we can potentially unlock new insights into physiological regulation, disease pathogenesis, and personalized medicine.

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