



REVIEW ARTICLE

UNDERSTANDING *SROTAS* THROUGH THE LENS OF MICROCIRCULATION: AN AYURVEDIC-MODERN CORRELATION

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ABSTRACT

Introduction: Ayurveda understands the human body as nourished by *Srotas* delicate channels that carry essential substances like *Rasa* (nutrients), *Prana* (air), and metabolic waste. Classical treatises like *Charaka Samhita* and *Sushruta Samhita* describe the anatomical and physiological functions of these channels. Contemporary physiology echoes this with microcirculation, consisting of arterioles, capillaries, venules, and lymphatics, which modulate tissue oxygenation, exchange of nutrients, and removal of wastes. This research endeavors to investigate the relationship between Ayurvedic *Srotas* and contemporary microvascular structures and to suggest an integrative model for pathophysiology of chronic disease. **Methods:** A comparative analytical methodology was employed. Root Ayurvedic books *Charaka Samhita*, *Sushruta Samhita*, and *Ashtanga Hridaya* were surveyed for accounts of *Srotas* and *Srotodusti*. Modern anatomical and physiological literature was searched in order to describe microcirculation and its disturbances. Analogies were charted between given *Srotas* and microvascular elements. Further, clinical studies assessing Ayurvedic treatments (e.g., *Panchakarma*, *Rasayana*) on circulatory variables were appraised. **Results:** *Rasavaha Srotas* mapped to capillaries and lymph channels, *Pranavaha* to pulmonary microcirculation, and *Raktavaha* to arterioles and venules. *Srotodusti* manifestations *Sanga* (obstruction), *Siragranthi* (dilation), and *Vimarga Gamana* (abnormal flow) corresponded with thrombotic events, microaneurysms, and arteriovenous shunts, respectively. Ayurvedic therapies like *Virechana*, *Basti*, and *Rasayana* herbs (*Guduchi*, *Amalaki*, etc.) showed enhancements in endothelial function and microvascular health. **Discussion:** The investigation proves a robust anatomical and functional relationship between microcirculation and Ayurvedic *Srotas*. Ayurvedic pathologies of *Srotodusti* resemble contemporary microvascular diseases. Combining Ayurvedic treatments with biomedical interventions can make management of chronic illnesses better by optimizing microvascular integrity and mitigating oxidative stress. **Conclusion:** *Srotas* and microcirculation are convergent paradigms of physiological transport and tissue viability. Integrating these paradigms supports a unified understanding and creates openings for integrative clinical studies in chronic disease prevention and treatment.

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INTRODUCTION

Ayurveda, the ancient life science, offers a holistic understanding of human physiology in the form of *Srotas* minute channels through which vital substances move around in the body. These channels are not just anatomical passages but dynamic channels that support life by allowing the delivery of *Rasa* (nutrients), *Prana* (vital air), *Udaka* (water), and wastes of metabolism. *Acharya Charaka* describes *Srotas* as channels through which vital materials are transmitted, highlighting their function in preserving physiological equilibrium.¹ *Sushruta*, in his surgical work,

further describes the anatomical origin and functional relevance of different *Srotas*, classifying them according to the elements they transmit.² In contemporary biomedical science, there is an analogous system in the microcirculation consisting of arterioles, capillaries, venules, and lymphatic vessels. It is through these microvascular units that oxygenation, exchange of nutrients, temperature regulation, and excretion of waste occur at the cellular level. Microcirculatory impairment is now becoming well-established as a causative factor for chronic diseases like diabetes mellitus, hypertension, and ischemic disease.³ The coming together of these two paradigms Ayurvedic *Srotas* and contemporary microcirculation makes it possible to study integrative models of health and disease in a

novel manner. This research aims to bridge the concept of *Srotas* to microcirculation, exploring how ancient descriptions of Ayurveda align with modern-day anatomical and physiological principles. Through mapping functional and structural similarities, the paper attempts to lay the groundwork for integrative clinical practice merging Ayurvedic treatments with current diagnostics and therapy methods.

REVIEW OF LITERATURE

Ayurvedic Understanding of *Srotas*: Thirteen major *Srotas* are described in classical Ayurvedic works to control the movement of certain body components. *Charaka Samhita* describes *Rasavaha*, *Raktavaha*, *Mamsavaha*, *Medovaha*, *Asthivaha*, *Majjavaha*, and *Shukravaha Srotas*, among others, each with specific roots (*Mula*), course (*Marga*), and doors (*Mukha*).⁴ The diseases of these channels, i.e., *Srotodusti*, present as systemic diseases ranging from nutritional deficiencies to sexual dysfunctions.⁵ *Sushruta Samhita* is anatomically clear by correlating *Pranavaha Srotas* with the lung and heart, *Udakavaha Srotas* with *kloma* and *palate*, and *Annavaha Srotas* with gastrointestinal tract.⁶ The accounts indicate a refined concept of organ systems and their interdependent relationships. *Ashtanga Hridaya* maintains the functional significance of *Srotas* by defining *Srotodusti* as obstruction (*Sanga*), dilation (*Siragranthi*), or abnormal flow (*Vimarga Gamana*), which interferes with physiological harmony.⁷

Modern Concept of Microcirculation: Microcirculation is the movement of blood in the minute vessels—arterioles, capillaries, venules and lymphatic vessels. These pathways are essential for tissue perfusion, diffusing oxygen, delivering nutrients, and carrying off carbon dioxide and waste materials from metabolism. Microcirculation also has a significant role to play in immune surveillance, regulation of temperature, and fluid balance. Microcirculation disruption causes edema, ischemia, endothelial dysfunction, and microangiopathy. In diabetes mellitus, for example, thickening of the capillary basement membrane compromises nutrient exchange, whereas in hypertension, remodeling of arterioles undermines tissue oxygenation. Microcirculation has increased importance in chronic disease pathophysiology and in the design of precision therapies.⁸

Previous Comparative Research: Various researchers have tried to relate Ayurvedic *Srotas* with contemporary anatomical pathways. *Rasavaha Srotas* have been compared with capillary and lymphatic channels involved in nutrient transport and fluid homeostasis. *Pranavaha Srotas* have been associated with pulmonary microcirculation, especially alveolar capillaries that are engaged in gas exchange. Ayurvedic therapies like *Snehana* (oleation), *Swedana* (sudation), and *Virechana* (purgation) have shown positive changes in microcirculatory parameters, such as endothelial function and blood viscosity, in clinical trials.

METHODOLOGY

The analysis utilizes a comparative methodology with four steps:

- **Ayurvedic Review:** The basic classical texts *Charaka Samhita*, *Sushruta Samhita*, and *Ashtanga Hridaya* were reviewed methodically to gather references on *Srotas*, their

anatomical origins, physiological functions, and pathological expressions.

- **Modern Literature Survey:** Standard anatomy and physiology textbooks and peer-reviewed articles were referred to frame microcirculation, its components, and related disorders.
- **Comparative Mapping:** Correlations of structural and functional relationships were established between individual *Srotas* and microvascular components based on transport mechanisms, pathological analogies, and therapeutic applications.
- **4. Clinical Evidence Analysis:** Research analyzing the effects of Ayurvedic treatments specifically *Panchakarma* and *Rasayana* on circulatory health was reviewed to evaluate their application in microvascular modulation.

RESULTS

Correlation Between *Srotas* and Microcirculation
 Ayurvedic *Srotas*/ Modern Equivalent/Functions
Rasavaha Srotas/ Capillaries & lymphatic channels/Transport of nutrients, plasma, lymph, tissue fluid regulation
Pranavaha Srotas/ Pulmonary microcirculation (alveolar capillaries)/Gaseous exchange, oxygenation, CO₂ excretion
Raktavaha Srotas/ Arterioles & venules/Transport of blood, oxygenation of tissues
Udakavaha Srotas/ Lymphatic drainage & interstitial fluid balance
 Fluid homeostasis
Srotodusti and Microvascular Pathologies.⁹

- ***Sanga* (Obstruction):** Similar to thrombosis, atherosclerosis, and ischemic states where blood supply is compromised.
- ***Siragranthi* (Dilation):** Corresponds to varicose veins, microaneurysms, and vascular ectasia.
- ***Vimarga Gamana* (Abnormal flow):** Represents arteriovenous shunts, hemorrhage, and vascular malformations.¹⁰

Ayurvedic Interventions Supporting Microcirculation

- ***Srotoshodhaka* Herbs:** *Guduchi* (*Tinospora cordifolia*), *Guggulu* (*Commiphora Mukul*), and *Haritaki* (*Terminalia Chebula*) are reported to increase endothelial function and decrease oxidative stress.
- ***Panchakarma* Therapies:** *Virechana* (therapeutic purgation) and *Basti* (medicated enema) enhance blood rheology, decrease inflammation, and promote detoxification.
- ***Rasayana* Therapy:** Rejuvenative herbs such as *Amalaki* (*Embllica officinalis*), *Ashwagandha* (*Withaniasomnifera*), and *Shatavari* (*Asparagus racemosus*) promote microvascular repair and increase tissue resilience.

DISCUSSION

Comparative examination identifies an extensive congruence between Ayurvedic *Srotas* and contemporary microcirculatory systems. The descriptive physiological functions of *Rasavaha*, *Pranavaha*, and *Raktavaha Srotas* correspond with those of capillaries, pulmonary vessels, and systemic arterioles. The pathological conditions characterized as *Srotodusti* resemble clinical presentations of microvascular disease, indicating ancient Ayurvedic thinkers possessed an intuitive

understanding of circulatory physiology.¹¹For instance, *Rasavaha Srotodusti* defined as inefficient transport of nutrients and fluid disturbance mimics lymphedema and capillary leak syndrome.¹²*Pranavaha Srotodusti*, with its disturbed gas exchange, is similar to pulmonary microangiopathy in chronic obstructive pulmonary disease (COPD) and pulmonary hypertension. *Raktavaha Srotodusti* mirrors vasculitis and microvascular ischemia.¹³ Ayurvedic therapies offer promising adjuncts to modern vascular medicine. *Panchakarma* procedures have shown efficacy in improving vascular tone, reducing inflammatory markers, and enhancing endothelial function. *Rasayana* herbs possess antioxidant, anti-inflammatory, and adaptogenic properties that support microvascular integrity and cellular regeneration. Yet, there are constraints. Ayurvedic texts are qualitative and metaphorical, yet contemporary science requires quantifiable measures. Interdisciplinary research combining Ayurvedic diagnostics with biomedical instruments like Doppler imaging, capillaroscopy, and endothelial biomarkers can overcome this divide. Conceiving clinical trials to measure microcirculatory parameters in combination with Ayurvedic outcomes like *Agni*, *Ojas*, and *Srotoshuddhi* can establish validation of older claims and support evidence-based integration.

CONCLUSION

This comparative analysis highlights the striking similarity between the Ayurvedic theory of *Srotas* and contemporary knowledge of microcirculation. The two systems detail elaborate networks for the delivery of essential substances nutrients, gases, fluids, and wastes required to sustain cellular and systemic equilibrium. The similarities in the functions of *Rasavaha*, *Pranavaha*, and *Raktavaha Srotas* with capillaries, pulmonary vessels, and arterioles validate the universal applicability of Ayurvedic anatomical knowledge. The pathologic expression of *Srotodusti Sanga* (blockage), *Siragranthi* (distension), and *Vimarga Gamana* (dysflow) reflects microvascular diseases like thrombosis, varicosities, and hemorrhages. This congruence indicates that ancient Ayurvedic experts had a sophisticated comprehension of circulatory pathologies, even though it was articulated in qualitative and symbolic terms. Ayurvedic therapies, especially *Rasayana* and *Panchakarma*, present promising opportunities for improving microvascular well-being. Their reported mechanisms of action on endothelial function, reduction of oxidative stress, and rejuvenation of tissues place them as potentially beneficial adjuncts in the treatment of chronic conditions associated with microcirculatory dysfunction. Plants such as *Ashwagandha*, *Amalaki*, and *Guduchi* show promise in maintaining vascular integrity and enhancing systemic resilience. However, the fusion of these paradigms requires demanding interdisciplinary investigations. Subsequent research must seek to measure Ayurvedic results through biomedical instruments Doppler flowmetry, endothelial markers, and microangiographic imaging within the limits of Ayurveda's holistic philosophy. Clinical trials conceived to assess both physiological parameters and Ayurvedic parameters such as *Agni*, *Ojas*, and *Srotoshuddhi* will be crucial to test and endorse conventional wisdom.

In summary, unifying *Srotas* and microcirculation not only extends our knowledge of human physiology but also provides avenues for integrative, preventive, and personalized medicine. This union celebrates the richness of ancient knowledge along with the accuracy of contemporary science.

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