Review Article

International Research Journal of Ayurveda & Yoga
Vol. 6 (5),108-115, May,2023
ISSN: 2581-785X: https://irjay.com/
DOI: 10.47223/IRJAY.2023.6517

Unveiling the *Ayurvedic* Approach to Water Balance and Hypertension: Insights and Connections.

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Article Info

Article history:
Received on: 08-04-2023
Accepted on: 22-05-2023
Available online: 31-05-2023

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ABSTRACT:

Background: Hypertension (HTN) is a non-communicable disease that contributes to heart disease, stroke, kidney failure, and premature mortality and disability. The majority of cardiovascular disease deaths, approximately 80%, occur in low and middle-income countries such as India. Therefore, it is crucial to explore the *Ayurvedic* perspective on HTN to enable *Ayurvedic* healthcare providers to effectively manage HTN and its complications.
Objective: The aim of this article is to review the *Ayurvedic* concept of water balance, blood, and blood pressure, and investigate their potential involvement in the development of HTN.
Materials and Methods: We conducted a critical review of scattered references in *Ayurvedic* literature pertaining to water balance and the role of *Doshas* in maintaining it.
Results: Water constitutes a major component of blood, and alterations in plasma volume can impact blood pressure levels. The literature review highlighted the similarity between the properties of *Kapha* and *Pitta* and the water-dominant attributes, suggesting their potential to disrupt water balance.
Conclusion: *Ayurveda* emphasizes the greater involvement of *Kapha* and *Pitta* in maintaining water balance in the body, while *Vata* is responsible for its circulation. Factors leading to the imbalance of *Kapha* and *Pitta* may initiate and contribute to the pathogenesis of hypertension, which necessitates thorough consideration for effective *Ayurvedic* management.
Keywords: Hypertension, *Ayurveda*, Water balance, Blood pressure, Non-communicable disease, *Ayurvedic* perspective

INTRODUCTION

Hypertension (HTN), is a significant global health problem. It is a non-communicable disease that contributes to heart disease, stroke, kidney failure, and premature mortality and disability.[1] Globally, cardiovascular diseases account for approximately 17 million deaths each year, with 9.4 million deaths attributed to hypertension-related complications. Hypertension is responsible for 45% of heart disease deaths and 51% of stroke deaths. The majority

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of cardiovascular disease deaths, about 80%, occur in low and middle-income countries like India. [2] In India, a significant portion of the population relies on traditional and complementary medicine for their health needs. *Ayurveda*, the indigenous system of medicine, is the most popular among various traditional health systems practiced in the country.[3] India has a well-established network of *Ayurveda* health centres, both government and non-government, catering to the health needs of the society, particularly in rural areas.[4] It is important to understand HTN from *Ayurveda* perspective so that *Ayurveda* healthcare providers can help to treat HTN and its complications. Hypertension (HTN) is diagnosed using a sphygmomanometer, a concept that was introduced in the late 1800s and early 1900s. *Ayurveda*, on the other hand, originated during the *Vedic* period and did not have a tool for recording blood pressure. Although *Ayurvedic* texts do not explicitly mention hypertension, *Acharya Charaka* suggests that if a disease is not named, its symptomatology should be the focus of treatment.[5] Critical review of literature revealed that *Ayurvedic* pathogenesis of hypertension has been linked with conditions such as *Vyanabala Vaishamya, Siragata Vata, Pittavrita Vata, Raktavrita Vata, Pittavrita Udana Vata, Pranavrita Udana Vata, and Raktagata Vata*.[6] Significant similarities were also found between the etiological factors and symptoms of hypertension and *Shonitpradoshaja Vikara* (disorders related to vitiation of *Rakta*).[7] This indicates the involvement of *Rakta* (blood) in the pathogenesis of HTN. In this conceptual review, *Ayurvedic* concept of water balance, blood and blood pressure will be explored and further how these concepts may be involved in development of HTN will be discussed.

MATERIALS AND METHODS

Type of review: Narrative review. All the classical texts of Ayurveda along with the texts of contemporary science were explored, reviewed, analysed, and presented in organised manner. Internet sources and search engines like google scholar, Pubmed etc. were also explored using keywords like hypertension, *Raktagata Vata, Vyanabala Vaishamya, Siragata Vata, Pittavrita Vata, Raktavrita Vata, Pittavrita Udana Vata, Pranavrita Udana Vata* etc.

RESULTS OF LITERATURE REVIEW

Blood pressure and its regulation

Blood pressure is a vital sign that is routinely checked in clinical settings to monitor a person's cardiovascular health. It is defined as the pressure exerted on the wall of arteries and is determined by cardiac output (CO) and peripheral vascular resistance (PVR).[8] Cardiac output, in turn, depends on the stroke volume (SV) and heart rate where stroke volume is the volume of blood ejected during each systole, which is influenced by preload, afterload, and the contractile power of myocardium.[9] On the other hand PVR is the force offered by the vasculature that heart has to overcome in order to push blood forward. Preload refers to the amount of blood in the ventricle during the end of diastole, known as the end diastolic volume (EDV). A reduction in circulating blood volume (CBV) leads to a decrease in preload, which reduces the SV and CO, resulting in a fall in blood pressure.[10] To maintain blood pressure, compensatory mechanisms like sympathetic stimulation and changes in levels of catecholamines are activated, which influence the heart rate to maintain blood pressure and organ perfusion.[11] In addition to it, blood pressure in the arterial tree is regulated by baroreceptors located in vessels, renin angiotensin aldosterone system (RAAS), and anti-diuretic hormone (ADH). All these functions are mediated under the influence of neural control and are activated by alteration in the water balance in the body in order to maintain it.[12] From this discussion it is clear that CBV plays a crucial role in reflecting the status of blood pressure. Blood pressure is lower in cases where CBV is less and vice versa. Blood volume is the fluid that circulates in the vessels, consisting of plasma (60%) and formed elements (40%) like red blood cells, white blood cells, and platelets. More than 90% of plasma is composed of water, which implies that CBV that maintains and reflects blood pressure is largely dependent on the water content of the body.[13]

To understand *Ayurveda* viewpoint of HTN, it is important to understand concept of water balance, formation of blood and their role in blood pressure and its regulation from the *Ayurveda* perspective.

Ayurvedic concept of water balance

Five *Mahabhutas*, *Akash*, *Vayu*, *Agni*, *Jala* and *Prithvi* are the basic elements of human body.[14] These elements are organized in the form of seven *Dhatus* and *Updhatus* which make the framework of cells and tissues. The functions of these structural elements are governed through *Tridosha (Vata, Pitta and Kapha)*.[15] Metabolism of the body is governed by thirteen types of *Agni*, which digest the food and provide nutrition to the body.[16] The excretion of metabolic wastes from the body is regulated by *Mutra*,

Purisha and Sweda. *Mutra* and *Sweda* are mainly involved with excretion of water soluble wastes whereas solid wastes are mainly excreted though faeces.[17] As we know blood pressure is largely influenced by water levels in the body hence, to understand blood pressure according to *Ayurvedic* principles, it is essential to comprehend the concept of water regulation in the body. According to *Ayurveda, Rasa, Rakta, Vasa, Kapha, Pitta, Mutra,* and *Sweda* are the *Jala* (water) dominant attributes in the body. (Fig 1) *Charaka*, one of the foundational texts of *Ayurveda*, has quantified these entities in the body with reference to *Anjali Pramana* (means the quantity hold by joining both palms). *Udaka*, which refers to water, is present in the highest quantity of ten *Anjali*, and its proportion is reflected in other water-dominant attributes like *Dosha, Dhatu, Updhatu*, and *Mala* in the body.[18] *Rasa*, which is water-dominant *Dhatu*, is nine *Anjali* and plays a significant role in maintaining the volume of blood and is similar to plasma. *Kapha* is the metabolic waste of *Rasa Dhatu*, having properties similar to *Rasa* and has been quantified as six *Anjali* in the body.[18] Clinical importance of this concept lies in the fact that any abnormality in *Udaka, Rasa* or *Kapha* may result in disturbance of water balance in the body and may result in water retention or excess secretion.The regulation of water in the body is crucial for maintaining homeostasis, and its balance is mediated by its excretion by various entities such as urine (*Mutra*), sweat (*Sweda*), faeces (*Purisha*), and lymphatic fluid (*Lasika*). (Fig 1) The understanding of the role of water balance in the body is critical to the *Ayurvedic* concept of maintaining health and balance. Any imbalance in the water content in the body can lead to various health issues, including blood pressure abnormalities.

Ayurvedic concept of blood and its regulation

According to *Ayurveda*, human body is made up of seven *Dhatus* (bodily tissues) and blood has been described as one among them, with several synonyms including *Rudhira, Asrika, Lohita, and Shonita*. It is formed primarily in the liver and spleen, by the action of *Ranjaka Pitta* on the *Sara* component of *Rasa Dhatu* (first bodily tissue in sequence).[19] The *Rasa*, or the essence of different forms of food (*Ashita, Khadita, Peeta* and *Leeda*) that we consume,[20] is *Saumya* or water-dominant in nature, [18] is circulated by the heart through twenty-four *Dhamani* to different bodily tissues.[21] *Rasa* on reaching the *Yakrita* (liver) and *Pleeha* (spleen) attains a red colour and is then called *Rakta*. [19] The normal quantity of *Rakta* varies in each individual, with an average amount of eight *Anjali*.[18] The metabolic waste of *Rakta* is *Pitta*, which primarily resides in the blood. The *Raktavaha Srotas* (blood circulatory channels) is associated with the transportation of *Rakta* after its formation in the *Mula Sthana*, i.e. liver and spleen. In its normal physiological state, blood is responsible for providing lustre, a happy state of mind, and helps the sense organs to perform their functions normally.[22]Although the concept of blood and its circulation in *Ayurveda* is considered outdated according to current concepts of anatomy and physiology and has been replaced by newer concepts, these concepts are still used in traditional systems of medicine for prevention and treatment of various diseases. Similarly, Galen, an ancient Greek scholar, proposed a similar concept of blood and its circulation, but it was later discarded after the works of Ibn al-Nafis and William Harvey.[23,24] Nonetheless, the knowledge of *Ayurveda* still offers a valuable insight into the ancient understanding of the human body and its functions.

Probable role of *Kapha, Pitta,* and *Rakta* in Hypertension

The *Ayurvedic* concept of water balance and its impact on blood pressure is critical in maintaining optimal health. Water dominant *Rasa*, which directly influences blood composition, plays a vital role in blood pressure regulation. It can be understood with the fact that, when the body loses water due to conditions like diarrhea, vomiting, or fever, the volume of blood decreases, and its viscosity increases. This reduction in water content can lead to *Rasa Kshaya* or decreased pulse volume, resulting in lower blood pressure. On the other hand, in conditions such as chronic renal failure, the reduction in urine output or retention of sodium and water can cause an increase in blood pressure. *Rasa*, an essential component of blood, starts circulating from its origin in the heart and vessels originating from it,[25] and any vitiation of *Rasa* can cause an increase in *Kleda* or *Kapha*.[26] An increase in *Kapha* which is *Snigdha, Sandra, Pichila* and *Guru* can increase plasma osmolality, [27] leading to water retention through the activation of RAAS and ADH mechanisms. This can increase the CBV and play a crucial role in hypertension development. Furthermore, *Kapha* vitiation may also lead to *Rakta* vitiation by virtue of its *Snigdha, Drava* and *Guru* properties and may cause various *Raktapradoshaja Vikara*. Thus, we can say that *Kapha* has an important role in water regulation and being closely associated with *Rakta* it has the probability to vitiate *Rakta* and cause disorders like HTN, dyslipidaemia

etc. Similarly, excess indulgence in factors like salt, meat, and alkalis can lead to aggravation of *Pitta* and may vitiate *Rakta*.[28] *Pitta* and *Rakta* share similar properties, and excess *Drava* and *Ushna* properties of *Pitta* may result in increased CBV, leading to hypertension and haemorrhagic complications.[29] The role of salt in the pathogenesis of hypertension is well-established, and it highlights the involvement of *Pitta* and *Rakta* in the pathogenesis of hypertension. Thus we can say that understanding the *Ayurvedic* perspective on the role of *Kapha*, *Pitta*, and *Rakta* in hypertension is essential for managing blood pressure and maintaining optimal health. Balancing water content in the body is critical in regulating blood pressure, and any imbalance in *Kapha*, *Pitta* or *Rakta* can lead to imbalance in water homeostasis and development of hypertension and various other health issues.

Role of *Vata* in blood pressure regulation

Blood pressure regulation is a complex process that involves various physiological components, including *Vata* or *Vayu*. *Vayu* is responsible for several physiological processes in the body.[30] *Samana Vayu* plays a vital role in digestion and water balance, [31] while *Vyana Vayu* regulates the forward circulation of *Rasa*.[32] *Prana Vayu*, located in the head, controls blood pressure and is the center of control situated in the medulla. *Udana Vayu* regulates voice, energy, and strength, while *Apana Vayu* is involved in the excretion of urine, stool, menstrual flow and parturition etc.[33] In the geriatric population, a decrease in the quantity of *Kapha* and aggravation of *Vata* [34] may result in arterial stiffness, reducing arterial compliance and increasing the probability of a rise in blood pressure. Additionally, *Vata* may also get aggravated due to *Avarana* pathogenesis activated as a result of aggravated *Kapha* and *Pitta*. It may cause a secondary rise in *Vata* leading to hypertension. [35] Thus, *Vata* can affect different components of the HTN pathophysiology. To plan *Ayurvedic* management of HTN, it is essential to analyse *Doshic* involvement during patient examination. This approach will help in determining the underlying *Dosha* imbalance and providing a tailored treatment plan.

Hypertension as *Shonitpradoshaja Vikara*

Hypertension is a complex medical condition, and various factors contribute to its development. One of the factors that can lead to hypertension is the vitiation of *Rakta* or blood, as described in *Ayurveda*. According to *Ayurveda*, disease arising due to vitiation of *Rakta* fall under the category of *Raktapradoshaja Vikara* or *Shonitpradoshaja Vikara*. Aggravated *Kapha* and *Pitta* can cause vitiation of *Rakta* and may result in elevation of blood pressure.[36]

There are several causes of vitiation of blood, as described in *Ayurveda*, such as excess consumption of alcohol (*Madya*), alkalis (*Kshara*), salt (*Lavana Rasa*), sour (*Amla Rasa*), and pungent (*Katu Rasa*) articles. Other factors that can lead to blood vitiation include anger, exposure to sunlight and wind, suppressing urges of vomiting, not performing seasonal blood-letting, excess labor, injury, and indigestion.[37]

Specific dietary articles that can lead to blood vitiation include *Kulatha*, *Masha*, *Nishpava*, *Tila Taila*, and the flesh of aquatic and marshy animals, living in burrows, and animals those snatch their meals from others. Curd, vinegars, and *Amla Mastu* (curd water) are also considered causative factors of blood vitiation. Consuming decaying food articles and day time sleeping, especially after consuming excess liquid, oily, and heavy food, can also lead to blood vitiation.[37]The *Ayurvedic* properties of these causative factors affect the *Doshas* differently. For example, alcohol (*Madya*) increases *Pitta Dosha*,[38] alkali (*Kshara*) reduces *Kapha Dosha* and increases *Pitta* and *Vata Doshas*,[39] and salt (*Lavana Rasa*) increases *Kleda*, *Rakta*, and *Pitta Doshas*. [40] Sour (*Amla Rasa*) taste increases *Kleda* and aggravates *Pitta Dosha* and vitiate *Rakta*. Pungent (*Katu Rasa*) taste reduces *Kapha Dosha*, increases *Vata* and *Pitta Doshas*, and aggravates *Kapha* and *Pitta Doshas*.[41] It is evident that the majority causative factors are responsible for aggravation of *Kapha* and *Pitta* which further vitiate *Rakta* causing impairment in water balance and blood pressure regulation and cause hypertension.

Thus, to manage hypertension, it is essential to avoid the causative factors that can lead to *Rakta* vitiation, as described in *Ayurveda*. A healthy diet and lifestyle that promote the balance of the *Dosha* can also help manage hypertension.

DISCUSSION

Proposed *Ayurvedic* Pathogenesis of Hypertension (Fig 2)

Hypertension, or high blood pressure, can result from various etiological factors, including excessive consumption of salt, alcohol, meat, oily, heavy and incompatible foods, etc. which can vitiate *Kapha* and *Pitta Doshas*. Vitiation of *Kapha* can lead to the production of *Ama*, an undigested metabolic residue,[42] which can

increase the plasma osmolality and activate mechanisms such as antidiuretic hormone (ADH), the renin angiotensin aldosterone system (RAAS), and atrial natriuretic peptide. These mechanisms help to maintain the sodium and water balance, but if the underlying cause persists, they may not be able to maintain the balance, resulting in salt and water retention and elevated blood pressure. *Ama* can also obstruct the channels and lead to the aggravation of *Vyana Vayu*, which may be another causative factor for HTN.[42] *Ama* related to lipid metabolism can lead to elevated cholesterol, a co-morbid factor with HTN.

Excessive alcohol consumption, long-term intake of fermented foods, and other *Pitta*-aggravating factors can also lead to HTN. Alcohol's *Ushna* and *Tikshna* properties can directly stimulate the sympathetic nervous system, cause endothelial dysfunction, activate RAAS, and increase oxidative stress, [43] leading to increased blood pressure. These properties can also aggravate *Pitta*, altering water homeostasis and increasing blood volume. In elderly individuals, *Vayu* aggravation can result from *Dhatu Kshaya* or *Avarana*, where *Kapha* and/or *Pitta* are initiating pathological factors leading to secondary aggravation of *Vayu*. Aggravated *Vayu* can reduce vascular compliance, increasing peripheral resistance and leading to HTN. (Abbreviations: CAD – coronary artery disease, CV – cardiovascular, HTN – hypertension, RAAS – renin angiotensin aldosterone system, SNS – sympathetic nervous system, ADH – anti diuretic hormone)

CONCLUSION

According to *Ayurveda* concept, *Udaka*, *Rasa*, and *Rakta* are water-dominant attributes, which constitute a significant portion of human body. These attributes circulate throughout the body via the *Rasa* and *Raktavahi* channels, facilitated by the *Vyana Vayu*. Maintaining water balance is crucial and achieved through regulated excretion processes involving urine, sweat, and faecal matter. Imbalances in *Kapha* and *Pitta*, which are metabolic byproducts of *Rasa* and *Rakta*, can arise from excessive indulgence in their respective causative factors. Such imbalances can disrupt water balance and further vitiate *Raktavahi* channels to initiate the pathogenesis of hypertension (HTN). Essential HTN, a lifestyle disorder, is often associated with sedentary habits and overnutrition, which contribute to *Kapha* and *Pitta* vitiation, making them significant factors in the *Ayurvedic* pathogenesis of HTN, particularly in young and middle-aged individuals. Prolonged imbalances in *Kapha* and *Pitta* may eventually lead to secondary aggravation of *Vata*, further complicating the pathogenesis. Therefore, when planning *Ayurvedic* management of HTN, it is vital to consider the features of *Tridosha* involvement. Screening individuals for *Kapha* and *Pitta* vitiation can aid in implementing appropriate lifestyle modifications and preventing HTN and its associated complications. From *Ayurveda* perspective, it is needful to further explore this concept through appropriate scientific studies.

Acknowledgment- Nil
Conflicts of Interest- Nil
Source of finance & support – Nil

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How to cite this article: Upadhyay A, Vaidya M, Joshi R.K, "Unveiling The Ayurvedic Approach to Water Balance and Hypertension: Insights and Connections" IRJAY. [online] 2023;6(5);108-115.
Available from: https://irjay.com.
DOI link- https://doi.org/**10.47223/IRJAY.2023.6517**

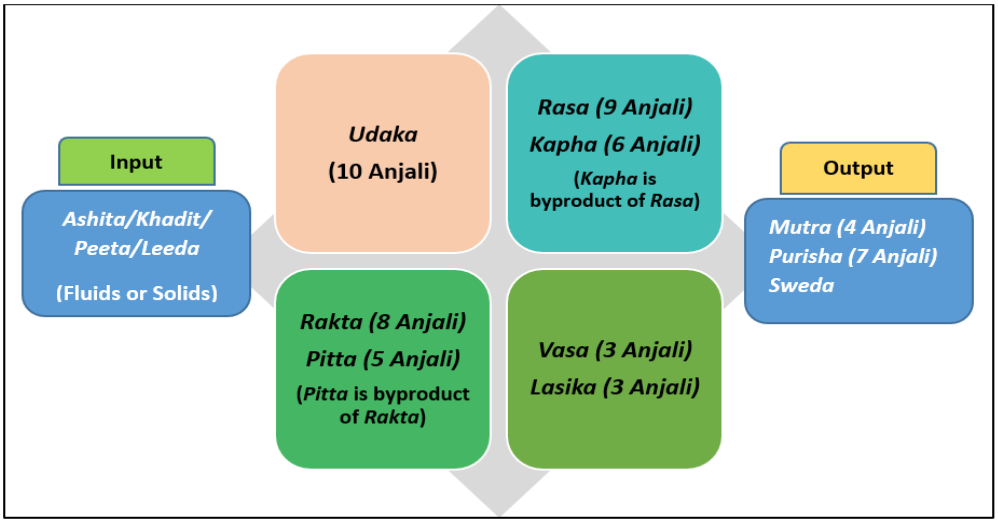

Fig 1: ***Ayurveda*** **concept of water dominant body components and its balance**

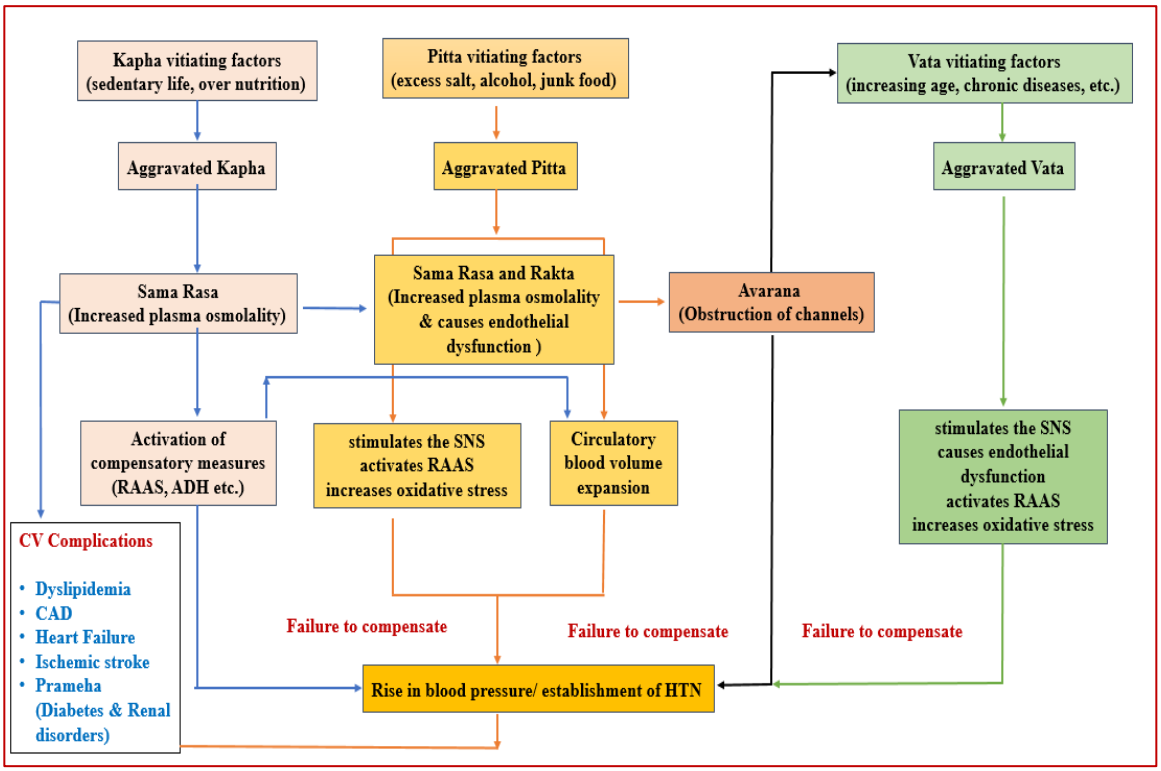

Fig: 2 Proposed ***Ayurvedic*** **Pathogenesis of Hypertension**