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“ANATOMY OF EXCRETORY SYSTEM (RENAL SYSTEM) WITH SPECIAL REFERENCE TO PATHOPHYSIOLOGY OF RENAL CALCULUS.”

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ABSTRACT:

Ayurveda, often referred to as the "science of life" and a branch of Atharvaveda, provides comprehensive descriptions of various bodily systems, including their anatomy, functions, and diseases. Among these systems, the Mutravaha Samsthana, responsible for urine production and expulsion, holds great importance. Disorders within this system can lead to various conditions related to the bladder, as described in Ayurvedic texts. These conditions, known as Mutra Roga or Urinary disorders, include Mutraghaat (Obstruction), Mutrakricchra (Urinary tract infection), and Ashmari (Urolithiasis or kidney stones). Renal calculi, in particular, are the most common and persistent ailment within the urinary tract system. This recurring and highly painful disorder rank as the third most prevalent urinary condition, causing significant discomfort.

KEYWORDS: Ashmari, Ayurveda, Renal stone, Basti, Excretory system**Corresponding Author:****Dr. Shinde P.U.**

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INTRODUCTION:

Ayurvedic practices focus on achieving a harmonious balance among three fundamental energies, namely Vata, Pitta, and Kapha. According to Ayurveda, maintaining this equilibrium is essential for good health, while any disruption in these energies can result in illnesses and overall poor health. This imbalance can be caused by various factors such as an irregular lifestyle, prolonged physical and mental stress, improper eating habits, consumption of incompatible foods, and misuse of the senses.¹ In Ayurvedic philosophy, the body is comprised of seven fundamental tissues known as "dhatus," which support its proper functioning. These dhatus include Rasa (Plasma), Rakta (Blood), Mamsa (Muscles), Meda (Fatty tissue), Asthi (Bones), Majja (Bone marrow), and Shukra (Semen and Reproductive tissue). Another important concept is "Mala," which refers to waste products generated during the body's physiological and metabolic processes. The primary types of Malas include Purish (Faeces), Mootra (Urine), and Sweda (Sweat). These waste products are vital for maintaining essential bodily functions.²⁻³ The body's circulatory channels are called "Srotas," and they hold great significance in facilitating various crucial physiological functions. According to Charakacharya, Srotas play a pivotal role in ensuring the circulation of essential products within the body. These channels are responsible for the distribution of vital substances. Regarding the physiology of tissues, they fulfill significant roles by ensuring their own nourishment and providing nutritional elements for the development of corresponding tissues. Among the waste products, urine (Mootra) holds particular importance in the human body, and the urinary channels of circulation, known as Mootravaha Srotas, originate from the

kidneys (Vrikka) and urinary bladder (Mootrashaya).⁴⁻⁶

Anatomy of urinary system in Ayurveda:

Renal calculi, commonly known as kidney stones, represent the oldest and most widespread issue within the urinary tract system. This condition exhibits a recurring pattern and ranks as the third most common disorder among urinary problems. Research suggests that more than 10% of the population in developed regions around the world suffer from urinary stone tract disease. In India, approximately 12% of the population is affected by urinary stone issues. Epidemiological studies have revealed that this condition is more prevalent in men (12%) compared to women (6%), with the highest occurrence observed in the age group of 20 to 40 years, followed by a decrease in incidence after the age of 50. Various factors contribute to the development of kidney stones, including hot climates, dietary choices, metabolic abnormalities, elevated urinary citrate levels, immobility, and inadequate urinary drainage.⁷ Regarding the composition of kidney stones, calcium stones are the most common type, accounting for 75-90%,

followed by struvite stones (10-15%), uric acid stones (3-10%), and cystine stones (0.5-1%).

Excretory System Development:

In embryology, according to Ayurvedic principles, the human body's formation is guided by the combination of the Panchbhautika (Five elements) and the Tridosha (Three Bio-elements) during the union of Shukra (Sperm) and Shonita (Ova). These eight factors collectively contribute to the development of each organ during fetal growth. The Basti (Bladder), a hollow structure, takes its shape through the blending of Vayu (Airy bio-element) with the essence of Rakta (Blood), Kapha (Watery bio-element), and Pitta (Fiery bio-element). Various Acharyas (Saints) have concurred that the Basti (Bladder) originates from Matrija Bhava, the maternal constituents.⁸⁻⁹

Vrikka (Kidneys) - Ayurvedic texts provide a basic and concise depiction of the anatomy and function of the excretory system. The term "Vrikka" is derived from "vrikkadane," meaning "to take." When discussing the urinary system, Sushruta does not associate the term "vrikka" with the "basti." Instead, there is a description of "mutravaha nadis" or channels responsible for transporting fluid waste ("drava mala") from the "pakwashaya" to the "basti," where it is released as urine drops. Both Charak and Sushruta mention that there are two internal organs known as "vrikka" in the human body, one on each side. These "vrikka" are described as nearly round in shape and are positioned in the posterior abdomen within the lumbar region. They are believed to be associated with the "medovaha srotas," responsible for nourishing abdominal fat, possibly due to their proximity to the adrenal glands located near the upper poles of the kidneys. The secretion of cortisol by the adrenal glands stimulates the release of fatty acids from adipose tissue. Excessive cortisol secretion is

associated with a unique form of obesity characterized by fat accumulation in the chest and head regions, which is indicated by signs of "vrikka vidradhi." Despite their location outside the renal capsule, the suprarenal glands are enveloped by the kidneys within the perirenal fascia. Within Ayurvedic teachings, it is said that there are two "mutravahi nadis," which are believed to form an intricate network, numbering in the millions. This network corresponds to the roughly one million nephrons found in each kidney.

Basti - It is described as a reservoir for urine, akin to the modern anatomical concept of the urinary bladder, which temporarily stores urine. In Ayurvedic texts, the "basti" is associated with various anatomical areas such as "nabhi," "prishtha," "kati," "mushka," "guda," "vankshana," "shepha," and "pourush granthi." Similarly, in modern anatomy, the apex of the urinary bladder is connected to the umbilicus through the median umbilical ligament. The upper part of the bladder is separated from the rectum by the rectovesical pouch, while the lower portion is related to the seminal vesicles and the terminal segment of the vas deferens. In males, the urinary bladder is continuous with the base of the prostate. The "basti" is described as having an ovoid shape resembling that of an "alabu," which mirrors the distended appearance of the urinary bladder. Just as the urinary bladder has a single urethral orifice, the "basti" also has a solitary outlet. Ayurvedic texts mention that the "basti" is surrounded by "sira" (veins) and "snayu" (ligaments). Similarly, modern anatomy recognizes the presence of various true and false ligaments around the bladder. True ligaments include the lateral true ligament, lateral puboprostatic ligament, medial puboprostatic ligament, median umbilical ligament, and the posterior ligament. False ligaments consist of the

median umbilical fold, medial umbilical fold, lateral false ligament, and the posterior false ligament. According to Sushruta, the "basti" is described as "adhomukha," meaning its opening points downward, aligning with the structure of the urinary bladder where the urethra is connected at the lower end or neck.⁹

Gavini (Ureters) - The body possesses two ureters, located on each side of the bladder, referred to as "Basti." These structures receive urine from the digestive system and convey it to the urinary bladder.

Mutrapraseka (Urethra) - The urethra is among the eight essential organs that require careful handling during bladder calculi surgery. It functions as the exit point from the bladder and varies in length, measuring two angulas in females and twelve angulas in males. In males, it serves the dual purpose of carrying both urine and semen, while in females, it exclusively transports urine.

Mutravaha Srotas (Nephrons) - According to Charaka, the term "Srotas" denotes channels through which substances flow. The channels responsible for conveying urine are identified as nephrons. These nephrons originate from the bladder and the inguinal region, although

Classification of Ashmari:

Table no. 1 On basis of characteristics of kidney stones:¹¹⁻¹²

Type	Incidence	X-ray findings
Calcium oxalate-dihydrate & monohydrate (mulberry stone)	75%	Radio-opaque Spherical, brown colour with sharp projection
Phosphate stone (staghorn calculus)	10-15%	Radiopaque, spherical, smooth with white color. It is either Ca phosphate or Ca, mg, ammonium phosphate
Uric acid	10%	Radiolucent, smooth, hard, yellowish,
Struvite of cystine from renal tubules.	10%	Radiopaque, stag horns common Defective absorption
Cystine	1%	Faintly radiopaque

there are differing viewpoints between Charaka and Susruta regarding their origins. Damage to these nephrons can lead to complications such as urinary retention, bladder distension, and painful erections, potentially resulting in fatal consequences for the patient.

Mutravaha Dhamanis (Arteries of the Urinary System) - Susruta describes "Adhogami Dhamanis," which are arteries that move downward and play a crucial role in distributing nutrients and waste materials, including urine, feces, semen, ova/menses, and flatulence. These arteries are further categorized into ten groups, totaling thirty, with two of them specifically involved in nourishing and containing urine within the urinary bladder.

Mutravaha Siras (Veins of the Urinary System) - While Charaka and Susruta's texts do not provide detailed descriptions of urinary system veins, the Ashtanga Hridaya introduces the concept of "Mutravaha Sira," which are small channels responsible for carrying urine to the bladder. These veins continuously filter and fill the bladder with urine.¹⁰

On basis of Doshic varieties:

Kaphaj Ashmari - When the Kapha dosha is dominant, it causes urine flow issues due to compactness and enlargement, leading to obstructions. This results in symptoms like a sharp bladder pain, a feeling of bladder heaviness, and a sensation of coldness. The Ashmari is comparable in size to a hen's egg, has a pale-white hue, a smooth texture, and is relatively large in appearance, resembling the madhuka flower.¹²⁻¹³

Pittaj Ashmari - In cases where both Kapha and Pitta doshas are involved, there is compactness leading to blockages in urine flow. This results in discomfort, including a burning sensation in the bladder-penis region and a feeling of heat emanating from the bladder. The Ashmari exhibits colors ranging from red to yellow and dark shades, resembling the seed of the Bhallataka tree.

Vataja Ashmari - The combination of Vata and Kapha doshas obstructs urine flow, causing intense pain. This pain is so severe that the individual clenches their teeth, applies pressure to their navel, external genitals, and anus, often expressing their agony vocally. Urinating becomes a strenuous task. The resulting Ashmari is hard, irregular, and has a rough texture, akin to the Shyava stone and featuring thorn-like structures resembling those found on the Kadamba Pushpa flower.¹⁴

Etiopathogenesis: In the realm of Ayurveda, Ashmari holds a significant place, regarded as a notable surgical condition. Vagbhata termed it as "Maharoga," while Susruta, a trailblazer in the field of surgery, presented a comprehensive account of Ashmari, encompassing its origins, symptoms, prognosis, complications, and both medical and surgical remedies. In the text known as Madhava Nidana, Kapha is identified as the fundamental Dosha responsible for the formation of Ashmari. It is elucidated that Ashmari occurs when Vata dries up semen,

urine, Pitta, or Kapha accumulated in the urinary bladder, somewhat akin to how bile solidifies in a cow's gallbladder. All types of Ashmari are attributed to the interplay of the three Doshas.¹⁵⁻¹⁶ According to Susruta, individuals who disregard proper cleansing practices (asamshodhana) and maintain unhealthy dietary habits (apathya karina) experience an aggravation of their Shlesma Dosha. This exacerbated Dosha combines with urine and enters the Vasti (urinary bladder), leading to the formation of calculi. Charaka, in the Mutrakrichra chapter, expounded upon Ashmari. He outlined factors such as excessive physical exertion, the use of potent medications (tikshna - ausadhi), rapid riding on horses or vehicles, excessive consumption of dry wine, consumption of food before the previous meal is digested (adhyasana), as the underlying causes for the eight types of Mutrakrichra and eventually Ashmari.¹⁷ During the course of treatment, Charaka advised patients to abstain from strenuous exercise, the consumption of coarse and dried foods, suppression of natural urges, the intake of baked foods, overexposure to wind and sun, and the consumption of foods that disrupt Vayu (such as lotus rhizomes, Jambu, etc.). In contrast to Susruta, Charaka emphasized the role of Vayu Dosha as a contributing factor. Kashyapa attributed the etiology of Mutrakrichra and Ashmari to the carrying of heavy loads on the loins (kati) and shoulders (skandha). This load-bearing leads to the vitiation of Pitta, which subsequently combines with Kapha and Vayu before entering the Vasti and affecting it.¹⁸

DISCUSSION:

Based on our current knowledge of the structure of this system, we understand that its primary components include the Kidneys, Ureters, Urinary Bladder, and Urethra. However, when it comes to Ayurvedic insights into these structures, our understanding is

limited and incomplete. Ayurvedic texts do not provide a clear description of the physiological aspects of this system. While they do mention the Kidneys as "Vrikka" and the Urinary Bladder as "Basti," there is no specific mention of the Ureters and Urethra. Although terms like "mutravahi nadi" and "dhamani" are present, the descriptions provided are insufficient for a comprehensive understanding of the anatomy and function of this system.¹⁴⁻¹⁹ In Ayurveda, it is noted that Vata is located in the "Pakvashaya" (large intestine), which plays a vital role in the elimination and retention of waste products such as "mala," "mutra," and toxins. An aggravated Vata is believed to be responsible for the formation of "ashmari" or stones. When Vata becomes imbalanced, it leads to the drying up of "Shukra," "Mutra," "Pitta," and "Kapha" in the region of the bladder, gradually resulting in stone formation. According to Sushruta, "Mutra" enters the "basti" through "Mutravahak nadies," much like how "mutra-Vata," "Pitta," and "Kapha" also enter the "basti." Applying the concept of "Upsneha nyaya" explains the process of stone formation, or "Ashmari."²⁰ The symptoms of calcium oxalate stones closely resemble those of "Vataja Ashmari." These stones exhibit characteristics such as an amber hue similar to lac or resin, a rough surface, irregular shapes, and a visual resemblance to the kadamba flower. Uric acid stones, known as "Urate Calculus," have a yellowish-brown color, distinguishing them from "Pittaja Ashmari." The color changes observed in cystine stones, initially yellow and green but transitioning to red, yellow, or black under external conditions, align with the fundamental hues associated with "Pitta." These stones are similar in size to bhallataka seeds and occasionally have a honey-like color.²¹⁻²² Phosphate stones appear as white formations with a smooth surface and larger dimensions, causing less

discomfort compared to other types of stones. These characteristics are consistent with the classical attributes of "Kaphaj Ashmari," characterized by a white, glossy texture, large oval shapes resembling hen's eggs, and a color similar to the madhuka flower. In light of these findings, renal stones can be identified as "Ashmari," as described in Ayurvedic foundational texts.

CONCLUSION:

Ayurveda offers a comprehensive explanation of the Mutravaha Samsthana, which refers to the urinary system responsible for creating and expelling urine. Urine formation is a crucial physiological process that helps remove waste and supports the body's detoxification. This process involves transforming Aahar Rasa, derived from digestion and metabolism, into urine. The urinary system eliminates most waste fluids, and any disruption in this process can lead to various health issues. Key elements such as Basti, Mutravaha Srotansi, Vrikka, Mutravaha Nadies, Mutravaha Dhamanis, and Mutravaha Sira are essential for urine formation within the body according to Ayurveda. In modern medical terms, the kidney, nephrons, urinary bladder, and urethra play crucial roles in the urine formation process. Understanding this process helps doctors identify the underlying causes of urinary system-related disorders.

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