

Review Article

Conceptual Review on Etiopathogenesis and Management of Urolithiasis in Ayurveda with Proven Clinical Trials

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ABSTRACT

Ashmari (Urolithiasis) is a very common worldwide problem, troubling mankind since ages and is one of the major reasons of abdominal pain these days. The therapies available in different systems of medicine are not able to prevent its pathogenesis, even the surgical methods available for the management of calculi like extracorporeal shock wave lithotripsy, cystolithotomy etc. also fail to prevent the recurrences and have even got many side effects such as sepsis, strictures, splenic rupture, renal haematoma, hydrothorax etc. So, the recurrences even after removal of the calculi is becoming a great problem and efforts are being made constantly to find out an effective treatment of urolithiasis as well as prevention of its recurrence. Hence, alternative treatment modalities have gained importance. A number of Ayurvedic single medicinal herbs or formulations have been used since past for managing disorders including urinary stones. They have been claimed to have litholytic and litho preventive properties. The main aim of this review paper is to understand the Ayurvedic concept of urolithiasis and to explore its management with herbs, dietary and lifestyle interventions on scientific basis.

Key words: Urolithiasis, *Ashmari*, *Mahagada*, *Ayurveda*, Litholytic herbal drugs.

INTRODUCTION

The word urolithiasis can be split as urolithiasis, which means stone in the urinary tract. Urinary calculi is a stone like body composed of urinary salts bound together by a colloid matrix of organic material (most commonly - calcium oxalate and others are calcium phosphate, uric acid, cystine or magnesium ammonium phosphate). It consists of a nucleus around which concentric layers of urinary salts are deposited. [1] It is a worldwide problem which does not spare any geographical or racial group. It is the third most common affliction and the most painful urologic disorder. A study from Saudi Arabia reported that renal calculus affect 23% of general population and males have higher

incidence than females, ratio being 3:12. [2] A relapse rate of 50% in 5-10 year and 75% in 20 year is seen in urolithiasis. It is estimated that 12% of world population experiences renal stone disease with a recurrence rate of 70-80% in male and 47-60% in female. [3] Renal stones may occur due to metabolic disturbances, infections, hormonal influences, dietary conditions and habits or obstructions in the bladder or kidney or increased excretion of stone forming components such as calcium, magnesium, oxalate, carbonate, phosphate, urate, cystine etc. The major factors are supersaturation of urine with the offending salt and crystallization. [4] The immediate treatment of renal colic is bed rest and hot fomentation locally. Pain can be relieved by

use of one of NSAID (Diclofenac sodium, Indomethacin, Hydromorphone, Metamizol, Pentazocine, and Tramadol) usually and changed to an alternative drug if the pain persists. The therapeutic agents that are used generally are alkalinizing agents (sodium citrate, citric acid and potassium citrate mixture), diuretics (hydrochlorothiazide), chelating agents (cellulose sodium phosphate), and Xanthine oxidase inhibitors (Allopurinol). If pain is not relieved by medical means, then stone is removed surgically. [5] The surgical removal, in addition to the traumatic effects of shock waves, persistent residual stone fragments and the possibility of infection, may cause acute renal injury, a decrease in renal function and an increase in stone recurrence. [6] Therefore, it is worthwhile to look for an alternative treatment.

Ashmari (calculi) comprises of two words, i.e. 'Ashma' and 'Ari.' 'Ashma' means a stone and 'Ari' means enemy. *Ashmari* (calculi), specifically called as *Moothrashmari* (urolithiasis), is a disease of *Moothravahasrota* (urinary tract) and involves formation of stone, resulting into severe pain as given by enemy. The stone can be formed at any level of the urinary tract, most frequently it occurs in kidney and may pass down the urinary tract from ureters to the urinary bladder and are intensely painful when they pass along the ureters and out via urethra. It is considered as *Mahagada* [7] (difficult to treat) as it is *Tridosha*, has *Vasti* (urinary bladder) as its *Vyakthasthan* [8] (area of presentation or site) i.e. *Marmashrayee* (situated at vital area) which is considered as *Pranayatana* [9] in *Ayurveda*. The severity of its pain is compared with the labour pains during child birth making the life of patient miserable. *Ashmari* has been mentioned in all our ancient texts but *Acharya Sushruta* has described it elaborately in *Sushruta Samhita* along with its medicinal as well as surgical management. He has clearly mentioned the site, character and severity of pain, its aggravating and relieving factors. The pattern of pain mentioned in the classics

resembles renal and ureteric colic given in modern texts which is among the main causes of abdominal pain today and it is estimated that every individual has 1 % chance of developing it in lifetime. [6] Hence, it is the need of hour to understand and find out the best possible way to treat and prevent this troublesome disease.

Nidana (etiology) - In Ayurveda, mainly non adoption of *Panchakarma* (five methods of purification of the body), unhealthy diet and lifestyle are responsible for the formation of calculi. [10] In conventional medicine, three primary factors are considered responsible for urolithiasis - supersaturation of stone-forming compounds in urine, presence of chemical or physical stimuli in urine and presence of inadequate amount of compounds in urine that inhibit stone formation. Heredity, geographical condition, dietetic factors also play a key. [4]

Samprapti (pathology) - According to *Ayurveda*, *Kapha Dosha* is vitiated (by indulging in unhealthy diet and lifestyle; non purification of the body) and reaches urinary system; with the help of *Vata - Pitta dosha*, *Kapha* reaches and stays in *Vasti* (urinary bladder) and forms *Ashmari* (calculi). [10] The two basic aspects of pathogenesis of urinary stone are as follows- (a) increased urinary excretion of stone forming substances like calcium, phosphorus, uric acid, oxalate and cysteine. (b) Physico-chemical change influencing stone formation like pH of urine, stone matrix and protective substance in urine. Urine should be supersaturated for precipitation of crystalline substance leading to formation of calculi in urinary tract. The agents modifying nucleation, crystallization, and aggregation pH of the urine also play important role in stone formation. [11]

The prodromal signs and symptoms (Ayurvedic Aspect) - There is severe pain in urinary bladder, scrotum and penis; fever, body ache, anorexia, dense and turbid urine; dysuria, fatigue and odour of urine resembling that of a sheep. [12] The major clinical features described are pain around

the umbilicus, urinary bladder region, raphe, penis and other nearby areas during micturition; obstructed urinary flow; scattering of urine; hematuria; color of urine resembles *Gomed* (hessonite stone), turbid urine; sand like particles passing along with urine; pain aggravated by jumping, swimming, running, riding, walking etc. [13] Modern texts have given different types of pain occurring at different sites according to the position of the calculi in the urinary tract as the main symptom. The pain may be fixed dull ache, colicky in nature or referred pain which may be accompanied by profuse sweating, nausea, vomiting, increased pulse and subnormal temperature. Pain worsens with movement like running, jumping, jolting and climbing upstairs and eases with rest. Also there may be haematuria. [14,15]

Classification of Renal Calculi - Ayurvedic texts have described four types of urinary calculi: *Sleshmaashmari*, *Pittaashmari*, *Vataashmari* and *Sukraashmari*. [16]

Sleshmaashmari stones are white, unctuous and as big as a hen's egg. They produce symptoms such as dysuria, cutting, incising, pricking pain, heaviness, and a cold sensation over area the bladder region. It resembles *Madhuca* (*Bassia longifolia* L.) flower in color. [17] *Pittaashmari* stones are reddish, yellowish, and blackish and resemble the color of honey and seed of *Bhallataka* (*Semecarpus anacardium*). They produce a sucking type of pain, burning sensation, a warm feeling over the bladder region and *ushna vata* [18] (burning and difficulty in urine). *Vataashmari* stones are bluish dusty in color, hard, irregular, coarse, rough and nodular or spiky like the *Kadamba* (*Neolamarckia cadamba roxb.*) flower. Patients experience severe pain (and may scream); squeezes penis, pull out the prepuce, touches rectum; and have difficulty when passing flatus, urine, and stools. [19] *Sukraashmari* occurs in adults only due to suppression of ejaculation for months or years and frequent coitus or coitus interruption. The semen to be ejaculated gets obstructed, condensed and brought in-between the scrotum and penis (prostatic

part of the urethra) by *Vata*. This causes dysuria, scrotal swelling, and lower abdominal pain. This calculi break at its place when squeezed by hand. [20] In conventional medicine, urinary calculi are classified as primary (uric acid and urate stone oxalate stone, cystine calculi, xanthine calculi, indigo calculi) and secondary calculi (phosphate stone, mixed calculi). These calculi can be compared as follows with the *Ayurvedic* counterparts - *Sleshmaashmari* can be correlated with the phosphatic stone (dirty white, smooth, soft, easily broken up and attains large size rapidly), *Pittaashmari* with urate stones (moderately hard, yellow to brown in color, usually multiple and smooth), *Vataashmari* with oxalate stones (usually single, dark in color, extremely hard with rough and spiky surface) [21] and *Shukraashmari* with spermolith or seminal concretions of conventional medicine.

Prognosis - From *Ayurvedic* perspective, except *Shukraashmari*, the other three types are manageable by medicine and surgery. If the renal calculus is associated with swelling in the scrotum and umbilical region, retention of urine with severe pain, and passing of urine with fine particles, the condition is said to be incurable. [22]

Ayurvedic management of Ashmari (Urolithiasis) - It can be presumed that the alteration of biochemical quality of urine can help in treatment and prevention of *Ashmari* which can be achieved by quality and quantity of fluid inputs, diet and the constitutional factors. It is treated with medicine if it is recent in origin and requires *Chedana Karma* (excision) if its size is large. [23] Our *Samhitas* mention a number of herbs that can break the stone helping in its easy removal by diuretic herbs via urine.

Shamana therapy (palliative treatment) - It includes administration of herbal drugs orally. *Ayurvedic* texts have given *Mutravirechaniya* [24] (diuretic) and *Ashmarighna Dravya* [25] (lithotriptic) which can be used for urolithiasis along with drugs having antispasmodic, anti inflammatory, anti bacterial and nephroprotective activity. Common drugs mentioned in our texts are-

Preparations of *Varuna* (*Crataeva nurvala*), *Gokshura* (*Tribulus terrestris*), *Pashanabheda* (*Bergenia ligulata*), *Shilajit* (*Asphaltum Panjabinum*), *Ela* (*Elettaria cardamomum*), *Veerataru* (*Dichrostachys cinerea* Linn.), *Brihati* (*Solanum indicum*), *Kantakari* (*Solanum xanthocarpum*), *Yava Kshara* (alkali preparation of *Hordeum vulgare* L.), *Kushmanda* (*Benincasa hispida* [Thunb.] Cong.), *Trapusa* (*Cucumis sativus*), *Hazrul yahood* / *Badrashma bhasma* (Lime Silicate calx.) etc.

Mutravirechaneeya dravyas [24] (diuretic herbs) - Most of the *Mutravirechaneeya dravyas* like *Trinapanchmool*, *Ikshu* (*Saccharum officinarum* Linn), *Pashanabheda* (*Bergenia ligulata*), *Gokshura* (*Tribulus terrestris*), *Punarnava* (*Boerhaavia Diffusa*), *Shali* (*Oryza sativa* Linn.), *Ksheera* (Milk), *Navadhanya* (grains) and so on, being *Sheeta* (cold), increase *Kapha* and *Dravata* (liquidity) in the *Shareera* (body). Among them *Ikshu* and *Gokshura* are considered to be *Shreshta* (best), whereas, herbs like *Ela*, *Gomutra* (cow's urine) and *Vana palandu* (*Urginea indica* Roxb), being *Ushna Veerya* (hot potency) cause *Virechana* (purgation) of the *Mutra* (urine).

Ashmarighna Dravyas [25] (lithotriptic herbs) - *Dravyas* of *Veeratarvadi gana*, *Mushkakadi Gana*, *Ushakadi Gana* i.e. *Laghupanchamoola*, *Pashanabheda* (*Bergenia ligulata*), *Kulattha* (*Dolichos biflorus* Linn.), *Shigru mula* (Roots of *Moringa olifera* Lam.), *Varuna* (*Crataeva nurvala* Buch-Ham.), *Gorakshaganjja* (*Aerva lanata* L.) etc. have been proved to be the best *Ashmarighna dravyas*.

Kshara Karma (alkali therapy) - Most of the *Kshara* (alkaline materials) act as diuretics, lithotriptic, alkalizer, antispasmodic agents and are effective in the management of urolithiasis. [26] For example *Palasa Kshara* (alkali preparation of *Butea monosperma*) and *Yava Kshara* (alkali preparation of *Hordeum vulgare* L.).

Experimental Studies

Palaash kshara (Alkali preparation of Butea monosperma) - In a study, 50

patients of urolithiasis (24 patients with renal calculus and 26 patients with ureteric calculus) were given *Palasa Kshara* (1 g TDS for 30 days). On the basis of radiological findings, the drug was found to be effective in expulsion of calculi (more effective in expulsion of ureteric calculi as compared to renal calculi). [27]

Yava Kshara (Alkali preparation of Barley) - Yava Kshara (pH 11.73) neutralize the acidic media, thereby prevents hyper-concentration of urine and formation of calculi. It also helps in dissolution of calculi as it changes the urinary pH. Trials on *Yava Kshara* support its impact on Calcium Oxalate crystallisation. [28]

Banana (Musa paradisiaca Linn. and Musa sapientum Linn.) - A study was conducted with 71 patients suffering from *Ashmari* (urolithiasis) who were diagnosed by kidney, ureter, and bladder intravenous pyelography (KUB, IVP). They were treated with juice of the core of the pseudostem of *Musaparadisiaca* Linn. and *Musa sapientum* Linn. A significant segment of them passed out calculi of varying size after consuming the drugs for 2 weeks. The recurrence of stone formation was also prevented by the treatment. The author concludes that the plant material is quite effective in curing urolithiasis, especially of the calcium oxalate variety. [29]

Shatavari (Asparagus Racemosus) - The antiurolithiatic effect of ethanolic extract of *Shatavari* was studied in experimentally induced urolithiasis in rats. Flavonoids, saponins, polyphenols, asparagamine a polycyclic alkaloid, racemosol a cyclic hydrocarbon (9, 10-dihydrophenantherene), and polysaccharides are its active principles among which flavonoids and saponins have diuretic activity; Flavonoids and polyphenols have antioxidant effect and 9, 10 - dihydrophenantherene has antibacterial effect. All these combine to give it its antiurolithic property. [30] In another study the ethanolic extract of *Asparagus racemosus* Willd. was studied for inhibitory potential on induced lithiasis in adult male albino Wistar rats and was found to reduce

the elevated level of these ions in urine significantly and also the elevated serum creatinine. It was found to raise the urinary concentration of magnesium also, which is considered as one of the inhibitors of crystallization. The histopathological findings revealed signs of improvement after the treatment. [31]

Veerataru (*Dichrostachys cinerea* Linn.) - *Veerataru* root *Kwatha* [decoction of *Dichrostachys cinerea* (Linn.)] Administration was studied in experimental animals and was found to increase urine output in a dose-dependent manner may be due to action of its individual or combined bioactive components. [32]

Shilajit (*Asphaltum Panjabinum*) - Study was done on Anti-oxidative effect of *Shilajit* in patients of urolithiasis as free radicals are considered as one of the reason for it and was found to be of value in preventing initial stage of nidus formation induced by oxidative stress as well as recurrence of stone formation. [33]

Kushmanda (*Benincasa hispida* [Thunb.] Cong.) - The study investigated the effect of ethanolic extract of *Benincasa hispida* seeds (BHE) in different dose of 250 and 500 mg/kg p.o against ethylene glycol (0.75%) induced hyperoxaluria and renal cell injury in Wistar albino male rats. The BHE significantly lowered the urinary excretion and kidney retention levels of oxalate, protein and calcium. Elevated serum levels of sodium, Creatinine and calcium, phosphorus were significantly reduced by the extracts. [34]

Kantkari (*Solanum xanthocarpum*) - The effects of *Solanum xanthocarpum* fruit extract in different doses of 100, 200, and 400 mg/kg p.o was studied in ethylene glycol (0.75%) induced urolithiasis in the male Wistar rats. Cystone (750 mg/kg, p.o.) served as a standard group. The study reported that treatment with *S. xanthocarpum* decreases hyperoxaluria, calcium and uric acid, improves renal function, and also produces antioxidant effects. [35] In another study, *Kantkari* showed inhibition of *in vitro* calcium

oxalate crystal (CaOx) nucleation as well as aggregation in artificial urine solution by SXS. The lithogenic treatment caused polyuria, damage renal function crystalluria, and oxidative stress which manifested as increased malondialdehyde, hyperoxaluria, hypercalciuria, hypocitraturia, hypomagnesaemia, depleted reduced glutathione and decreased antioxidant enzyme catalase activities of the kidneys; also deposition of CaOx in renal tissue and cellular injury were seen in histopathology. Co-administration of SXS had potential to prevent these pathological changes due to lithogenic treatment. SXS also raised the level of glycosaminoglycan (a stone inhibitor macromolecule in urine). [36]

Punarnava (*Boerhaavia Diffusa*) - Calculi were induced in Wistar male rats which were later treated with aqueous and alcoholic extracts of *B. Diffusa*. The results revealed significant decrease of stone forming constituents (calcium, oxalate and phosphorous) in the urine and increased magnesium levels. [37]

Varuna (*Crataeva nurvala*) - In experimental urolithiasis, cytoprotective action of lupeol isolated from *Varuna* (stem bark) against free radical toxicity was studied. Administration of lupeol showed remarkable reduction in renal oxalate level and was also effective against free radical toxicity as there was a significant reduction in peroxidative levels and an increase in antioxidant status. [38] In another study done in rats by observing the weight of the stone, biochemical analysis of serum and urine, histopathology of bladder and kidney, Lupeol was not only found to reduce size of preformed calculi but also prevented the formation of vesicle calculi. [39]

Gokshura (*Tribulus terrestris*) - Antiurolithiatic activity of ethanolic extract of *Gokshura* (fruit) was studied in albino rats against induced urolithiasis and it inhibited stone formation almost completely along with normalization of leukocytosis, elevated serum urea levels and altered histopathology of urinary bladder. [40]

Pashanabheda (*Bergenia ligulata*) - The crude aqueous-methanolic extract of *Bergenia ligulata* rhizome (BLR) was studied using *in vitro* and *in vivo* methods. BLR inhibited calcium oxalate (CaC₂O₄) crystal aggregation as well as crystal formation in the metastable solutions and exhibited antioxidant effect against 1,1-diphenyl-2-picrylhydrazyl free radical and lipid peroxidation in the *in vitro*. In an animal model of urolithiasis, developed in male Wistar rats by adding 0.75% ethylene glycol (EG) in drinking water, BLR (5-10 mg/kg) prevented CaC₂O₄ crystal deposition in the renal tubules. The lithogenic treatment caused polyuria, weight loss, impairment of renal function and oxidative stress, manifested as increased malondialdehyde and protein carbonyl contents, depleted reduced glutathione and decreased antioxidant enzyme activities of the kidneys, which were prevented by BLR. Unlike the untreated animals, EG intake did not cause excessive hyperoxaluria and hypocalciuria in BLR treated groups and there was a significant increase in the urinary Mg²⁺, instead of a slight decrease. [41]

Shiguru (*Moringa Oleifera*) - The alcoholic extract of seeds of *Shiguru* was found to be a potent analgesic when study was carried out in wistar male albino rats. The methanolic extract of the root produced analgesia in mice and also potentiated the analgesic action morphine and pethidine. The roots and ethanol extract of the leaves showed antispasmodic action, possibly through calcium channel blockade. The administration of aqueous and alcoholic extract of root-wood significantly reduced the elevated urinary oxalate showing a regulatory action on endogenous oxalate synthesis and also lowered the increased deposition of stone forming constituents significantly in the kidneys of calculogenic rats. [42]

Jasmine (*Jasminum auriculatum*) - In male albino rats, the effect of oral administration of aqueous and alcohol extracts of *Jasminum auriculatum* Vahl

(Oleaceae) flowers on calcium oxalate nephrolithiasis was studied. There was a significant reduction in elevated urinary oxalate showing a regulatory action on endogenous oxalate synthesis and also the deposition of stone forming constituents in the kidneys of calculogenic rats was significantly lowered by using aqueous and alcohol extracts. [43]

Bakul (*Mimusops Elengi*) - Petroleum ether, chloroform, and alcohol extracts of *Mimusops elengi* bark were evaluated for antiurolithiatic and antioxidant activity against ethylene glycol (0.75%) induced urolithiasis in male albino Wistar rats. Cystone 750 mg/kg P.O served as standard. Serum BUN, creatinine, uric acid and excretion of oxalate, calcium, and phosphate excretion were monitored in the urine along with antioxidant parameters such as lipid peroxidation (MDA), glutathione (GSH), superoxide dismutase (SOD), and catalase (CAT). The study concluded that in hypercalculi animals, the oxalate, calcium, and phosphate excretion grossly increased. The increased deposition of stone forming constituents in the kidneys of calculogenic rats were significantly ($P < 0.001$) lowered by curative and preventive treatment with alcohol extract of *M. elengi*. Alcoholic extract of *M. elengi* produced significant ($P < 0.001$) decrease in MDA, and increased GSH, SOD, and CAT. [44]

Shodhana Therapy (purification treatment) - It includes pre-panch karma procedures i.e. *Snehana* (external and internal oleation) and *Swedana* (induced sweating) and *Panchakarma* (five methods of purification of the body) procedures i.e. *Vamana* (medicated emesis), *Virechana* (medicated purgation) and *Vasti* (medicated enemas). *Ayurvedic* classics recommend *Vasti* for management of urolithiasis. Generally, *Saindhavadi Taila Niruha Vasti* and *Vrushadi Asthapana Vasti* are used in renal calculi. This may encourage transmucosal fluxes away from the kidney which lead to the removal of unwanted metabolites, hence reduce the ionic load on kidney. [5]

Prevention - Ayurvedic texts provide detailed information regarding the dietary habits and lifestyle which should be adopted in *Ashmari* (urolithiasis). It is advised to take whole rice, wheat, barley, horse gram, green gram, matured pumpkin, *Varuna*, ginger, *Gokshura* and amaranthus, flesh of birds residing on dry soil or barren land, and measures such as medicated enemas, emesis, purgation, fasting or light diet, and sudation. The intake of sour, dry, and heavy foods, food substances that cause indigestion and unwholesome food items should be avoided. [45]

CONCLUSION

The herbal medicines are the heritage of our ancient civilizations. India is sitting on a gold mine of herbal drugs but is not able to capitalize its herbal wealth till now which is still the mainstay for primary health care especially in the developing countries because of better acceptability, compatibility with the human body and lesser side effects. Urolithiasis is a common trouble effecting people all around the world and frustrating physicians and surgeons by its recurrence, herbal drugs may prove beneficial here and should be given a chance. They may come out as a miracle for the management and prevention of recurrent urolithiasis. This article provides a number of herbal treatments that provide scope for future research also.

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