

A Review on Kidney Stones and Its Treatment By Medicinal Plants

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ABSTRACT

All around the world the kidney stone disease is a extreme problem with increased reoccurrence rate. Talking about the logistics of its occurrence, it is the third most common disease after urinary tract infection and prostate disease. Many other health problems are also named related to this systemic disorder. The key factors for the occurrence of kidney stone formation are imbalance of urinary promoters and inhibitors which are involved in the process of crystallization. The main constituents of urine are crystalloids such as calcium carbonate, ammonium magnesium, urea, cystine, potassium, uric acid etc. and colloids for instance chondrotin, mucin etc. The mechanism responsible for stone formation and all the factors effecting were noted. Treatment of Urolithiasis is possible with the help of some plants (medicinal plants) which belong to different families the therapies of such type of plants was found quite effective with very less to no self respect. A table is compiled for the list of those plants (which possess antiurolithic property) and their parts which are being used.

Keywords: *Crystal aggregation, Kidney stones, Medicinal plants, Treatment, Urolithiasis*

INTRODUCTION

Kidney stone disease also popular as Urolithiasis has become a prominent as a intense health issue all around the globe [1]. Affecting almost 12% of total world population nephrolithiasis is denoted by the formation of stone in the urinary tract [2]. It has a high reoccurrence rate in both males and females. It is more frequent in males as compared to females (because of their ability to inhibit oestrogen, more muscular mass and high levels of estrogen)

and is noticeable in almost all age groups ranging from infants to elders of more than 70 years of age. The basic reason for kidney stone is supersaturation of urine with various salts like oxalate, cystein, calcium, phosphorous etc. which leads to biomineralization in the kidney [3]. Most commonly occurring type of kidney stone are calcium oxalate stones (nearly 75%) followed by calcium hydroxyapatite stones, struvite stones, urate and cystein stones by 50%, 10-20%, 5% and 1-2% respectively [4]. The size of these kidney stones differs from micrometers to centimeters in diameter and because of this these kidney stones can stay anonymous for a long time and are generally noticed accidentally by painful symptoms or with the help of ultrasound scanning [5]. Several studies have demonstrated that a number of physicochemical events like supersaturation, nucleation, growth, aggregation and retention of crystals inside kidney lead to Urolithiasis, making it a complex process. Most of the urinary calculi (size ranging from 5mm to 7mm) have chances of passing out of urine easily but the stones larger than 7mm are not so easy to elute out on their own and urological involvement is required for their removal. Only 10% of total urinary calculi are required to be removed surgically while the rest of 90% are excreted out of the urinary tract which is followed by severe increase in the abdominal pain [6]. Various treatments are helpful for the removal of urinary calculi namely ureteroscopy, open intervention, shock wave lithotripsy etc. but these treatments exhibit major drawbacks of severe side effects and are quite expensive. Apart from these treatments a number of plants are known to exhibit antiurolithic property and are known for effectively treating kidney stone disease [7].

It is in the glomerulus, the urinary filtrate is formed. It is then made to pass through the tubules where its contents and volume is adjusted by secretions or by reabsorption. Maximum absorption of solutes occurs in the proximal tubules, while alteration in the composition of urine occurs in the distal tubule and in the collecting ducts. Essential ions such as sodium, chloride, glucose, water and important nutrients namely proteins, amino acids, calcium, potassium, phosphate, are reabsorbed at the proximal tubules and returned to the blood stream. Regulation of acid-base balance and the salt content occurs in the distal tubule. balance are Henle's loop helps in concentrating urine to a composition of water - 95%, urea - 2.5 %, minerals - 2.5%, hormones, salts, enzymes etc. [8]

TYPES OF KIDNEY STONES

The abnormalities in the chemical composition of urine directly influence the chemical composition of urine. Different stones have their respective shape, size and chemical composition [9]. Depending on the variations in pathogenesis and its mineral composition kidney stones can be classified in to the following categories [10].

Calcium stones: A significant amount of kidney stones are formed from calcium along with oxalate, phosphate as well as uric acid [10]. The naturally occurring components like oxalates are present in a number of foods like fruits, nuts, vegetables and chocolates. These possess high oxalate levels. In addition to this oxalates are also synthesized metabolically in the liver. 20-40 mg/d is the normal range for oxalates in the body of a healthy adult [11]. Various dietary ingredients like high vitamin D doses, interstinal bypass surgery and few metabolic disorders adds to the oxalate and calcium concentrations in the urine. Calcium monohydrate crystals are white, grey or blackish in colour and represent a radio opaque appearance with a rough diameter of 1cm having dense and sharp structures in the radiographs [12]. Health problems like renal tubular acidosis and hyperparathyroidism shows relationship with calcium phosphate calculi [13].

Uric acid stones: 5-10% of total kidney stone is uric acid stones which are yellowish orange in colour (if not mixed with calcium crystals) having round and smooth structures [12]. These stones have a changeable structure which can be polarized [5]. It is most commonly observed in people with problems like obesity, gout syndrome. It can also be caused with protein or purines rich diet specially the one eating fish or meat [14].

Struvite stones: These are second most commonly occurring calculi forming 10-15% of total stones. These are caused by presence of bacterial infection and are consists of magnesium ammonium phosphate. The progress of struvite stones is enhanced by the urease enzyme which breaks down the bacteria into ammonium and carbon dioxide, hence resulting in alkaline pH of urine. These stones are found in patients with diseases like idiopathic hypercalciuria and hyperparathyroidism. These stones are usually glazed, laminated and large in size [5].

Cystine stones: These are the stones caused by genetic disorders which make the kidney to secrete excessive amino acid. These are very rare. Being greenish yellow in colour, these are noticed by shiny crystals [15].

MECHANISM OF KIDNEY STONE FORMATION

Urolithiasis is caused by the uneven proportion of promoters and inhibitors [16]. The prime reason for kidney stone formation is supersaturation of the urine with oxalate and calcium salts which leads to crystalline particle formation [4]. The next step for formation of kidney stone is nucleation of crystal particle which up to a size so big so that they can interact with intra renal structures. Incarceration of crystal inside the kidney is done by further aggregation which finally forms clinical stone [17]. A major proportion of these kidney stones is calcium oxalate (Caox) stones (nearly 80%) [18], while CaP (calcium phosphate) contributes a small percentage (which is 15%) of these stones [5]. Supersaturation can cause declined urine volume, a disturbed pH of urine along with mechanisms leading to enhanced secretion of components like hypercalciuria, hypercitrauria, hyperuricosuria, etc [19]. All these are enhanced by a reciprocal action between environmental factors and genetic susceptibility. Some rare autosomal disorders, potential abnormalities of anion transporters of kidney and gut, enhanced oxalate intake, declined calcium intake, decrease in the degradation of oxalate caused by changes in normal flora of the gut can lead to primary hyperoxaluria type 1 and 2 [20]. The mechanism of kidney stone formation is depicted in Figure 1.

MANIFESTATION OF KIDNEY STONES

Generally urinary calculi are painless until they move from the kidney through ureter, into the bladder. These stone depending on their size while travelling through the urinary tract can lead to intense pain with abrupt dawning. Patients suffering from stones often explain that pain is agonizing, abdomen, the lower back, sides being the sites for the pain and cramping. Blood can also be observed in the urine of the patients along with fever and chills (which indicate the presence of some infection). The urine is cloudy as well as has a foul smell. Various promoters and inhibitors are tabulated in Table 1.

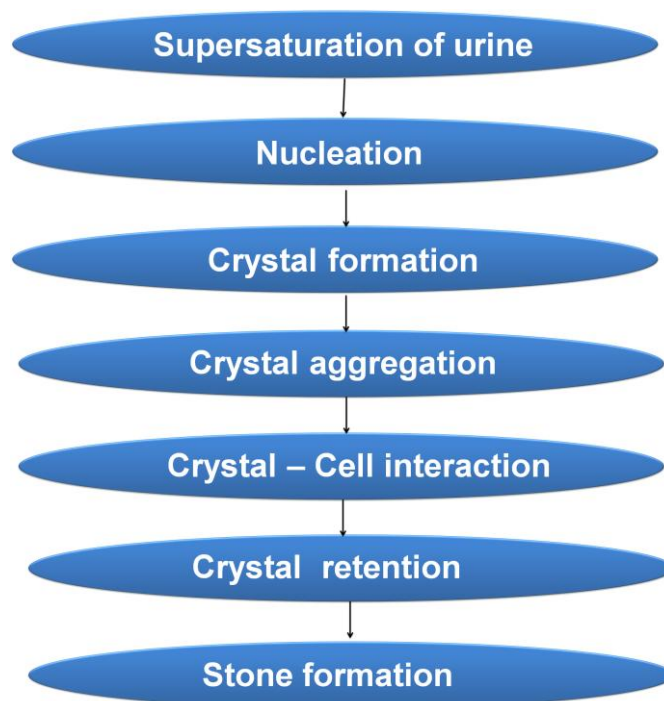


Figure 1: Mechanism of kidney stone formation

Promoters	Inhibitors
Calcium	(Inorganic) Magnesium
Phosphate	(Inorganic) Citrate
Oxalate	(organic) Tamm horsefall protein
Uric acid	(organic) nephrocalcin
Cystine	(organic) urinary prothrombin fragment 1
Altered pH of urine	High urine flow
Tamm horsefall protein	(organic) glycosaminoglycons

Table 1: List of promoters and inhibitors for Urolithiasis

TRADITIONAL APPROACH TO TREAT KIDNEY STONES

In the Ayurvedic system of medicine in India, a group plants called, ‘Pashanabheda’ is claimed to be helpful in the treating urinary stones. In Sanskrit ‘Pashanabheda’ means a group of plants with antiurolithiatic and diuretic activities (Pashana – stone, bheda - break). In this article, a compilation of some useful plants with anti-urolithic activity has been tabulated in Table 2.

Sr. no.	Botanical name	Part used	Family	Effects	References
1	<i>Achyranthus indica</i> Linn.	Roots	Amaranthaceae	Prevents kidney stone formation	21
2	<i>Beta vulgaris</i> L.	Leaves and rhizome	Amaranthaceae	Prevents kidney stone formation	22
3	<i>Helianthus annuus</i> Linn.	Leaves	Asteraceae	Used to treat kidney and urinary problems	23
4	<i>Achyranthus aspera</i>	Leaves	Amaranthaceae	Prevents the damage of renal epithelial cells, prevents stone formation	24
5	<i>Xanthium strumarium</i> Linn.	Roots	Asteraceae	Treatment of cancer and kidney stone	25
6	<i>Ananas comosus</i> L.	Ripe fruit	Broneliaceae	Helpful for the treatment of asthma, bronchitis and Urolithiasis	25

7	<i>Berberis aristata D.C.</i>	Leaves	Berberidaceae	For the treatment of urinary tract infections and Urolithiasis	25
8	<i>Curcuma angustifolia Roxb.</i>	Whole plant	Cucurbitaceae	Used for jaundice and Urolithiasis	26
9	<i>Hormonoia riparia Lour.</i>	Roots	Euphorbiaceae	Diuretic, antioxidant and lithotryptic	27,28
10	<i>Mallotus philippenis</i>	Bark	Euphorbiaceae	Used to treat stone in urinary tract	25
11	<i>Saccharum officinarum linn</i>	Stem	Poaceae	Urolithiasis, liver infection, blood purification	29
12	<i>Cassia fistula L.</i>	Fruit/stem	Caesalpiaceae	Litholytic	29
13	<i>Herniaria glabra L.</i>	Ariel parts	Caryophyllaceae	Lithotriptic	29
14	<i>Herniaria hirsuta L.</i>	Whole plant	Caryophyllaceae	Dissolves or prevents the formation of stone	26
15	<i>Spergularia rubra L.</i>	Leaves	Caryophyllaceae	Diuretic, Lithotriptic	27
16	<i>Cucumis sativus L.</i>	Leaves	Cucurbitaceae	Lithotryptic and litholytic	27,30
17	<i>Acalypha indica Linn.</i>	Whole plant	Euphorbiaceae	Antirolithiatic, anti-inflammatory, diuretic, analgesic and antioxidant	27
18	<i>Myriogyne minuta Less</i>	Ariel parts	Asteraceae	Used in treating stone in urinary tract when given	25

				along with equal ratio of sugarcane juice	
19	<i>Enhydra fluctuans</i> Lour.	Ariel parts	Asteraceae	Dissolves or prevents the formation of stone	31
20	<i>Acanthus ilicifolius</i> L.	Whole plant	Acanthaceae	Diuretic	31

Table 2: List of medicinal plants used for anti-urolithiatic property

CONCLUSION

Urolithiasis is a common disease in various communities of India and is also considered as a prime reason for various other diseases. Patients who had been previously treated with synthetic drugs are more likely to have kidney stone again and again along with various serious side effects causing a chaos in the patients. Plant waste therapeutic agents regulate the crystal imbalance and improve renal function, regulate oxalate metabolism. Since they are plant waste therapeutics they possess antioxidant activity by free radical scavenging and membrane stabilization. They also have antimicrobial analgesic and anti-inflammatory activity along with anti-urolithic activity. Therefore, the use of various plant parts as a treatment for kidney stone can provide relief to the patients being both economical and safe (as it has lesser/negligible side effect).

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