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Original Review Article

AN OVERVIEW ON POTENT HERBS FOR UROLITHIASIS

Shaneza Aman[1]*, Mr. Mohit Khandelwal[1], Mr. Ashok Kumar Sharma[2], Mr. Purushottam Prajapati[2], Ms. Ayushi[3], Ms. Deepika[4]

[1]PhD Scholar, Faculty of Pharmacy, Lords University, Alwar, Rajasthan

[2]PhD Scholar, Faculty of Pharmaceutics, B. N. University, Udaipur, Rajasthan

[3]Asst. Professor, Sunderdeep pharmacy College, Ghaziabad, UP

[4]Asst. Professor, Vivekananda College of Pharmacy, Sikar, Rajasthan

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Corresponding author: Shaneza Aman

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Abstract

Urolithiasis, or stone disease occurs in 7% of women and 12% of men at some point, and these statistics are rising. Furthermore, for those who form a stone, the likelihood of a recurrence is nearly 50% within 5 years of initial diagnosis. Therefore, the need for effective, minimally invasive alternatives for stone eradication and prevention is critical. In general, urinary stones may include various combinations of chemicals. Mainly typical stones have calcium in combination with either oxalate or phosphate. The uric acid stones are much less common and the rare cystine stones. It was found that 80% of kidney stone cases are among men and only 20% are women.

Keywords: Urolithiasis, eradication, combinations, phosphate, alternatives.

UROLITHIASIS

Urolithiasis is a common condition affecting many parts of the world, with a peak prevalence of 5-10% in western societies (Knoll & Pearle, 2012). Recurrent calculi can be prevented in most patients by the use of a simplified evaluation, reasonable dietary and fluid recommendations, and directed pharmcologic intervention. The mainstays of metabolic investigation are 24-hour urine collections and Serum studies and usually are warranted in patients with recurrent calculi. Even though some stones are the result of inborn conditions, most result from a complex interaction between diet, fluid habits, and genetic predisposition. To treat hypercalciuria, we often used thiazides which are calcium-sparing diuretics. Naturally occurring stone inhibitor level is increased by citrate medication. Aggressive fluid intake and moderated intake of salt, calcium, and meat are recommended for most patients (Pietrow and Karellas, 2006).

In general, urinary stones may include various combinations of chemicals. Mainly typical stones have calcium in combination with either oxalate or phosphate. The uric acid stones are much less common and the rare cystine stones. It was found that 80% of kidney stone cases are among men and only 20% are women. (Andersond, 1996).

Etiology

Stone formation is usually multi-factorial with more than one element increasing a patient‘s risk for stone formation (Blomen, 1982). The etiology of this disorder is multifactorial and is strongly related to dietary lifestyle habits or practices (Boyce, 1974).

A wide variety of metabolic or environmental disturbances develop stones, including varying forms of hypercalciuria, hypocitraturia, undue urinary acidity, hyperuricosuria, hyperoxaluria, infection with urease-producing organisms, and cystinuria. The cause of stone formation may be ascertained in most patients using the reliable diagnostic protocols that are available for the identification of these disturbances (Pak, 1991).

Table 1: Causes of Stones

	Condition	Causes
All stones	Low Urine volume	Reduced intake or increased loss of water
Calcium Stones	Hypercalciuria	➢ Absorptive hypercalciuria: Increased GI calcium absorption renal hypercalciuria: impaired renal Ca absorption ➢ resorptive hypercalciuria: primary hyperparathyroidism ➢ Immobilisation ➢ Excess of sodium in diet ➢ Excess of protein or acid in diet
	Hyperoxaluria	➢ Excess of oxalate in diet ➢ Increased production of endogenous oxalate
	Hypocitraturia	➢ distal renal tubular acidosis: impaired renal tubular acid excretion ➢ High acid load (absence of detectable acidemia)
	Hypomagnesuria	limited intake of magnesium-rich foods
Uric Acid Stones	Hyperuricosuria	High acid load, Metabolic syndrome
Cystine Stones	Cystinuria	Congenital mutations of dibasic aminoacid transporter subunits rBAT and b0_AT
Infection Stones	Urinary Tract Infection	Urea Splitting Organisms

(Moe, 2006; Worcester and Coe, 2008; Park and Pearle, 2007)

Epidemiology

Inorganic and organic crystals amalgamated with proteins form kidney stones. The most common nephrolithsare still calcareous stones, 15–19 accounting for more than 80% of stones. Uric acid stones represent about 5–10%, trailed by cystine, struvite, and ammonium acid urate stones (Moe, 2006).

- Flank pain –pain in upper abdomen and back
- Urinary tract infections
- Obstructive uropathy --urinary tract disease due to obstruction
- Hematuria --blood in the urine (Fan *et al*., 1999)

The clinical features of urinary tract stones are as follows:

- Urinary tract symptoms:
  - ➢ Pain-classic colicky loin to groin or renal,
  - ➢ Haematuria-gross or microscopic, Dysuria and strangury
- Systemic symptoms:Restless, writhing, Nausea, vomiting, Fever and chills Bloody, cloudly or foul-Smelling urine
- Asymptomatic symptoms:Incidental stones (one third may become symptomatic), Fluctuations in pain intensity, with periods of pain lasting 20 to 60 mints, Persistent urge to urinate (Finlayson, 1974).

Risk Factors for the Development of Urinary Calculi

Table 2: Risk factors and mechanism for the development of calculi

Risk Factor	Mechanism
Bowel disease	Exaggerate low urine volume; acidic urine diminish available citrate; hyperoxaluria
Excess dietary meat (including poultry)	Creates acidic urinary milieu, decreaseavailable citrate; increase hyperuricosuria
Excess dietary oxalate	Promotes hyperoxaluria
Excess dietary sodium	Promotes hypercalciuria
Family history	Genetic predisposition
Insulin resistance	Ammonia mishandling; alters pH of urine
Gout	Promotes hyperuricosuria
Low urine volume	Allows stone constituents to supersaturate
Obesity	May exaggerate hypercalciuria; other outcome similar to excess dietary meat
Primary hyperparathyroidism	Creates persistent hypercalciuria
Prolonged immobilization	Bone turnover creates hypercalciuria
Renal tubular acidosis (type 1)	Promotes calcium phosphate supersaturation due to alkaline urine; loss of citrate

Pathophysiology

The common reason of blood in the urine iskidney stones and often severe pain in the abdomen, flank, or groin. Kidney stones are sometimes called renal calculi. Kidney stones are classified on the basis of their chemical composition. For crystals to form, urine must be supersaturated with respect to the stone material, meaning that concentrations are higher than the thermodynamic solubility for that substance (Ernst, 2010). A state in which stone salts are soluble at much higher concentrations in urine than in water is termed as urinary supersaturation. The explanation for this phenomenon is that urinary glycoproteins, glycosaminoglycans (GAG), citrate, and magnesium form complexes with these salts so that they can be kept in solution at much higher concentrations (Verkoelen, 2006).

Three conditions must coexist for the formation of struvite calculi.

1. Alkaline urine.
2. The presence of urea or ammonia in the urine.
3. Higher concentration of minerals in the urine (Atmani, 2003).

The agents who can modify nucleation, crystallization, and aggregation, pH of the urine also play important role in stone formation (Malhotra, 2008).

Nucleation:

It is the first step in crystal formation and form smallest unit lattice of a crystal species, the. There are two types of nucleation: homogenous nucleation and heterogenous nucleation. In human urine, homogenous nucleation is unlikely to occur; rather, a heterogeneous nucleation process, by which crystal nuclei can form on structures such as cellular material, urinary crystals occur. In fact, most urinary stones are a mixture of more than one crystal type suggesting that a process of heterogeneous nucleation is responsible for the formation of most stones.

Growth:

To generate a stone the urine must contain crystalline material in excess. That is to say, with these stone-forming crystals the urinary environment must be

supersaturated. As the concentration of the salt increases above its solubility product, there will be a second point encountered where the solution becomes unstable with respect to the salt and crystallization will spontaneously begin; this point is termed the formation product. The region between the solubility product and the formation product is known as the metastable region. When a solution is metastable with respect to a salt, crystallization is unlikely to occur, although growth may occur on existing crystals.

Aggregation:

Crystal nuclei bind to one another to form larger particles, a process known as aggregation. In the urinary environment, chemically or electrically induced forces can promote crystal aggregation; once crystals have aggregated to one another, they are held in place by strong intermolecular forces, and cannot be easily separated. Crystal aggregation is likely an important mechanism in stone formation, as a single crystal will never be large enough to be retained in the urinary collecting system (Pearle and Nakada, 2009).

Treatment

The foremost treatment is considered with pain medication as the worst pain known as colicky pain is produced in the lower back. The accepted managing of stone disease starts from observation (watchful waiting) to surgical removal of the stone. Diverse factors such as severity of symptoms, size of calculi, kidney function, location of the stone and degree of obstruction and the presence or absence of associated infection influence the selection of one type of intervention over the other (Nabi *et al*., 2007).

All management of stones can be thought of as acute, definitive and preventative. Defensive management includes education of patients to reduce their risk of stone disease by modifying diet and hydration. Hydration is the most essential step as chronic dehydration has been identified as a source of urolithiasis. Increasing fluid intake has been shown to decrease stone incidence in calcium oxalate calculus formers that increasing the urine output to greater than 2 liters a day, results in a 12% recurrence in stone formation, compared to those with no specific fluid recommendations who had a 27% recurrence of calculi (Moran *et al*., 2002).

SURGICAL PROCEDURE

For treatment of urolithiasis medicinal or surgical procedure is carried out. Surgical treatment like:

Extracorporeal Shockwave Lithotripsy (ESWL):

ESWL uses non-electrical shock waves that are created outside of the body to travel through the skin and body tissues until the shockwaves hit the dense stones. For this procedure, the person lies on a table or, less commonly, in a tub of water or onto a water cushion machine that acts as a medium for transmitting these non-electrical shockwaves that passes through the person’s body to break the kidney stone into smaller pieces to pass more readily through the urinary tract.

Percutaneous Nephrolithotomy (PCNL)

Percutaneous nephrolithotomy, or PCNL, is a procedure for removing medium-sized or larger renal calculi (kidney stones) from the patient's urinary tract by means of a nephroscope insert into the kidney through a track created in the patient's back. During the procedure, a tube is inserted directly into the kidney through a small incision in the patient’s back.

Ureteroscopic Stone Removal:

Ureteroscopic stone removal is achieved by passing a small fiber optic instrument (an ureteroscope) through the urethra and bladder into the ureter. The urologist removes the stone or, if the stone is large, uses a flexible fibres attached to a laser generated to break the stone into smaller pieces that can pass out of the body in the urine

Open (incisional) Surgery:

Open surgery involves opening the affected area and removing the stone(s). One more, less known procedure (called coagulum pyelolithotomy) also removes kidney stones. This process involves the injection of a liquid containing cryoprecipitate, calcium chloride, thrombin and indigo carmine into the kidney. This injection of substances traps the stones inside by forming a jelly like clot. Through an incision made in the kidney, the doctor extracts the stone with forceps (Goswami *et al*., 2013; Cicerello *et al*., 2011)

TYPES OF STONES

There are numerous types of renal stones that differ in pathogenesis and composition. The majority of kidney stone is composed of calcium oxalate and is caused by metabolic disorders that are often treatable.

1. Calcium Stones-

The most common constituent of urinary tract calculi is calcium. The majority stones contain calcium in combination with oxalate, phosphate, or occasionally uric acid. Such stones are radio-opaque.

Calcium oxalate-

Also called mulberry stones, these stones are characteristically dark brown/ black in colour, with a dense, smooth appearance shows the crystals under electron microscopy. When viewed under light microscopy calcium oxalate monohydrate crystals are seen as dumbbell-shaped.

Calcium phosphate-

Calcium hydroxyphosphate stones commonly comprise a significant proportion of carbonate to form apatite stones. These stones are usually white in colour and are comparatively poorly crystallized compared to hydrated acid calcium phosphate stones

2. Non-calcium stones

Uric acid stones-

Uric acid stones may consist of uric acid only, or they also may contain calcium. Uric acid is a by-product of ingested or endogenous purine metabolism and primarily it is excreted in the urine in insoluble form. Diets high in purines, especially those containing meats and fish, result in hyperuricosuria, and, in combination with low urine volume and low urinary pH, can exacerbate uric acid stone formation.

Struvite stones-

Struvite stones, also known as infection or triple-phosphate stones consist of magnesium, ammonium, and calcium phosphate. They happen more often in women than in men and are the foremost cause of staghorn calculi. They are associated with substantial morbidity infection. Signs of struvite stones consist of urinary pH greater than 7, staghorn calculi, and urease that grow bacteria on culture (proteus, klebsiella, Pseudomonas).

Cystine stones-

These are rare stones occurring in 1% of stone patients, due to an autosomal recessive disorder of dibasic amino acid transport leading to decreased cystine resorption in the kidney. People excrete more than 600 mg per day of insoluble cystine who are homozygous for cystinuria. The stones are moderately radio-opaque with a rounded appearance, greenish- yellow and flecked with shiny crystallites (Pietrow and Karellas, 2006; Barbas *et al*., 2002)

COMPOSITION OF KIDNEY STONES

(Afaj and Sultan, 2005; Herring, 1962; Mandel and Mandel, 1989; Pak, 2003)

Table 3: Composition of kidney stones

Crystals	Percentage of stones	Characteristics
Calcium oxalate-monohydrate	40-60 %	Radio-opaque Well circumscribed
Calcium oxalate-dehydrate	40-60 %	
Calcium phosphate (apatite; Ca10[PO4]6[OH]2)	20-60 %	
Calcium phosphate (brushite; CaHPO4·2H2O)	2-4 %	
Uric acid Rarely staghorn	5-10 %	Radiolucent
Struvite (magnesium ammonium phosphate)	5-15 %	Can be staghorn
Cystine Can be staghorn	1·0–2·5%	Mildly opaque
Ammonium urate	0·5–1·0%	
Phophate	38.4 %	
Urate	15.4 %	
Mixed stones		
Mixed calcium oxalate-phosphate	35-40 %	
Mixed uric acid-calcium oxalate	5 %	

LIST OF PLANTS USED IN UROLITHIASIS

Table 4: Plants used in urolithiasis

S. No.	Name of Plants	Family	Parts Used	References
1.	*Achyranthes aspera L. and Bryophyllum pinnatum Lam*	Amaranthaceae and Crassulaceae	Leaves	Agarwal and Varma, 2015
2.	*Aerva lanata*	Amaranthaceae	Aerial parts	Soundararajan *et al*., 2006
3.	*Asarum europaeum*	*Aristolochiaceae*	Leaves	Mamillapalli & Akkiraju, 2015
4.	*Bergenia ligulata*	Saxifragaceae	Rhizome	Bashir & Gilani 2009
5.	*Beta vulgaris L.*	Amaranthaceae	Leaves and roots	Saranya & Geetha, 2014
	Chenopodium album	Chenopodiaceae	Leaves	Sharma *et al*., 2016
6.	*Chlorophytum borivilianum*	Asparagaceae	Roots	Patel *et al*., 2014
7.	*Convulvulus arvensis*	Convolvulaceae	Leaves and Flowers	Rjeshwari *et al*., 2013
Cont...				

8.	*Costus igneus*	Costaceae	Stem	Manjula *et al*., 2012
9.	*Cymbopogon proximus*	Poaceae	Whole plant	Warrag *et al*., 2014
10.	*Glochidion velutinium*	Euphorbiaceae	Leaves	Vijaya *et al*., (2013)
11.	*Melia azedarach* Linn.	Meliaceae	Leaves	Dharmalingam *et al*., 2014
	Pergularia daemia	Asclepediaceae	Whole plant	Vyas *et al*., 2011
12.	*Phyllanthus niruri Linn.*	Phyllanthaceae	Leaves	Mishra *et al*., 2014
13.	*Piper longum*	Piperaceae	Fruits	Patel *et al*., 2011
14.	*Portulaca oleracea Linn.*	Portulacaceae	Aerial parts	Kishore *et al*., 2013
15.	Spirulina	Cyanophyta	Algae	Al-Attar, 2010
16.	*Trigonella foenum graecum* L.	Fabaceae	Seeds	Shekha *et al*., 2015

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