

## ETIOPATHOGENESIS OF RENAL STONE DISEASE

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**Abstract:** Renal lithiasis is a common condition encountered specially in 'Stone belt' in India. Majority of stones in India and all over the globe consist of calcium stones. Nucleation is an important mechanism, which increases the tendency of stone formation. In addition to concentration of solutes, stone inhibitors are also important components; decreased concentration of which leads to calculus formation. There are two types of stone inhibitors; organic and inorganic. hypercalcuria, hyper-oxaluria, hyperuricosuria and hypocitraturia are primary metabolic abnormalities in more than 95%. Renal stone disease is of multifactorial etiology but the basic defect is relative concentration of solvent and solutes along with disturbance of urinary inhibitors. In the background of some genetic abnormality in a risk prone person, dietary and environmental changes lead to renal stone formation.

### EPIDEMIOLOGY

Renal stone disease (RSD) is third commonest disorder of urinary tract after urinary tract infection (UTI) and benign prostatic hyperplasia (BPH). It is more common in a region of India, called "stone belt", which runs in the north part of India. Peak incidence of RSD is in thirties and new stone formation goes on decreasing with age. RSD has tendency to recur with average 50% recurrence rate in 10-year time.

True prevalence in India is not known, as there are no good population based studies. It is estimated that prevalence is 7% in men and 3% in women. In a hospital-based study from AIIMS, Agarwal et al have shown that of the 14,456 new patients who attended renal outpatient department, 6.6% patient had RSD<sup>1</sup>. Of these new patients 60% were male. Of these patients, 72.3% presented as RSD, 15% as chronic kidney disease (CKD), 5% as obstructive uropathy and 7.7% with other miscellaneous presentations. Further, Agarwal et al in a community based study, while studying prevalence of CKD in Delhi, showed that at least 4.4% adult population in community had self reported renal stone disease out of 5000 approximate population screened<sup>2</sup>.

The **common types of stone** found in clinical practice are:

- |                     |      |
|---------------------|------|
| 1. Calcium stone    | 80%  |
| 2. Struvite stones  | 12%  |
| 3. Uric acid stones | 6%   |
| 4. Cystein stones   | 1.5% |
| 5. Others           | 0.5% |

### ETIOPATHOGENESIS OF RENAL STONE DISEASE<sup>3</sup>

Urine is a liquid, which as in any liquid has solvent and solutes. It is primarily imbalance of solvent and solutes relative concentration, which leads to tendency of precipitation of solutes which leads to stone formation. In addition to solvent and solute concentration, there are some crystal inhibitor substances, which prevent renal stone formation.

Depending upon concentration of solute, the state of urine as a fluid is classified into different stages of saturation of solute. *First stage* is **under-saturation**; in which majority of crystal of solute remains dissolved and very few crystals remain in solution.

*Next stage* is called **saturation** in which majority of crystals remain in solution and though there is little new crystal nucleation, previous **crystal aggregation does increase in size. Once the concentration of**

solute increases further, it reaches to *Third stage* of **super-saturation**. In this stage there is new crystal nucleation and further aggregation of previous nucleated crystals.

**Nucleation** is an important mechanism, which increases the tendency of stone formation. Nucleation is of two types: **homogenous nucleation**, in which nucleation material is same as of the stone itself. This type of nucleation is basically due to over excretion of a particular type of solute. Another type of nucleation is called heterogeneous nucleation; in which nucleation is due to substance other than stone material itself; this tendency is also called '**nidus formation**'. The few examples of heterogeneous nucleation are uric acid for calcium oxalate stone, infection in urinary tract and hypovitaminosis-A causing changes in epithelium, which act as a nidus.

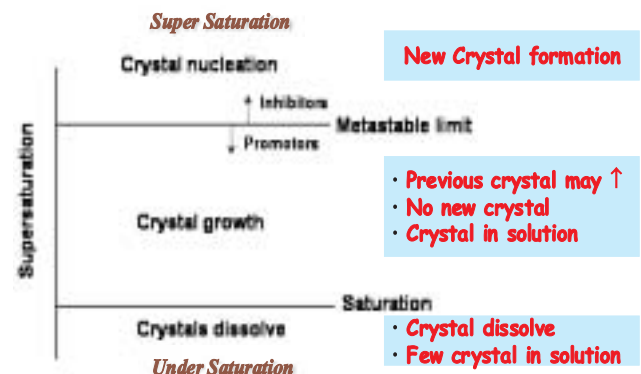


Figure 1: Renal Stone: Basic Pathogenesis

### STONE INHIBITORS

In addition to concentration of solutes, stone inhibitors are also important components; decreased concentration of which leads to RSD. There are *two types* of stone inhibitors; *organic and inorganic*.

#### I. Inorganic Stone Inhibitors

##### 1. Citrate

Hypocitraturia is defined as urinary citrate excretion of <250 mg in 24 hours. Urinary citrate forms a soluble complex with calcium that inhibits the formation and propagation of crystals. It is a common correctable cause of recurrent pure calcium phosphate or brushite stones. Women excrete more citrate and have lower incidence of stone formation than men. Urinary citrate is mainly derived endogenously through the tricarboxylic acid cycle and is excreted by renal tubular