

## Kidney stones

<b>What are kidney stones?</b>	<ol style="list-style-type: none"> <li>1/ Renal calculi (kidney stones) are formed in renal tubules, ureter or bladder</li> <li>2/ Composed of metabolic products present in glomerular filtrate <ul style="list-style-type: none"> <li>- These products are in high conc</li> <li>. Near or above maximum solubility</li> </ul> </li> </ol>
<b>Conditions causing kidney stone formation.</b>	<ol style="list-style-type: none"> <li>1/ High conc. of metabolic products in glomerular filtrate</li> <li>2/ Changes in urine pH</li> <li>3/ Urinary stagnation</li> <li>4/ Deficiency of stone-forming inhibitors in urine</li> </ol>
<b>1/ High conc. of metabolic products in glomerular filtrate due to :</b>	
<ol style="list-style-type: none"> <li>1- Low urinary volume (<b>with normal renal function</b>) due to restricted fluid intake</li> <li>2- Increased fluid loss from the body</li> <li>3- Increased excretion of metabolic products forming stones</li> <li>4- High plasma volume (high filtrate level)</li> <li>5- Low tubular reabsorption from filtrate</li> </ol>	
<b>2/ Changes in urine pH due to:</b>	
<ol style="list-style-type: none"> <li>1- Bacterial infection</li> <li>2- Precipitation of salts at different pH</li> </ol>	
<b>3/ Urinary stagnation due to:</b>	
<b>Obstruction of urinary flow</b>	
<b>4/ Deficiency of stone-forming inhibitors:</b>	
<ul style="list-style-type: none"> <li>- <b>substances that inhibit growth of calcium phosphate and calcium oxalate crystals like:</b></li> </ul> <ol style="list-style-type: none"> <li>1-Citrate</li> <li>2-pyrophosphate</li> <li>3-glycoproteins</li> </ol> <ul style="list-style-type: none"> <li>- <b>conditions related:</b> In type I renal tubular acidosis, hypocitraturia leads to renal stones</li> </ul>	
<b>Types of kidney stones</b>	<ol style="list-style-type: none"> <li>1- Calcium salts</li> <li>2- Uric acid</li> <li>3- Mg ammonium PO<sub>4</sub></li> <li>4- Cystine</li> <li>5- Other (xanthine, etc.)</li> </ol>
<b>1- Calcium salts stones</b>	
<b>General information</b>	<ul style="list-style-type: none"> <li>- <b>80%</b> of kidney stones contain calcium</li> <li>- General appearance: <b>White, hard, radio-opaque</b></li> <li>- Calcium salt stones are formed in alkaline urine</li> </ul>
<b>Types Calcium salts stones</b>	<ol style="list-style-type: none"> <li>1- Calcium PO<sub>4</sub>: staghorn in renal pelvis (large)</li> <li>2- Calcium oxalate: present in ureter (small)</li> </ol> <ul style="list-style-type: none"> <li>- <b>The type of salt depends on :</b> Urine pH &amp; Availability of oxalate</li> </ul>
<b>Causes of calcium salt stones</b>	<ol style="list-style-type: none"> <li>1- <b>Hypercalciuria:</b> Increased urinary calcium excretion, Men: &gt; 7.5 mmols/day Women &gt; 6.2 mmols/day, ( <b>May or may not be due to hypercalcemia</b> ).</li> </ol>

	<p>2- <b>Hyperoxaluria:</b> Causes the formation of calcium oxalates without hypercalciuria, Diet rich in oxalates&amp; Increased oxalate absorption in fat malabsorption.</p> <p>3- <b>Primary hyperoxaluria:</b> Due to inborn errors. Urinary oxalate excretion: &gt; 400 mmols/day</p>
<b>Treatment:</b>	<p>1- Treatment of primary causes such as : infections, hypercalcemia, hyperoxaluria</p> <p>2- Oxalate-restricted diet</p> <p>3- Increased fluid intake</p> <p>4- Acidification of urine (by dietary changes)</p>
<b>2- Uric acid stones</b>	
<b>General information</b>	<ul style="list-style-type: none"> <li>- <b>About 8%</b> of renal stones contain uric acid</li> <li>- Form in acidic urine</li> <li>- <b>General appearance:</b> Small, friable, yellowish</li> <li>- May form staghorn</li> <li>- Radiolucent (plain x-rays cannot detect)</li> <li>- Visualized by ultrasound or <b>i.v. pyelogram</b></li> </ul>
<b>Causes</b>	May be associated with hyperuricemia ( <b>with or without gout</b> )
<b>Treatment</b>	<p>1- Purine-restricted diet</p> <p>2- Alkalinization of urine (by dietary changes)</p> <p>3- Increased fluid intake</p>
<b>3- Mg ammonium PO4 stones</b>	
<b>General information</b>	<ul style="list-style-type: none"> <li>- <b>About 10%</b> of all renal stones contain Mg amm. PO4</li> <li>- Also called <b>struvite kidney stones</b></li> <li>- Commonly associated with staghorn calculi</li> <li>- <b>75% of staghorn stones</b> are of struvite type</li> </ul>
<b>Causes</b>	<p>Associated with chronic urinary tract infection</p> <p>Microorganisms (<b>such as from Proteus genus</b>) that metabolize urea into ammonia</p> <p>Causing urine pH to become alkaline leading to stone formation</p>
<b>Treatment</b>	<p>1- Treatment of infection</p> <p>2- Urine acidification</p> <p>3- Increased fluid intake</p>
<b>4- Cystine stones</b>	
<b>General information</b>	<ul style="list-style-type: none"> <li>- <b>A rare type</b> of kidney stone</li> <li>- Form in acidic urine</li> <li>- Soluble in alkaline urine</li> <li>- Faint radio-opaque</li> </ul>
<b>Causes</b>	- Due to homozygous cystinuria
<b>Treatment</b>	<p>1- Increased fluid intake</p> <p>2- Alkalinization of urine (by dietary changes)</p> <p>3- Penicillamine (binds to cysteine to form a compound more soluble than cystine)</p>
<b>Laboratory investigations of kidney stones</b>	
<b>If stone has formed</b>	Chemical analysis of stone helps to: 1- Identify the cause 2- Advise patient on

<b>and removed:</b>	prevention and future recurrence
<b>If stone has not formed:</b>	This type of investigation identifies causes that may contribute to stone formation Serum calcium and uric acid analysis Urinalysis: volume, calcium, oxalates and cystine levels Urine pH > 8 suggests urinary tract infection (Mg amm. PO4)
<b>Urinary tract imaging:</b>	Ultrasound and i.v. pyelogram
<b>Remember:</b>	- If the stones formed in acidic urine the treatment will be Alkalinization of urine and vice versa