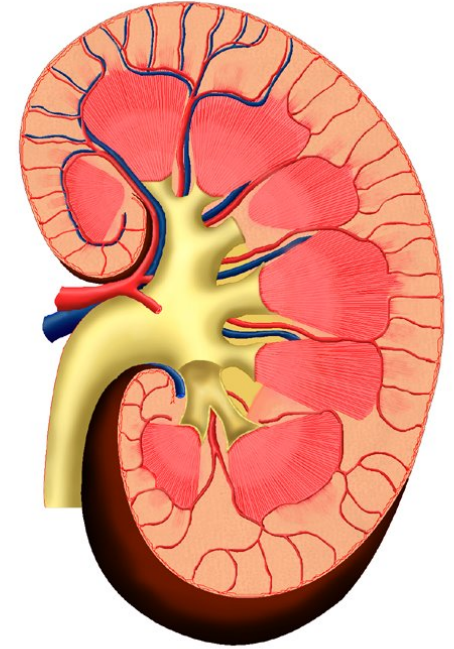
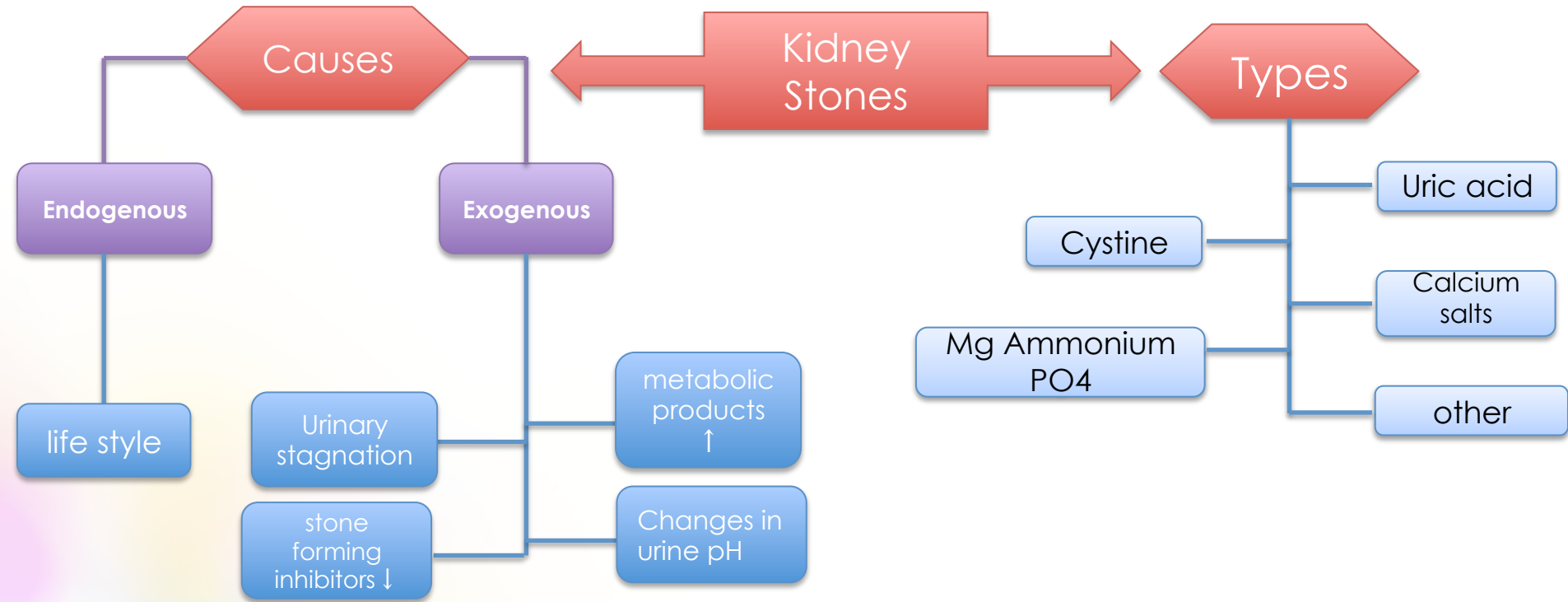


# Kidney stones

## Lecture 3



Renal Block  
Biochemistry433@hotmail.com



What are kidney stones  
(nephrolithiasis) ?

Renal calculi (kidney stones) are formed in **renal tubules, ureter** or **bladder**. Composed of metabolic products present in glomerular filtrate. These products are in high conc. (Near or above maximum solubility).

# CONDITIONS CAUSING KIDNEY STONE FORMATION

1 <sup>st</sup> : High conc. of metabolic products in glomerular filtrate :	2 <sup>nd</sup> : Urinary stagnation (Stagnation means obstruction):	:3 <sup>rd</sup> : changes in urine PH	: 4 <sup>th</sup> : Deficiency of stone-forming inhibitors in urine
<ul style="list-style-type: none"> <li>• ↓ urinary volume (with normal renal function)               <ul style="list-style-type: none"> <li>○ Restricted fluid intake</li> <li>○ ↑ fluid loss over a long period of time</li> </ul> </li> <li>• ↑ rate of excretion of metabolic products forming stones               <ul style="list-style-type: none"> <li>○ ↑ plasma volume (that increases filtrate level)</li> <li>○ ↓ tubular reabsorption from filtrate</li> </ul> </li> </ul>	<p>due to:  <b>Obstruction</b> of urinary flow → In case of enlarged prostate .</p>	<p>(change in pH inhibits some metabolic actions and makes stone insoluble)            due to: Bacterial infection .</p> <ul style="list-style-type: none"> <li>• Precipitation of salts at different pH .</li> <li>• A persistently <b>acidic</b> urine promotes uric acid precipitation</li> <li>• A persistently <b>alkaline</b> urine (due to upper urinary tract infection) promotes Mg Ammonium</li> <li>• Phosphate crystals (Struvite stones)</li> </ul>	<ul style="list-style-type: none"> <li>♣ <u>Citrate, pyrophosphate, glycoproteins</u> inhibit growth of <b>calcium phosphate</b> and <b>calcium oxalate crystals</b></li> <li>♣ In type I renal tubular acidosis, hypocitraturia leads to renal stones.</li> </ul>

# 1- CALCIUM SALT

- 80% of kidney stones contain calcium
  - Mostly it consists of: Ca-Oxalate
  - Less often: Ca-Phosphate
- The type of salt depends on
  - Urine pH
  - Availability of oxalate (Oxalate binds with Ca and makes it more solid)
- General appearance:
  - White, hard, radio-opaque
  - Calcium PO<sub>4</sub>: staghorn in renal pelvis (large)
  - Calcium oxalate: present in ureter (small)



- **Causes of calcium salt stones**
  1. Hypercalciuria:
    - Increased urinary calcium excretion
    - Men: > 7.5 mmols/day
    - Women > 6.2 mmols/day
    - May or may not be due to hypercalcemia (high Ca in blood)
  2. Hyperoxaluria:
    - favours formation of calcium oxalates (even with no hypercalciuria)
    - causes:
      - exogenous (diet rich in oxalate )
      - ↑absorption (in fat malabsorption) (Fat malabsorption → fat will bind to Ca and excreted → low ca and high oxalate)
      - Primary hyperoxaluria: inborn errors , in childhood , urinary oxalates > 400 mmol/ 24 hours

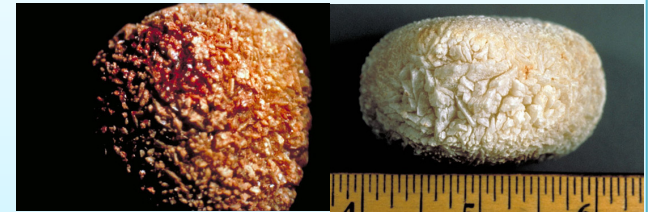
N.B: Numbers are not important

## Treatment of calcium salt stones:

- Treatment of primary causes such as infection, hypercalcemia, hyperoxaluria
- Oxalate-restricted diet (It's not recommended to reduce calcium in diet)
- Increased fluid intake (If there is no glomerular failure)
- Acidification of urine (by dietary changes)
  - Calcium salt stones are formed in alkaline urine

## 2- URIC ACID STONES

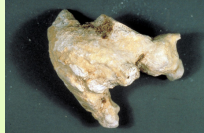
- About 8% of renal stones contain uric acid
- May be associated with **hyperuricemia** (with or without gout)
- Form in acidic urine
- General appearance:
  - Small, friable, yellowish
  - May form staghorn
  - Radiolucent (plain x-rays cannot detect)
  - Visualized by ultrasound or i.v. pyelogram
- Treatment:
  - Treatment of cause if hyperuricemia.
  - Purine-restricted diet (Since uric acid is the product of breakdown of purine)
  - Alkalinization of urine (by dietary changes)
  - Increased fluid intake (If there is no glomerular failure)



Deer's horn in the picture is staghorn shape

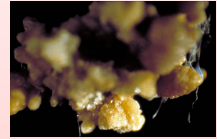
### 3- MG AMMONIUM PO4 STONES

- About 10% of all renal stones contain Mg amm. PO4
- Also called **struvite** kidney stones
- Associated with chronic urinary tract **infection**
  - Microorganisms (such as from Proteus genus) that metabolize urea into ammonia
  - Causing urine pH to become alkaline and stone formation
- Commonly associated with staghorn calculi
- 75% of staghorn stones are of struvite type
- **Treatment:**
  - Treatment of infection
  - Urine acidification
  - Increased fluid intake
  - It may need complete stone removal (Percutaneous nephrolithotomy)

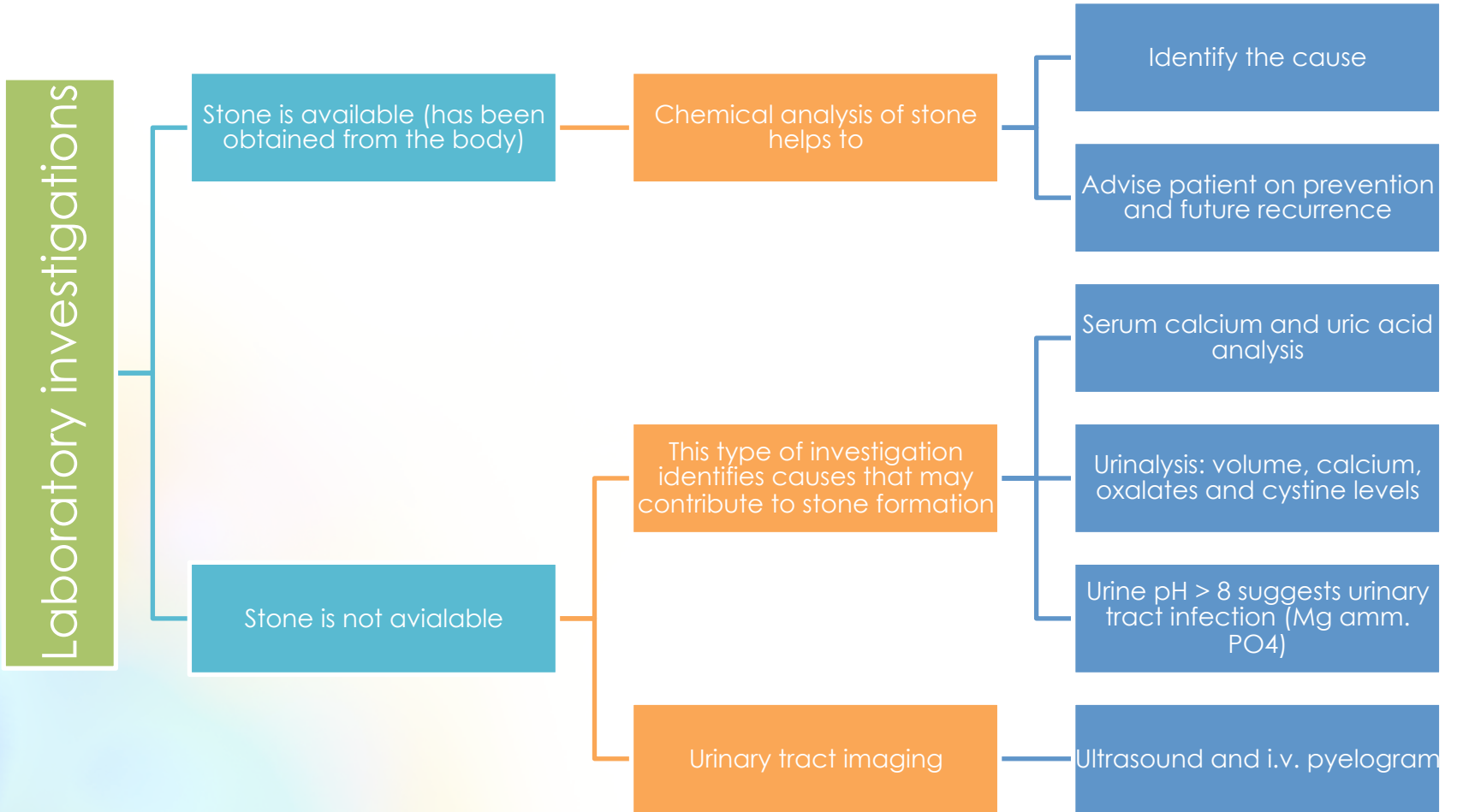


### 4- CYSTINE STONES

- A rare type of kidney stone
- Due to **homozygous cystinuria**
- Form in acidic urine
- Soluble in alkaline urine
- Faint radio-opaque
- **Treatment:**
  - Increased fluid intake
  - Alkalinization of urine (by dietary changes)
  - Penicillamine (binds to cysteine to form a compound more soluble than cystine)

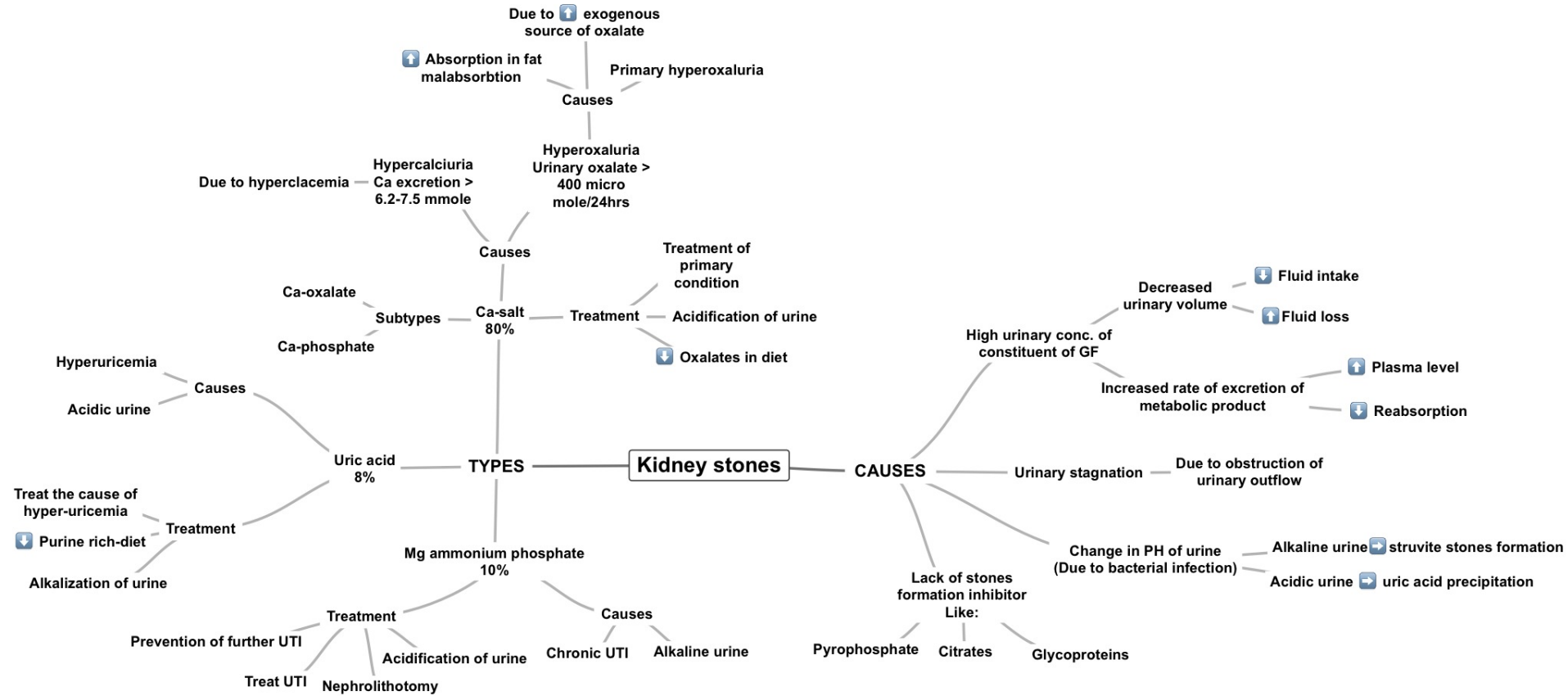


Stone	Formed in	treatment
Calcium	Alkaline urine	Acidification of urine
Uric acid	Acid urine	Alkalization of urine
MG ammonium PO4	Alkaline urine	Acidification of urine
Cystine	Acid urine	Alkalization of urine





# SUMMARY





## MCQS

**Q1: kidney stones may form in all of the following except:**

- a) Ureter
- b) Urethra
- c) Renal tubules
- d) Urinary bladder

**Q2: hypocitraturia leads to renal stones in:**

- a) Type 1 renal tubular acidosis
- b) Type 2 renal tubular acidosis
- c) Type 1 renal tubular alkalosis
- d) Type 2 renal tubular alkalosis

**Q3) 80% of stones contain:**

- a) NA
- b) Uric acid
- c) Ca
- d) MG

**Q4: staghorn appearance stones are found in:**

- a) Ureter
- b) Bladder
- c) Minor calyces
- d) renal pelvis

**Q5: calcium salt stone are formed in:**

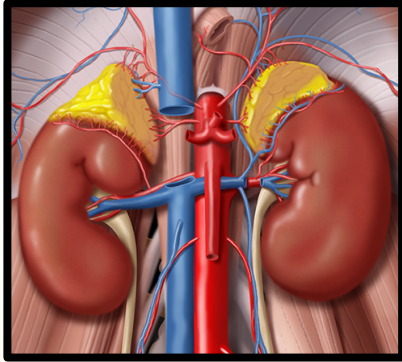
- a) alkaline urine
- b) acidic urine
- c) balanced urine
- d) none of the above

**Q6: alkalization of urine will treat:**

- a) Calcium salt stones
- b) Uric acid stones
- c) Cysteine stone
- d) Ans B + C

Ans 1:b 2:a 3:c 4:d 5:a 6:d

# GOOD LUCK



## DONE BY:

Ahmed Alqhtani

Meshal Al-Ohali

Ahmed Al-hussien

Mojahed Otyef

Jowaher Alabdulkarim

## REVISED BY:

Sara alDokhayel

Maha AlRajhi

