

# ***General Urine Examination or Urinalysis***

***Assistant Prof. Dr. Ayad almakki  
Department of Clinical Laboratory Science  
College of Pharmacy  
5<sup>th</sup> stage  
Lab training  
University of Basra***

# Why Urinalysis ?

- ❖ It can detect diseases which pass unnoticed
- ❖ Diagnosis of many renal diseases
- ❖ Screening for drug abuse (e.g Sulfonamide or aminoglycosides)

# Collection of urine specimens

- ❖ For most of the routine investigations fresh mid stream specimen of 10-20 ml urine is collected in a clean dry vial
- ❖ Analysed within 2 hours of collection
- ❖ In some cases 24 hour urine sample is also collected

# Types of specimens

- ❖ Random specimen (at any time)
- ❖ First morning specimen
- ❖ Clean catch sample (mid stream urine)
- ❖ 24 hr's collection
- ❖ Postprandial sample
- ❖ Supra-pubic aspired

# Urinalysis; what to look for ?

## Urinalysis



### A-physical Examination

- 1-Volume
- 2-Color
- 3-Odor
- 4-Reaction (pH)
- 5-Specific gravity

### B-Chemical analysis

- 1-Urobilinogen
- 2-Glucose
- 3-Bilirubin
- 4-Ketones
- 5-Blood
- 6-Protein

### C-Microscopic Examination

- 1-Red blood cells (RBCs)
- 2-White blood cells (WBCs)
- 3-Mucus
- 4-Various Epithelial cells
- 5-Various Crystals
- 6-Casts
- 7-Bacteria
- 8-Fungi
- 9-Parasite
- 10-Artifacts

# A-physical Examination

## 1-Volume

- Adult urine volume= 0.6-2.5 L/day  
average 1.5 L/day
- Children urine volume= 0.2-0.4 L/day
- **The volume of urine is affected by:**
  - 1) Water intake
  - 2) External temperature
  - 3) Type of diet
  - 4) Mental and physical state
  - 5) Cardio-Vascular status
  - 6) Intake of fluid and diuretics (drugs, alcohol and tea)
  - 7) Renal functions

# A-physical Examination

## 1-Volume

❖ Variations in volume of urine excreted :-

**A- Polyuria**

**B- Oliguria**

**C- Anuria**

# A-physical Examination

## 1-Volume

❖ Variations in volume of urine excreted :-

**A- Polyuria** (Urine output  $> 2.5$  L/day )

▪ **Conditions causing polyuria:**

- 1- Increased water ingestion
- 2- Diabetes mellitus and insipidus
- 3- Late stage of chronic glomerulonephritis
- 4- Drug induced-diuretics
- 5- Alcohol
- 6- Compulsive polydipsia



# A-physical Examination

## 1-Volume

❖ Variations in volume of urine excreted :-

**B- Oliguria** (Urine output  $< 0.4$  L/day )

▪ **Conditions causing Oliguria:**

- 1- Fever
- 2- Diarrhea and Dehydration
- 3- Shock
- 4- Sever edema
- 5- Acute nephritis
- 6- Early stage of acute glomerulonephritis
- 7- Cardiac failure and hypotension (reduced circulatory volume )

# A-physical Examination

## 2-Color

- ❖ The color of normal urine may vary from pale yellow to dark amber due to the presence of pigments urochrome, urobilin and uroerythrin
- ❖ Turbidity may be caused by excessive cellular material or protein in the urine or may develop from crystallization
- ❖ Color of urine depending upon it's constituents

# A-physical Examination

## 2-Color

### ▪ Variations in urinary abnormal colors:

Color	Interpretation
Colorless	Very dilute urine (Diabetes and polyuria)
Deep yellow	Concentrated urine, Excess bile pigments and Jaundice
Orange	Carrots or Vitamin A
Red/smoky	RBCs ,Myoglobin ,beetroot and menstrual contamination
Blue-Green	Pseudomonas infection
Black	Iron therapy
Cloudy	Pus cells and bacteria

# A-physical Examination

## 3-Odor

❖ Normal urine has an aromatic odor due to the volatile fatty acid

### ▪ abnormal Odors:

Odor	Interpretation
Ammonia	On keeping sample for a long time
Foul or offensive	Due to bacterial infections
Fruity	Due to acetone(Diabetic urine)
Mousy	Phenylketonuria
Rancid	Tyrosinaemia

# A-physical Examination

## 4-pH

- Urine pH range from 4.5 to 8
- Normally it is slightly acidic lying between 6-6.5
  - **Acidic urine : seen in**
    - 1- Ketosis (such as diabetes, starvation and fever )
    - 2- Systemic acidosis
    - 3- Urinary tract infections (UTI)- E. coli
    - 4- Acidification therapy
  - **Alkaline urine : seen in**
    - 1- Diet rich in citrus fruits
    - 2- Excessive intake of milk and antacids
    - 3- UTI
    - 4- Conditions of alkalosis

# A-physical Examination

## 4-Specific gravity (SG)

- It is measurement of urine density which reflects the ability of the kidney to concentrate or dilute the urine relative to plasma from which it is filtered
- Measured by dipsticks
- The normal SG of urine ranges from 1.001 to 1.035

# B-Chemical analysis

➤ The chemical analysis of urine undertaken to evaluate the levels of the following component:-

- Urobilinogen
- Glucose
- Bilirubin
- Ketones
- Blood
- Protein

# B-Chemical analysis

- The presence of normal and abnormal chemical elements in the urine are detected using dry reagent strips called dipsticks
- When the test strip is dipped in urine the reagents are activated and a chemical reaction occurs.
- The chemical reaction results in a specific color change
- After 60 seconds , this color change is compared against a reference color chart.



# C-Microscopic examination

## ➤ **Requirements:**

- 1- Centrifuge tube or test tube
- 2- Glass slide
- 3- Cover slips
- 4- Pasteur pipettes
- 5- Centrifuge
- 6- Microscope
- 7- Sample

## ➤ **Principle:**

The microscopic elements present in urine are collected in the form of deposit by centrifugation. A small drop of the sediment is poured onto a glass slide, a coverslip is placed over it and observed under microscope

# C-Microscopic examination

➤ A variety of normal and abnormal cellular elements may be seen in urine sediment such as:

- 1- Red blood cells or Erythrocytes (RBCs)
- 2- White blood cells (WBCs)
- 3- Mucus
- 4- Different types of epithelial cells
- 5- Different types of Crystals
- 6- Casts
- 7- Bacteria
- 8- Fungi
- 9- Parasite
- 10- Artifacts

# C-Microscopic examination

## ■ Abnormal findings:

### ❖ Per high power field (HPF) (400X)

- > 3 Erythrocytes
- > 5 Leukocytes
- > 2 Renal tubular epithelial cells (RTE)
- > 10 Bacteria

### ❖ Per low power field (LPF) (200X)

- > 3 Hyaline casts or > 1 Granular casts
- Any other cast (RBCs and WBCs)

### ❖ Presence of :

- Yeast and parasite
- Pathological crystals (Cystine ,Leucine and Tyrosine)
- Large number of Uric acid or Calcium oxalate

# C-Microscopic examination

## 1- Red blood cells or Erythrocytes (RBCs)

- Hematuria is the presence of abnormal numbers of red cells in urine due to any of several possible causes:
  - a) Glomerular damage
  - b) Kidney trauma
  - c) Urinary tract stones
  - d) Urinary tract infections
  - e) Physical stress

In fresh urine these cells have a normal, pale or yellow appearance , they do not contain nuclei

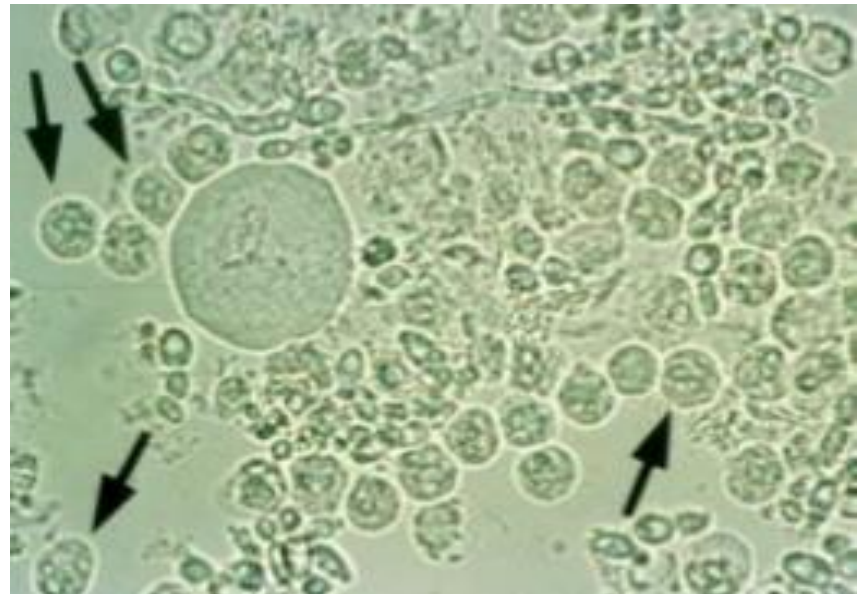


# C-Microscopic examination

## 2- White blood cells (WBCs)

- Pyuria refers to the presence of abnormal numbers of WBCs that may appear with infection in the urinary tract

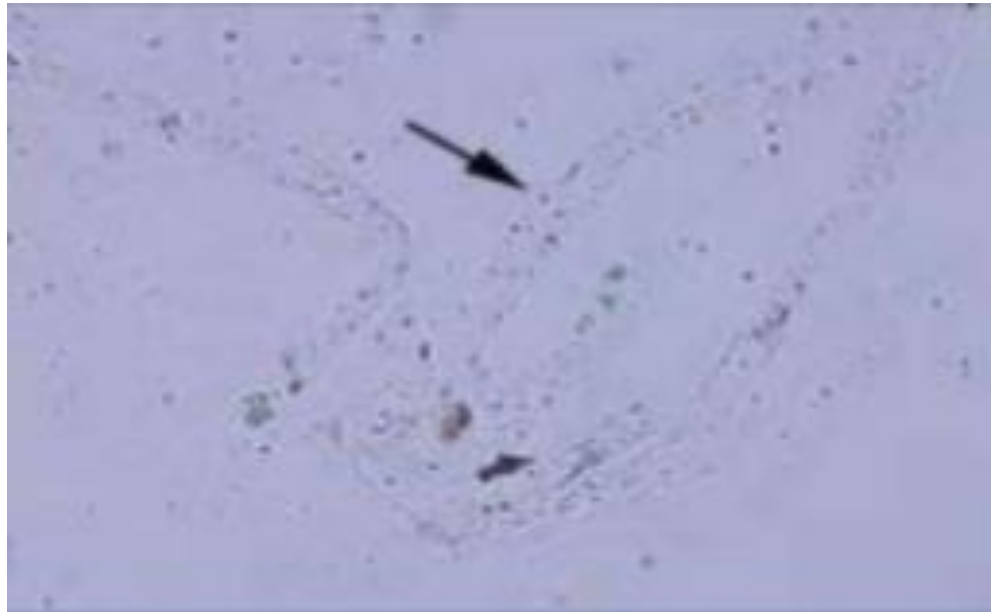
WBCs have lobed nuclei and granular cytoplasm



# C-Microscopic examination

## 3- Mucus

- A protein material produced by the glands and epithelial cells of lower genitourinary tract and the renal tubular epithelial (RTE)



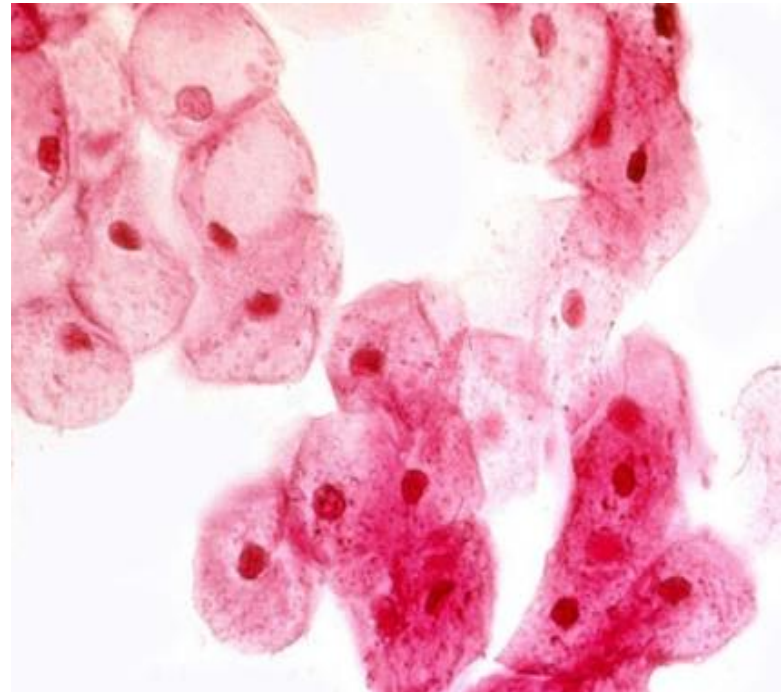
# C-Microscopic examination

## 4- Different types of epithelial cells

- Three types of epithelial cells may be recognised

### A- Squamous epithelial cells

- These are large, flat and irregular in shape and contain abundant cytoplasm and small central nuclei



# C-Microscopic examination

## 4- Different types of epithelial cells

### B- Transitional epithelial cells

- They may be pear shaped or round
- These cells may contain two nuclei





# C-Microscopic examination

## 4- Different types of epithelial cells

### C- Tubular epithelial cells

- They may be round shaped or egg-shaped
- These cells may contain a large round or oval nucleus



# C-Microscopic examination

## 5- Different types of Crystals

- Formed by precipitation of urinary salts when alteration in multiple factors affect their solubility like pH, temperature and concentration
- Urine can contain several types of crystals
- They are found in both acidic urine and alkaline urine

# C-Microscopic examination

## 5- Different types of Crystals

- Crystals found in acidic urine
  - 1- Calcium oxalate
  - 2- Uric acid
  - 3- Amorphous urate
  - 4- Sodium urate
  - 5- Calcium sulphate
  - 6- Cystine
  - 7- Tyrosine

# C-Microscopic examination

## 5- Different types of Crystals

- Crystals found in acidic urine

### 1- Calcium oxalate

- These are colorless and envelop shaped
- These can be present in urine after the ingestion of tomatoes ,Oranges and Vitamin C
- Can cause extensive tubular injury



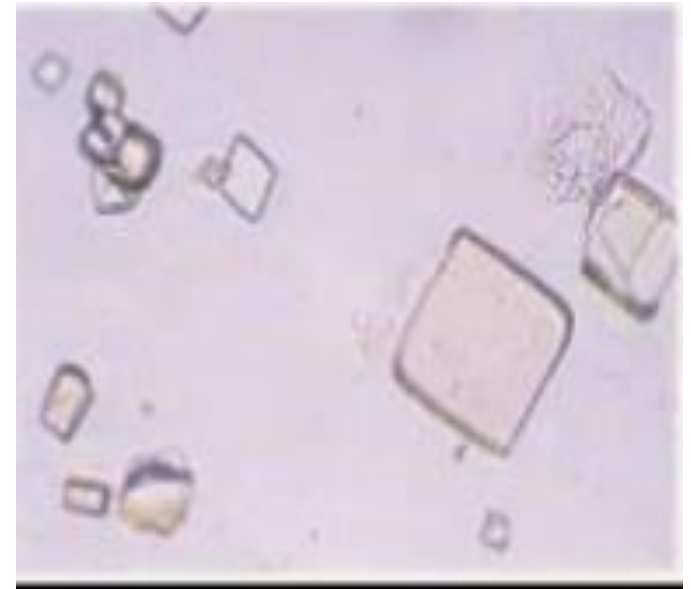
# C-Microscopic examination

## 5- Different types of Crystals

- Crystals found in acidic urine

### 2- Uric acid

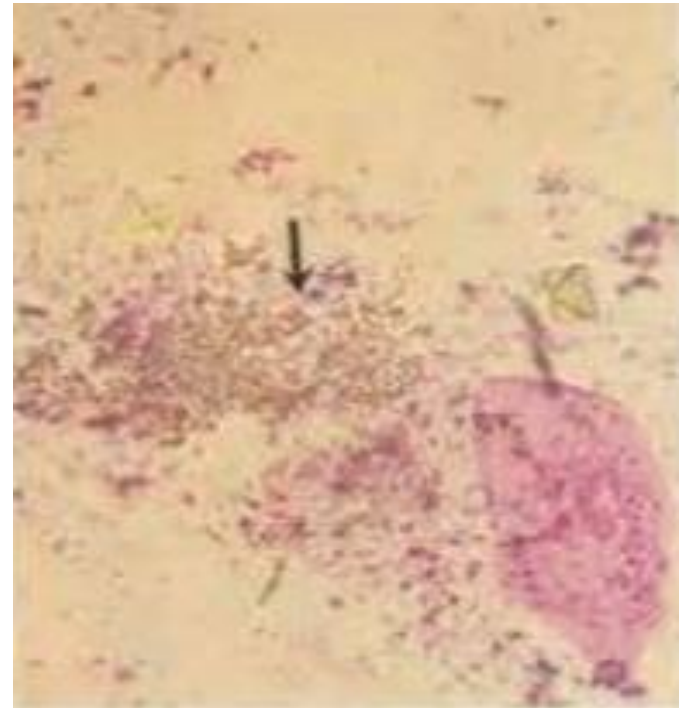
- Appear mostly as diamond rhombic or rosette form
- Increase amount are associated with increase levels of purine and nucleic acids, also, in patients with leukemia receiving therapy .



# C-Microscopic examination

## 5- Different types of Crystals

- Crystals found in acidic urine
  - 3- Amorphous urate
    - Pink to red dust , they do not form a crystalline



# C-Microscopic examination

## 5- Different types of Crystals

- Crystals found in acidic urine

### 4- Sodium urate

- These are in the form of elongated prisms or plates



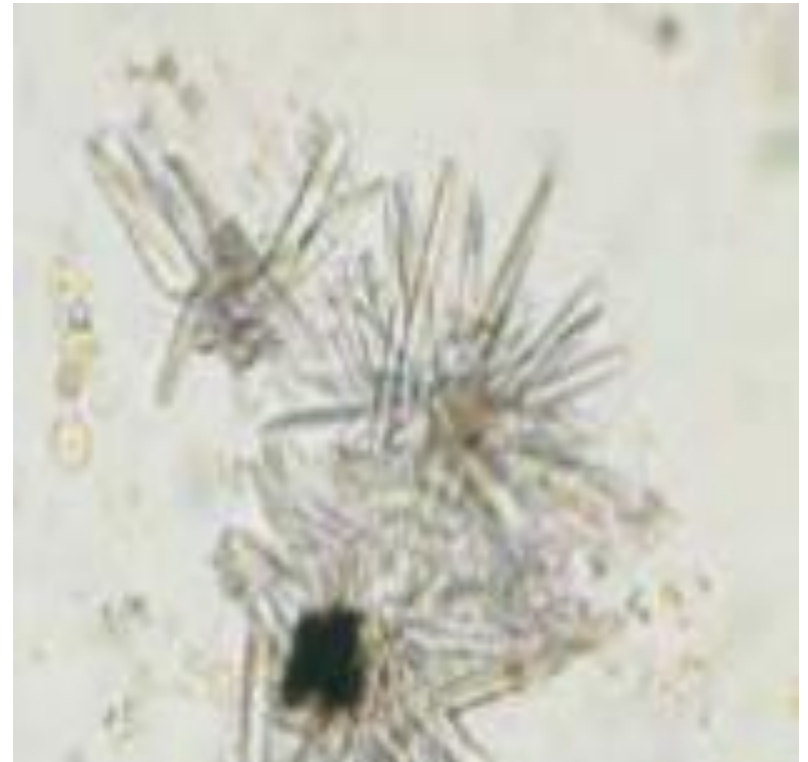
# C-Microscopic examination

## 5- Different types of Crystals

- Crystals found in acidic urine

### 5- Calcium sulphate

- These are long ,thin needle arranged in star-like manner





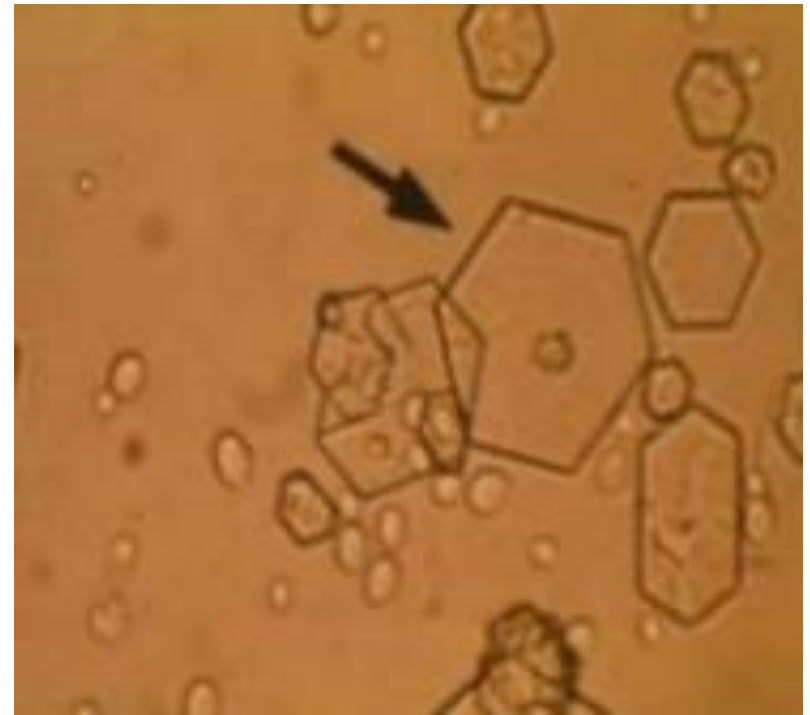
# C-Microscopic examination

## 5- Different types of Crystals

- Crystals found in acidic urine

## 6- Cystine

- These are hexagonal plates with equal or unequal sides



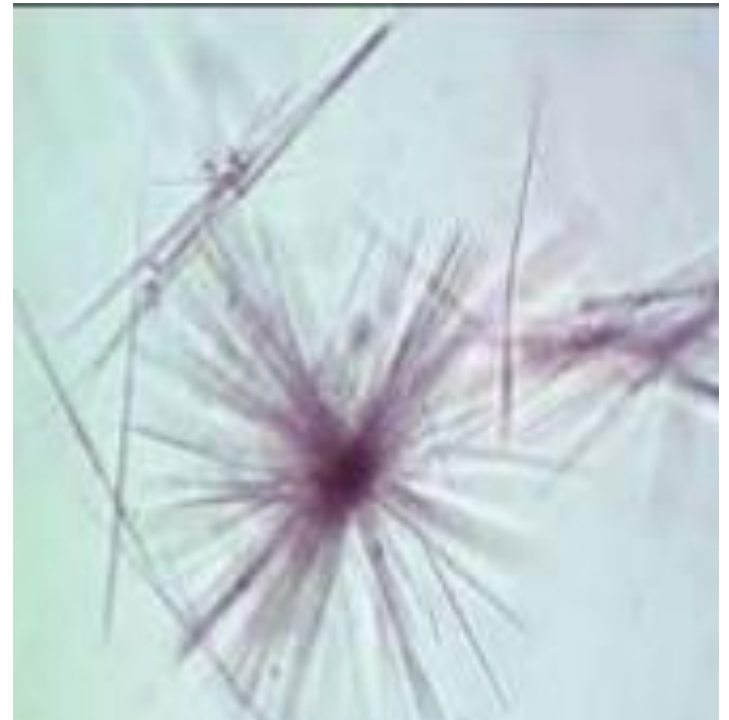
# C-Microscopic examination

## 5- Different types of Crystals

- Crystals found in acidic urine

### 7- Tyrosine

- These appear in the form of fine, needles that forms rosettes



# C-Microscopic examination

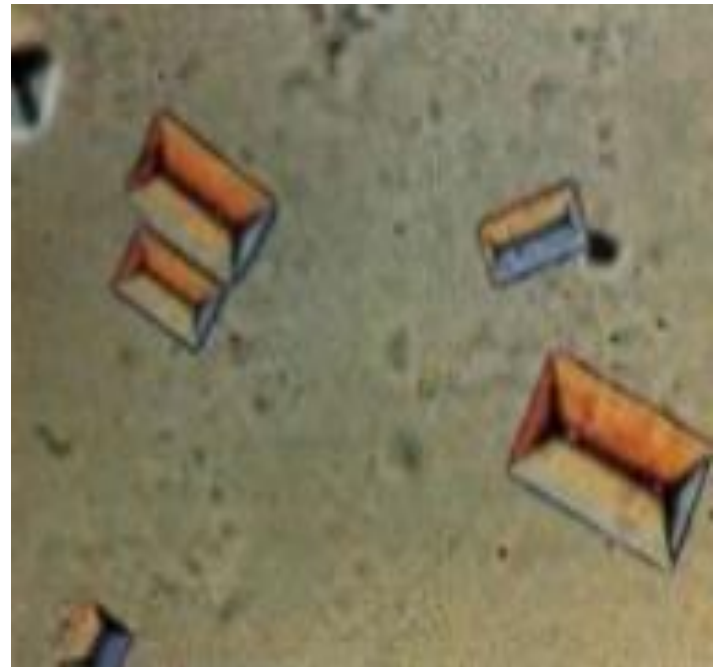
## 5- Different types of Crystals

- Crystals found in alkaline urine
  - 1- Triple phosphate
  - 2- Amorphous phosphate
  - 3- Calcium carbonate
  - 4- Calcium phosphate
  - 5- Ammonium biurates

# C-Microscopic examination

## 5- Different types of Crystals

- Crystals found in alkaline urine
  - 1- Triple phosphate
- The crystals are colorless prisms with three to six sides and frequently with oblique end



# C-Microscopic examination

## 5- Different types of Crystals

- Crystals found in alkaline urine
  - 2- Amorphous phosphate
- These are present in amorphous, granular form



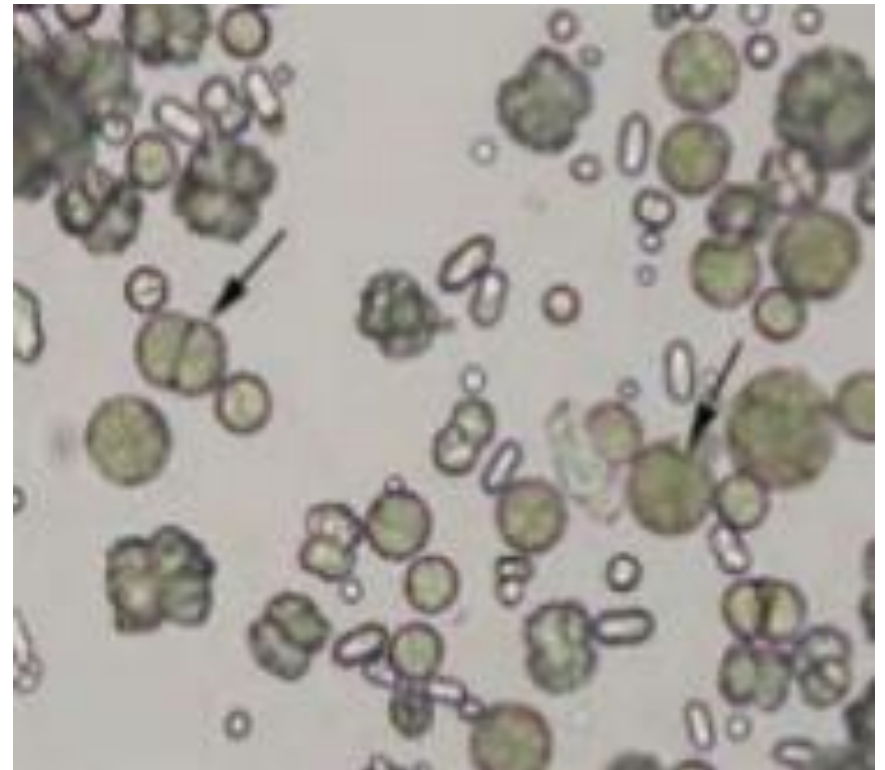
# C-Microscopic examination

## 5- Different types of Crystals

- Crystals found in alkaline urine

### 3- Calcium carbonate

- These appear as small, colorless and in the form of spherical, dumbbell shape



# C-Microscopic examination

## 5- Different types of Crystals

- Crystals found in alkaline urine

### 4- Calcium phosphate

- These are long, thin and colorless. The appearance is like prisms with one pointed end, arranged as rosettes or stars



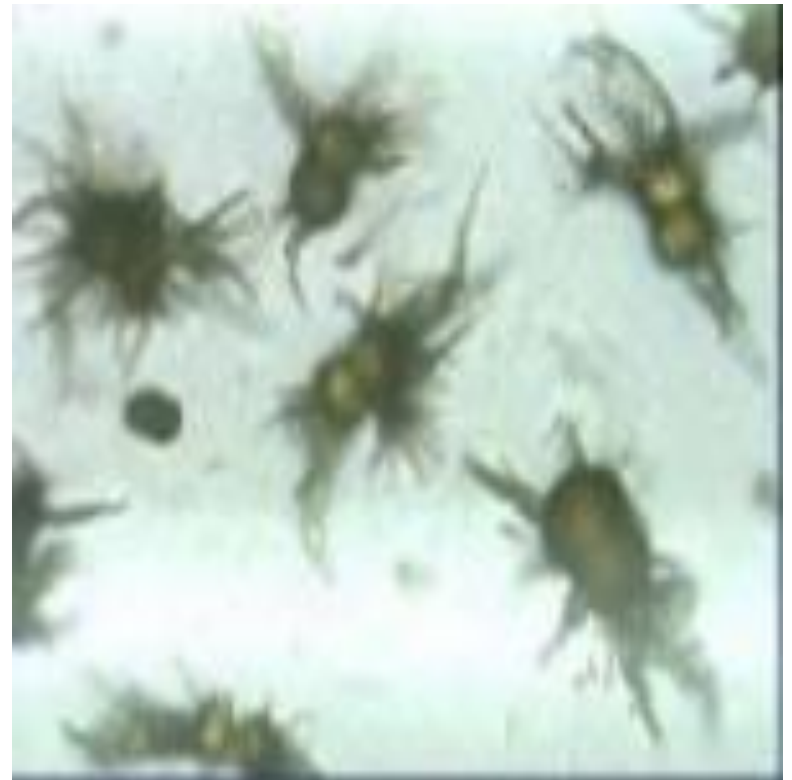
# C-Microscopic examination

## 5- Different types of Crystals

- Crystals found in alkaline urine

### 5- Ammonium biurates

- These are yellow-brown , spherical bodies with or without long, irregular spicules





# C-Microscopic examination

## 6- Casts

- Urinary casts are cylindrical aggregations of particles that form in the distal nephron , dislodge and pass into the urine. In urinalysis they indicate kidney disease

- Types of cast seen :

- **Acellular cast:**

- 1- Hyaline casts
    - 2- Granular casts
    - 3- Waxy casts
    - 4- Fatty casts

- **Cellular cast:**

- 1- Red cell casts
    - 2- White cell casts
    - 3- Epithelial cell casts

# C-Microscopic examination

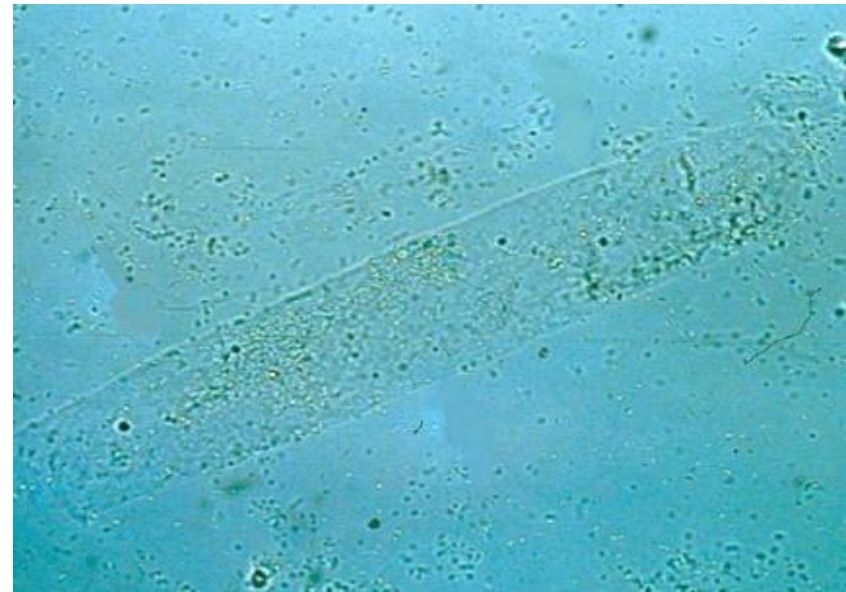
## 6- Casts

### ▪ Types of cast seen :

#### ▪ **Acellular cast:**

##### 1- Hyaline casts

- Consists almost entirely of a mucoprotein
- They are colorless, homogeneous, transparent and with rounded ends



# C-Microscopic examination

## 6- Casts

### ▪ Types of cast seen :

#### ▪ **Acellular cast:**

#### 2- Granular casts

- These casts can contain either fine or coarse granules
- Originate from plasma protein aggregates that pass into tubules from damaged glomeruli



# C-Microscopic examination

## 6- Casts

### ▪ Types of cast seen :

#### ▪ **Acellular cast:**

#### 3- Waxy casts

- These are yellow or colorless and have a homogenous appearance
- These result from the degeneration of granular casts



# C-Microscopic examination

## 6- Casts

### ▪ Types of cast seen :

#### ▪ **Acellular cast:**

#### 4- Fatty casts

- Fatty casts are formed by incorporated free fat droplets or oval fat bodies
- These are frequently seen in nephrotic syndrome and toxic renal poisoning



# C-Microscopic examination

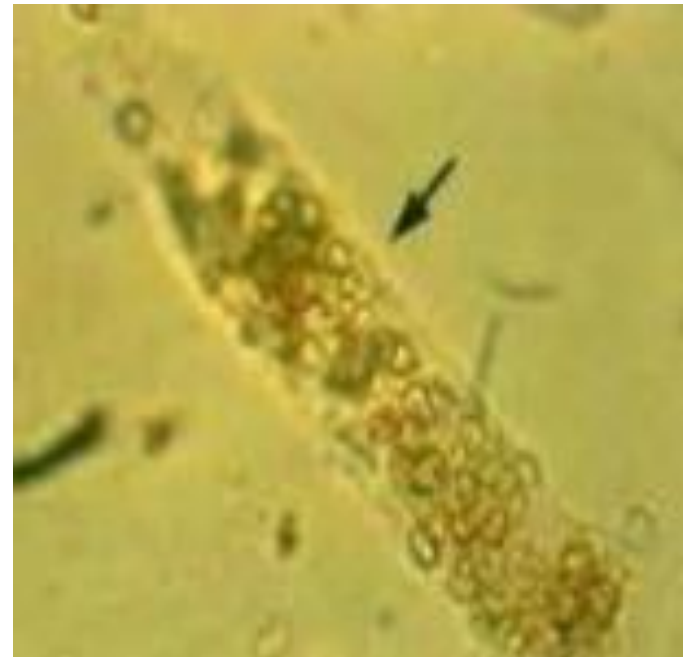
## 6- Casts

### ▪ Types of cast seen :

#### ▪ Cellular cast:

##### 1- Red cell casts

- The cast may contain variable amounts of erythrocytes embedded in the matrix of the cast
- Indicator of bleeding within nephron and a highly specific marker of glomerular bleeding



# C-Microscopic examination

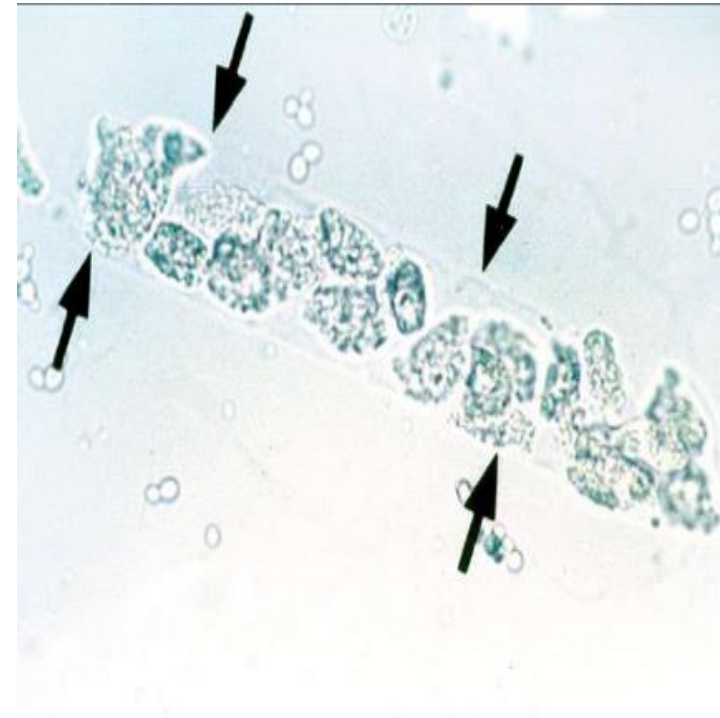
## 6- Casts

### ▪ Types of cast seen :

#### ▪ Cellular cast:

##### 2- White cell casts

- Contain variable amounts of neutrophils
- These casts may be present in acute pyelonephritis and glomerulonephritis





# C-Microscopic examination

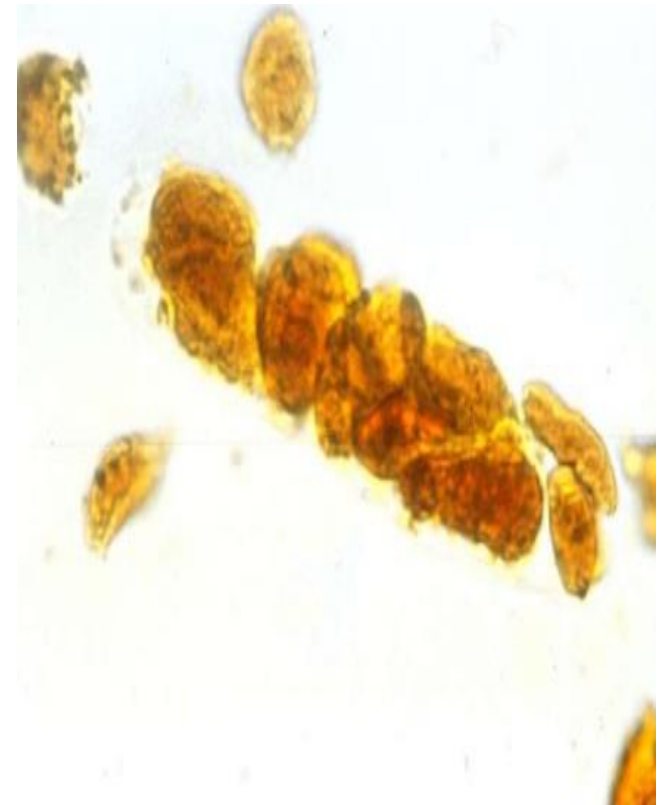
## 6- Casts

### ▪ Types of cast seen :

#### ▪ Cellular cast:

##### 3- Epithelial cell casts

- These contain epithelial cells
- Presence of these casts indicate tubular degeneration and necrosis
- Present in severe chronic renal disease

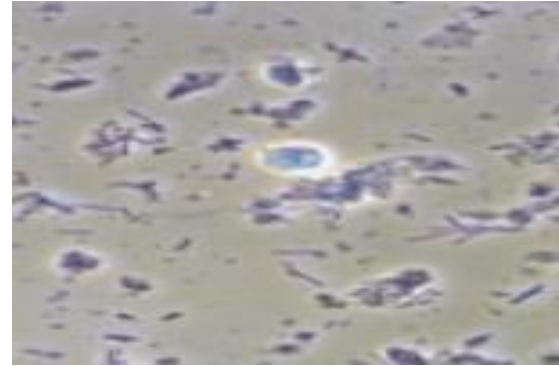




# C-Microscopic examination

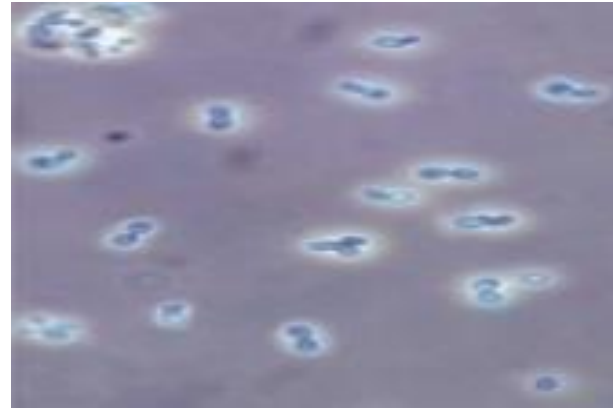
## 7- Bacteria

- Seen as rods or cocci



## 8- Fungi

- Candida  
(Elongated, Ovoid or spherical)
- Presence of buds

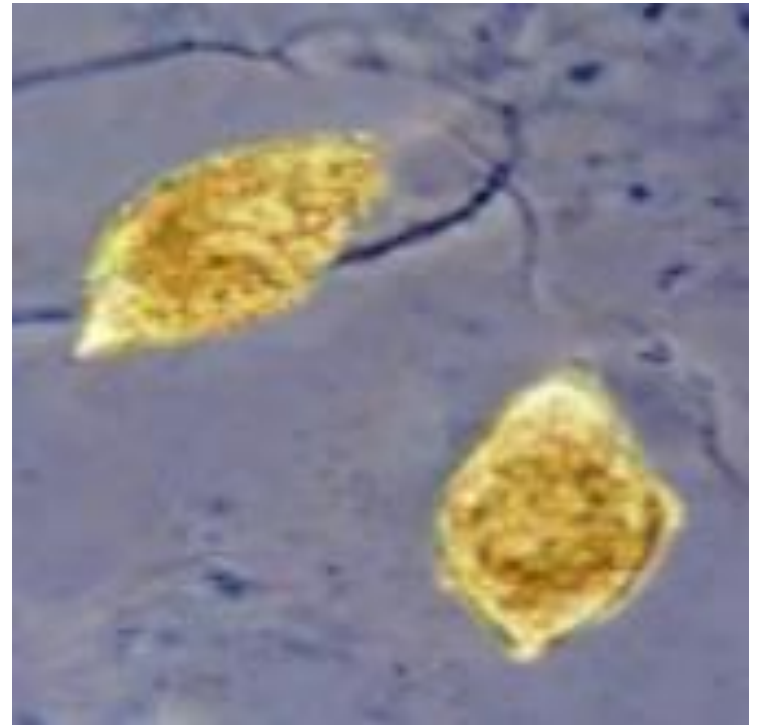


# C-Microscopic examination

## 9- Parasite

- Schistosoma haematobium

Eggs with terminal spine  
which causes haematuria



# C-Microscopic examination

## 10- Artifacts

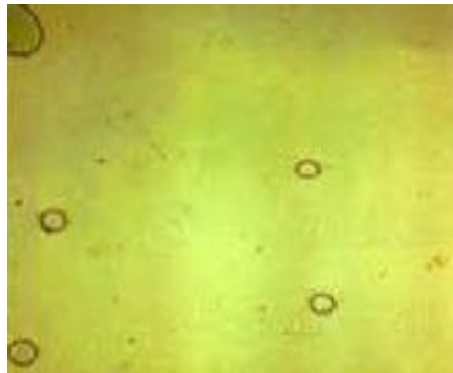
1- Fibers: they may come from clothing and toilet paper



3- Hair



2- Oil droplets



4- Air bubbles



**Thank you for  
your attention**