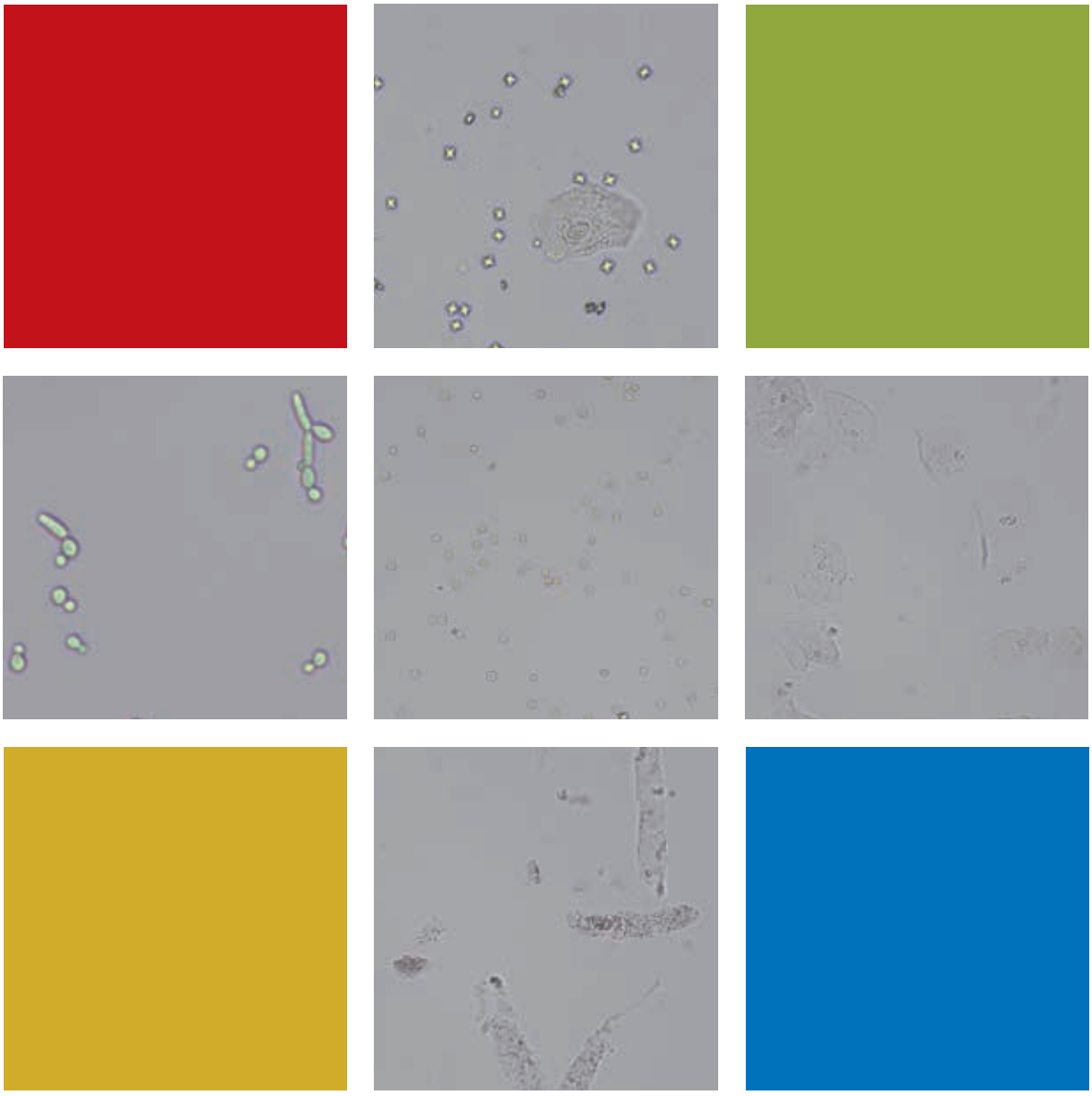
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Urine Sediment Atlas



Introduction

EH-2090 Urine Sediment Analyzer and EU-5600 Pro Urinalysis Automated System are In Vitro Diagnostic devices, which utilizes the computer vision imaging and identifying technology, to perform morphology and quantitative analysis of the formed elements (for example, RBCs) in the urine.

This device is designed to automatically simulate the operation processes of microscope technology, achieving identification, classification and counting of the formed elements including Red blood cell White blood cell White blood cell clump Bacteria Yeast Squamous epithelial cell Non squamous epithelial cell Crystal Hyaline cast Unclassified cast Mucous and Sperm.

All images are representative of a 40x objective field of view. All these images are taken from EH-2090/EU-5600 Pro. including like panoramic images / segmented images along with the corresponding morphological description, source mechanism and clinical significance of the sediments.



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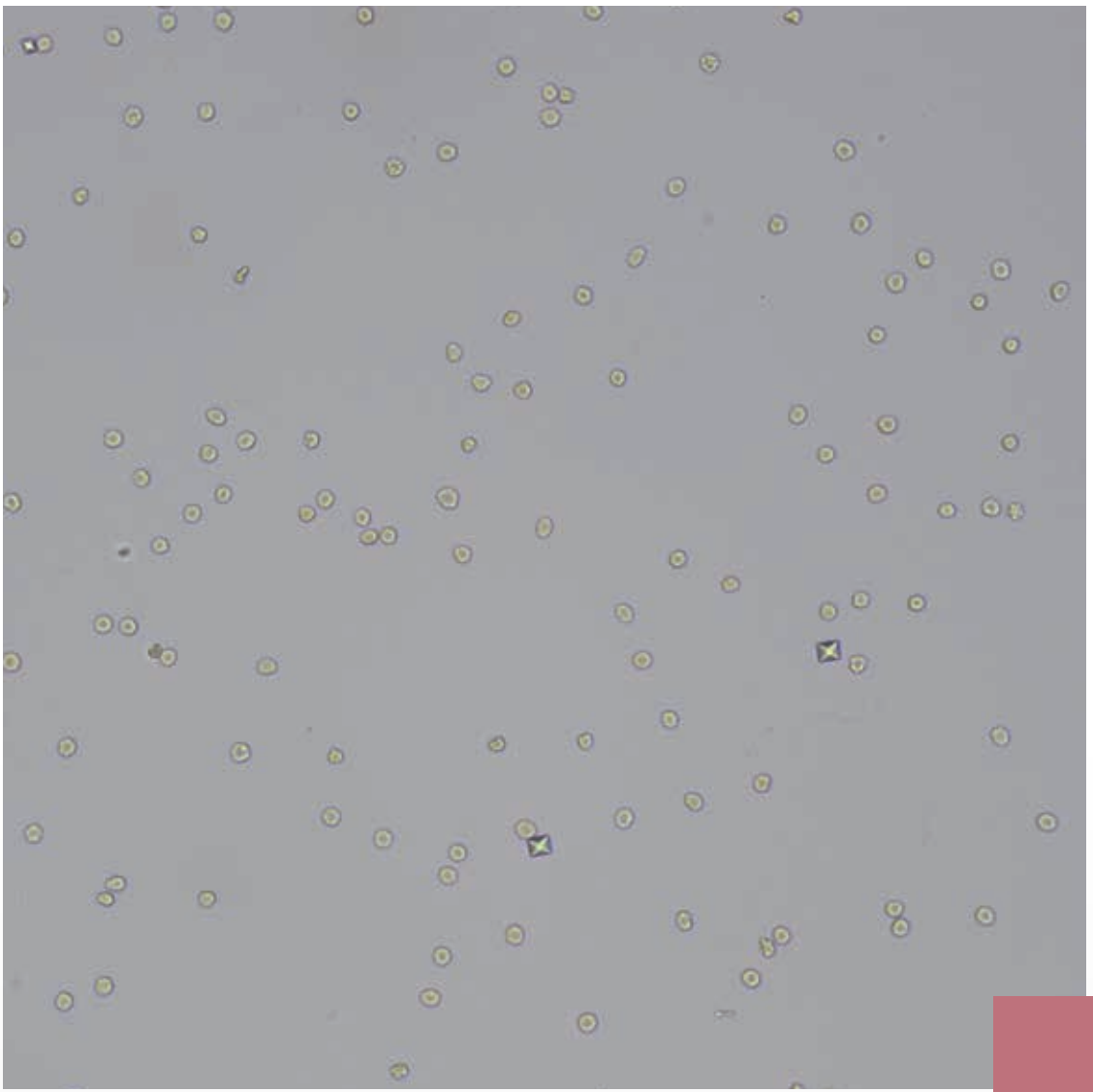
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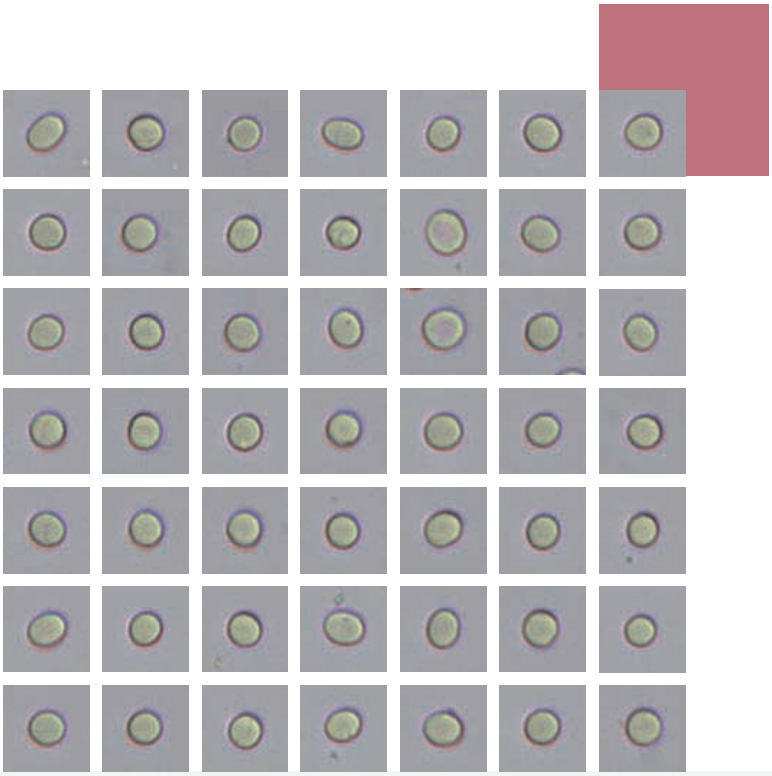
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Red Blood Cells

RBCs
Humped Spherocytes
Acanthocytes
Crenocytes
Annular RBCs
Ghost cells
Microcytes
Macrocytes

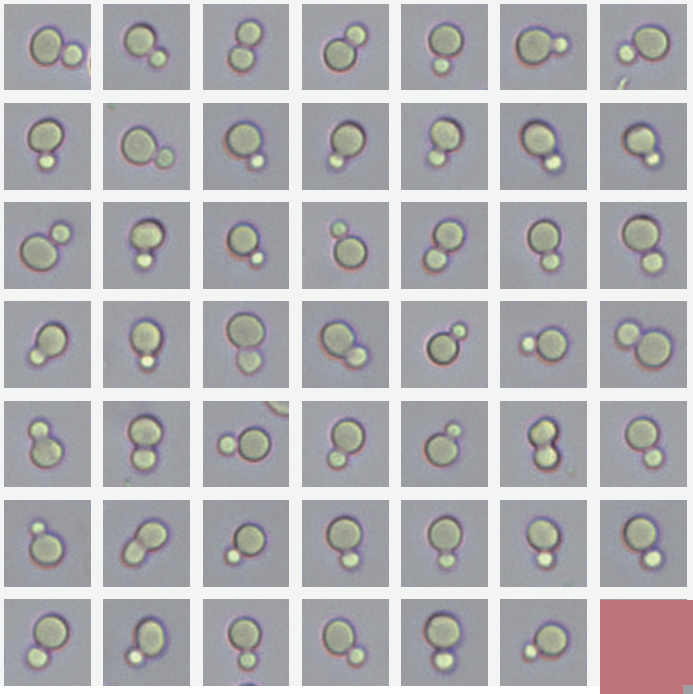


RBCs

- **Morphology features**:
  Fresh red cells tend to have a red or yellow color, with a diameter of 6-8μm, similar morphology to RBCs found in peripheral blood.

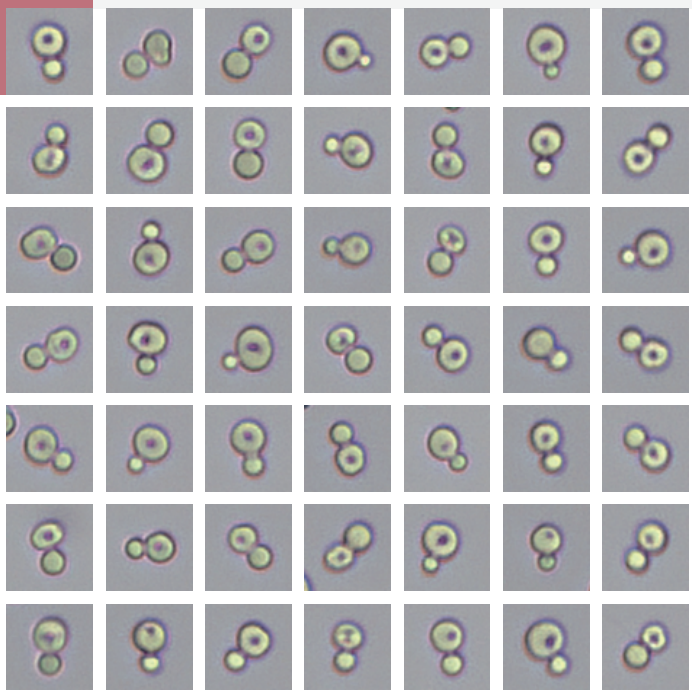
- **Origins and mechanisms introduction**:
  RBCs from the blood.

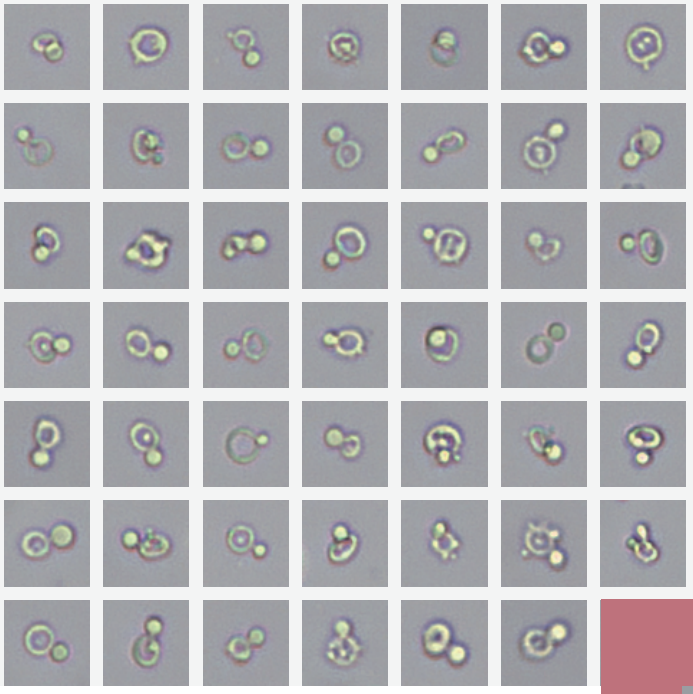
- **Clinical significance**:
  Seldom seen in urine samples of healthy people. Microscopic hematuria is associated with more than 3/HPF RBCs under microscope.



Humped Spherocytes

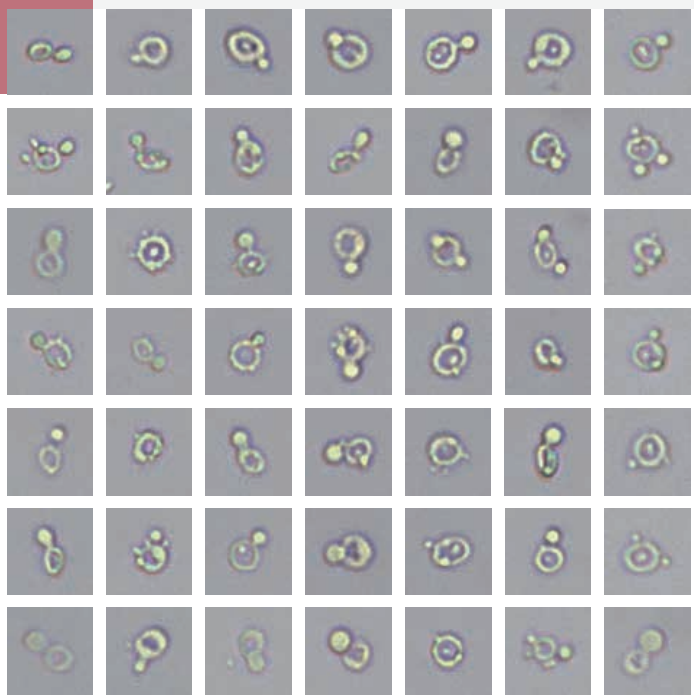
- **Morphology features:**
  Cells of unequal sizes, containing strumous (coccoid) knobs at margin and rich in hemoglobin, with or without visible regular holes. The coccoid knobs may detach from the erythrocyte.
- **Origins and mechanisms:**
  Formation mechanism unknown yet.
- **Clinical significance:**
  May be seen in hematuria of non-glomerular origin.

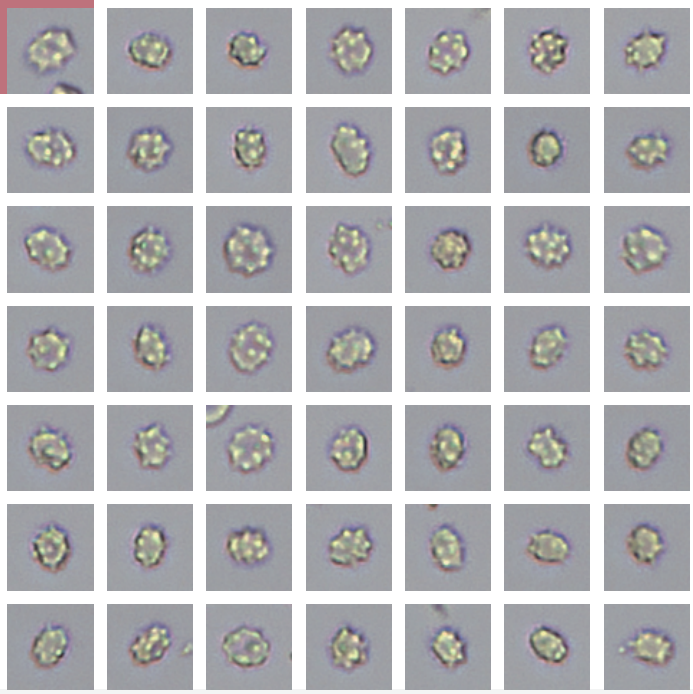




Acanthocytes

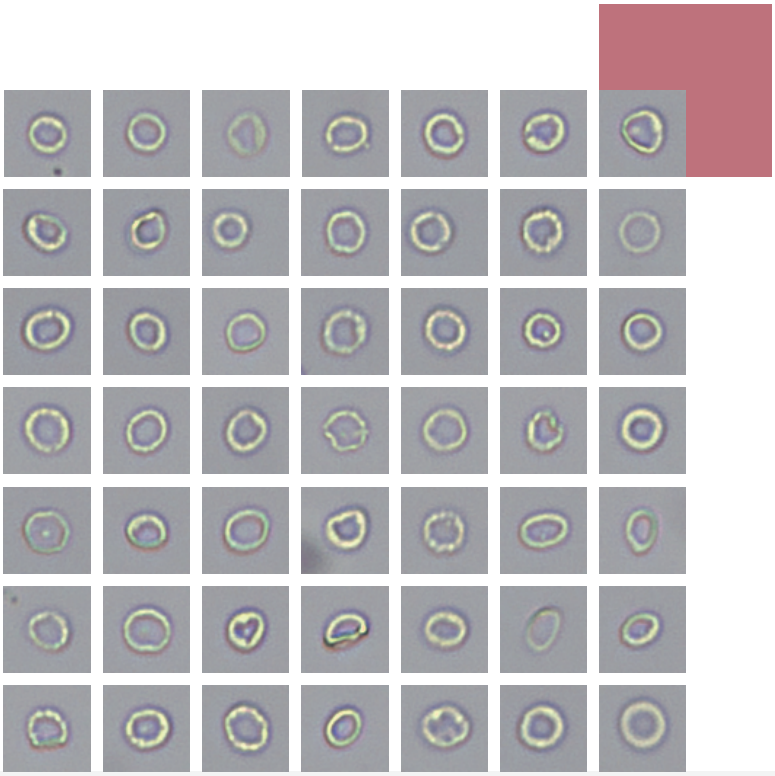
- **Morphology features:**
  Cells of unequal sizes, with one or more spine-like process(es) at margin or in central area, or spore-like pseudopodia(e); the center may be stomata- shaped, target-shaped, or irregular-shaped.
- **Origins and mechanisms:**
  Morphological changes of RBCs as a result of the mechanically damage cause by excessive filtration tension or extrusion in pathological glomerular basement membrane or under the effect of continuously varying osmotic pressure in the tubular filtration process .
- **Clinical significance:**
  Commonly seen in glomerular diseases.





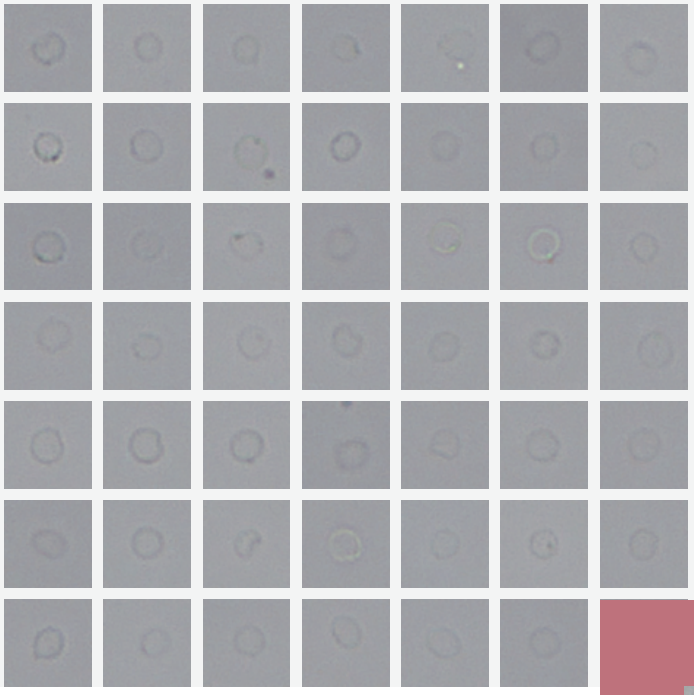
Crenocytes

- **Morphology features:**
  RBCs with reduced volume and crenulated membrane, rich in hemoglobin pigment, having mulberry-like, strawberry-like, and/or stellate appearance.
- **Origins and mechanisms:**
  Formed as a result of the dehydration of RBCs in hypertonic, acid urine.
- **Clinical significance:**
  Not related to any specific types of disease.



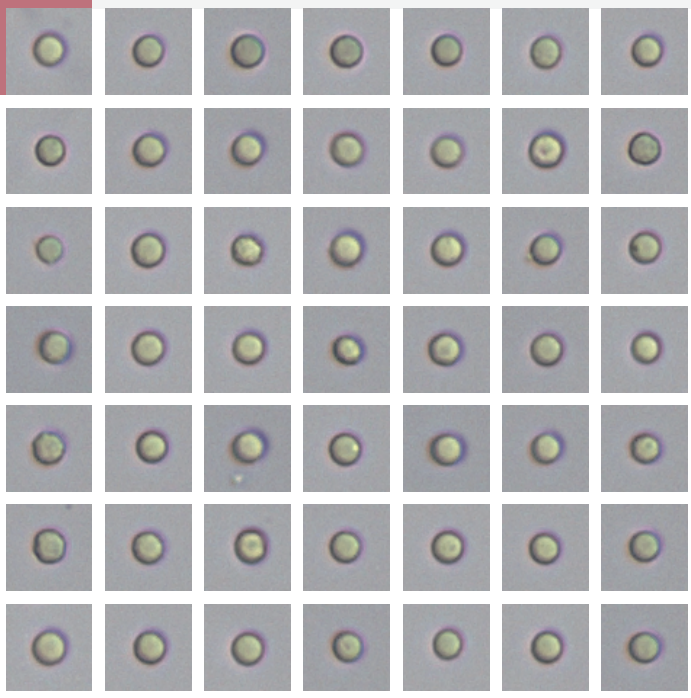
Annular RBCs

- **Morphology features:**
  Cells of unequal sizes, mainly of doughnut-like shape, but annular rings with triangle-shaped, cross-shaped, square-shaped or target-shaped hollowness may also be present.
- **Origins and mechanisms:**
  Formed as a results of the loss of hemoglobin in great amount or the aggregation of cytoplasm to inner wall of RBCs.
- **Clinical significance:**
  Commonly seen in glomerular diseases.



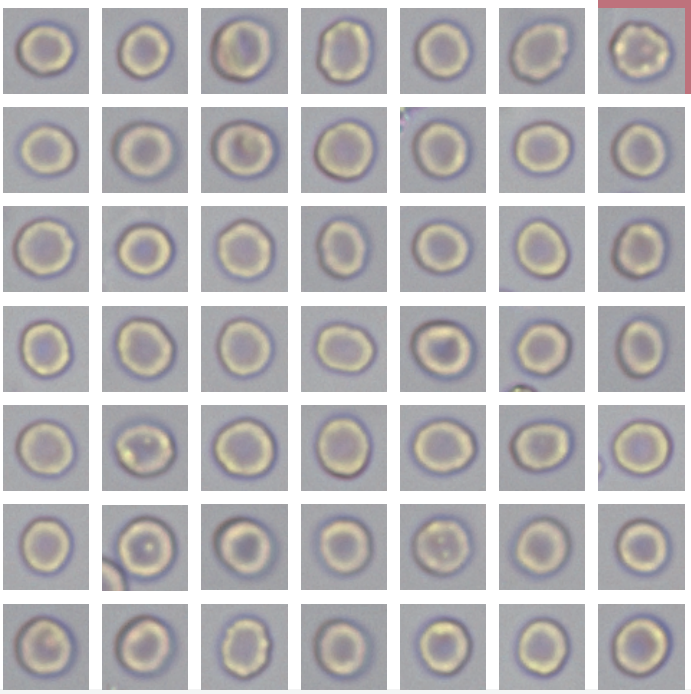
Ghost cells

- **Morphology features:**
  Various in size, very thin membrane with ring-like and faint shadow circular shape.
- **Origins and mechanisms introduction:**
  Loss of hemoglobin from cells or cytoplasm condensing to the membrane to forma ring.
- **Clinical significance:**
  Commonly seen in hypotonic urine or aging urine samples, associated with glomerular diseases.



Microcytes

- **Morphology features**:
  With a diameter <6 μm, decreased cell volume. Some have uniform sizes, complete cell membranes and concentrated hemoglobin. They resemble pellets and form aggregations. Some vary in size and shape.
- **Origins and mechanisms**:
  introduction: Derived from the glomerulus or own small RBCs of patient's blood. Normal RBCs dehydrated in hypertonic and acid urine samples.
- **Clinical significance**:
  Commonly seen in Occult nephritis, IgA Nephropathy, Purpura nephritis, and Iron deficiency anemia.

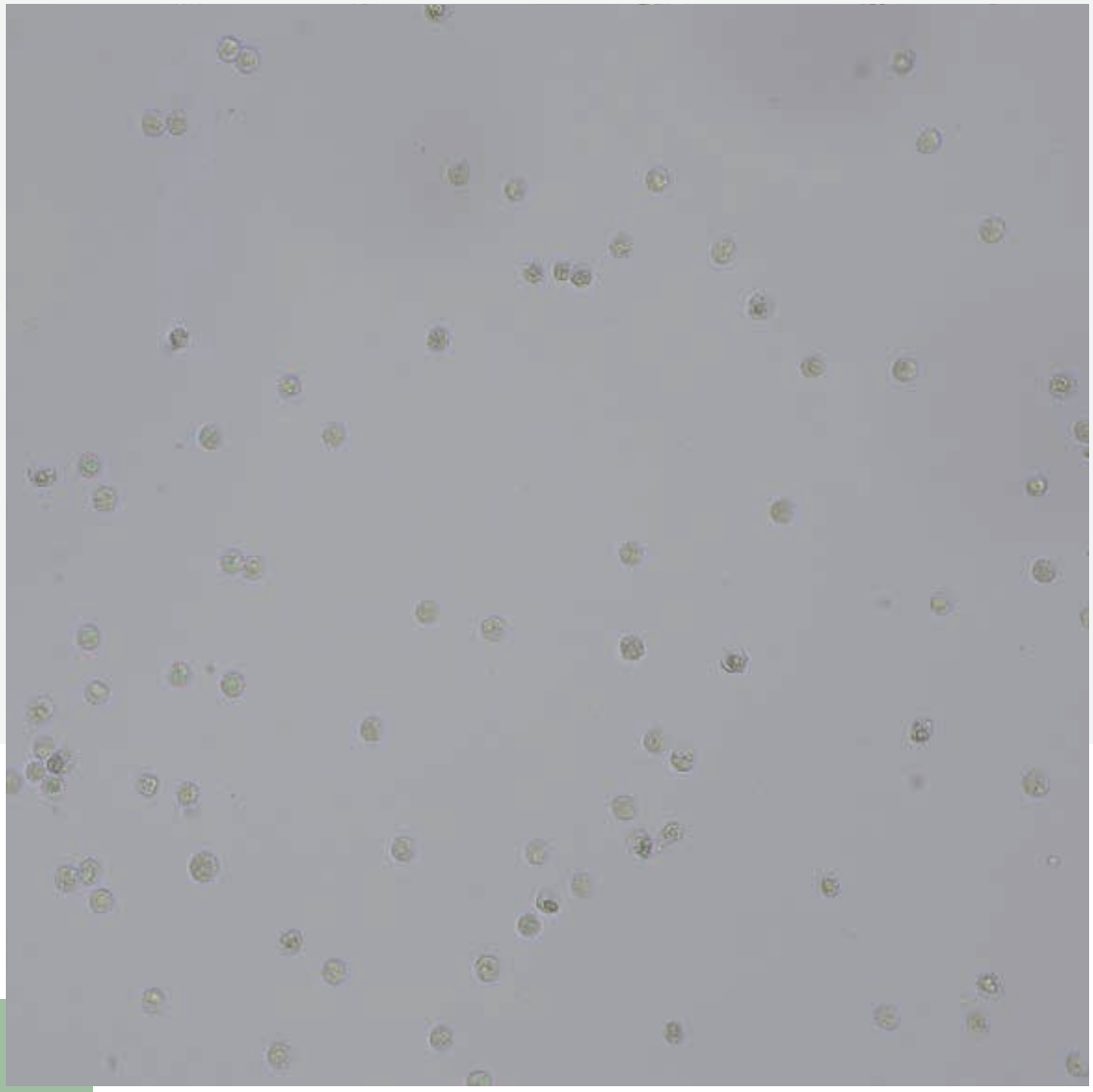


Macrocytes

- **Morphology features**:
  With a diameter >8μm, increased cell volume and no obvious difference from normal RBCs.

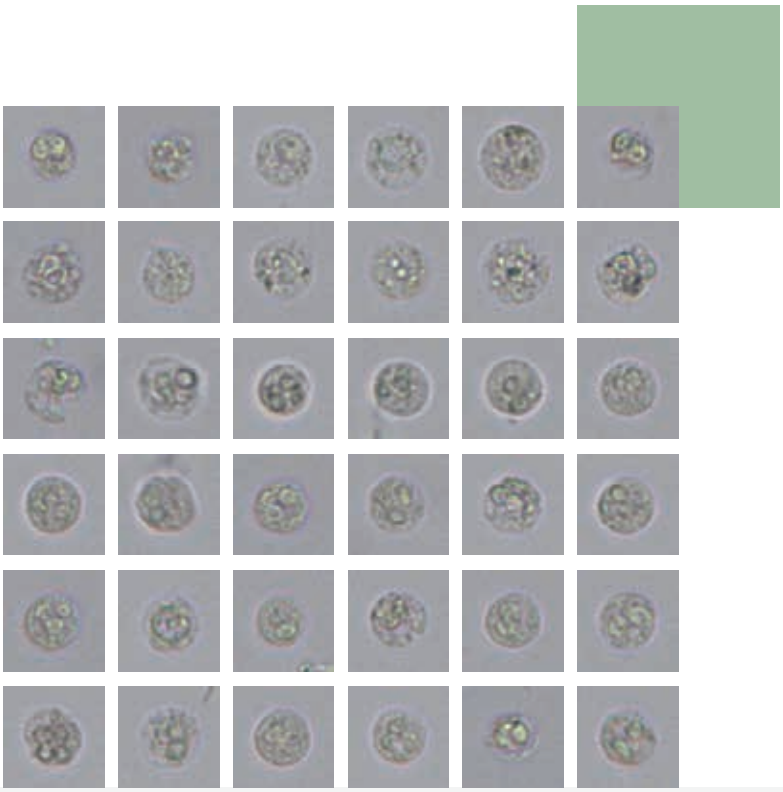
- **Origins and mechanisms introduction:**
  RBCs expand and become larger in hypotonic urine or originate from big RBCs in the patient's blood.

- **Clinical significance**:
  Not related to specific types of urinary system diseases, but also seen in megaloblastic anemia.



White Blood Cells

Neutrophils, polymorphonuclear/ Segmented
Mononuclear cells
Amoeboid WBCs
WBC Clumps
Phagocytes

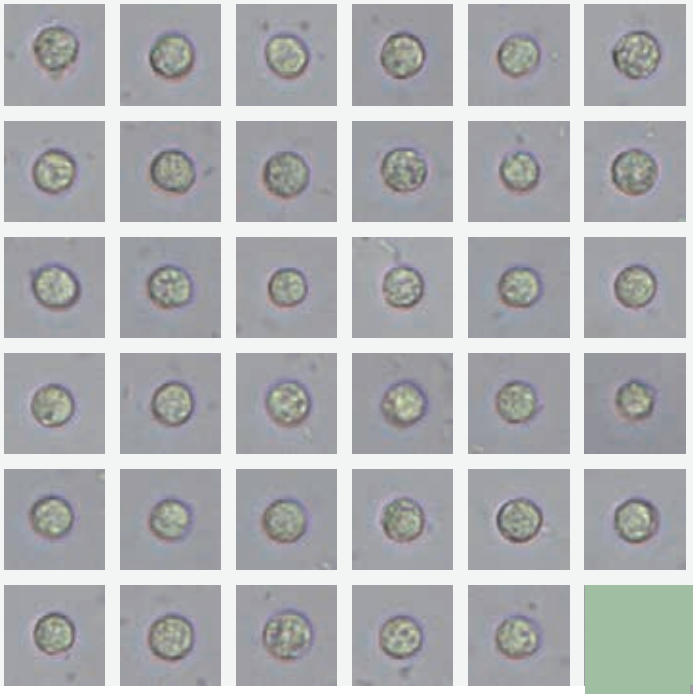


Neutrophils, polymorphonuclear/ Segmented

- **Morphology features:**
  Intact leukocytes in fresh urine are basically the same with those in peripheral blood in terms of morphology and structure; both are round-shaped and with a diameter of 10~14 μm.

- **Origins and mechanisms:**
  Healthy human urine contains no or very few RBCs. Increased RBCs in urine, generally attributable to the increase in neutrophils, is mainly indicative of inflammatory urinary system.

- **Clinical significance:**
  Generally indicative of pyelonephritis, urethritis, prostatitis, tuberculous prostatitis, carcinoma of bladder, carcinoma of urethra, and/or other malignant tumors.



Mononuclear cells

Morphology features:

- Morphology features:
- Size: 6~15 μm
- Shape: Round or suborbicular
- Nucleus: Large, round or suborbicular
- Cytoplasm: Few, mostly particle-free

Morphology features:

Originated from lymphocytes.

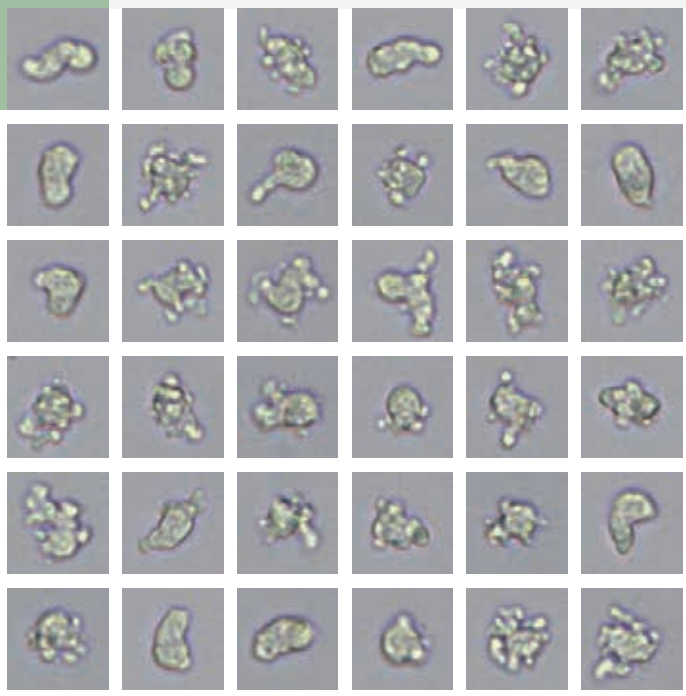
Clinical significance:

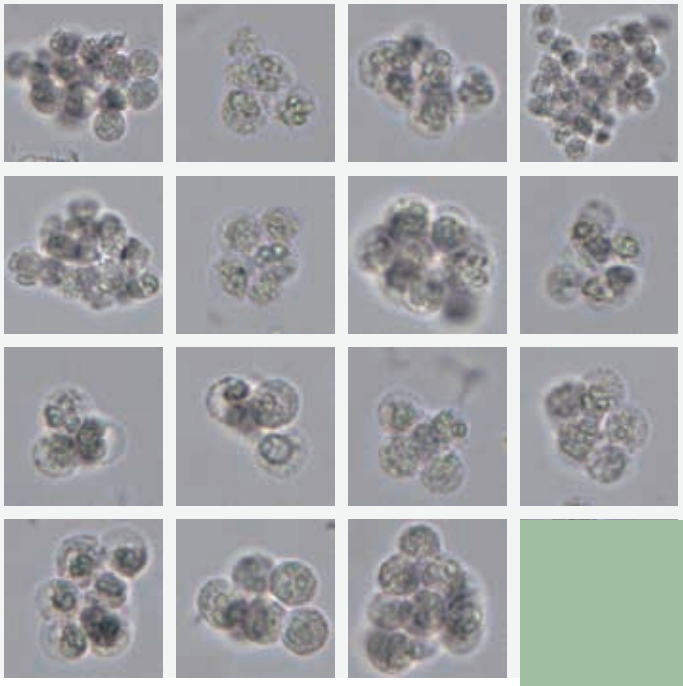
Generally seen in post renal transplant rejection, cresentic glomerulonephritis, etc.

Amoeboid WBCs

Morphology features:

Amoeboid WBCs with pseudopodiae are generally seen in the urine of patients with active inflammations, e.g., urinary tract infection. This is generally seen in unstained specimen and seldom seen in S-stained specimen.

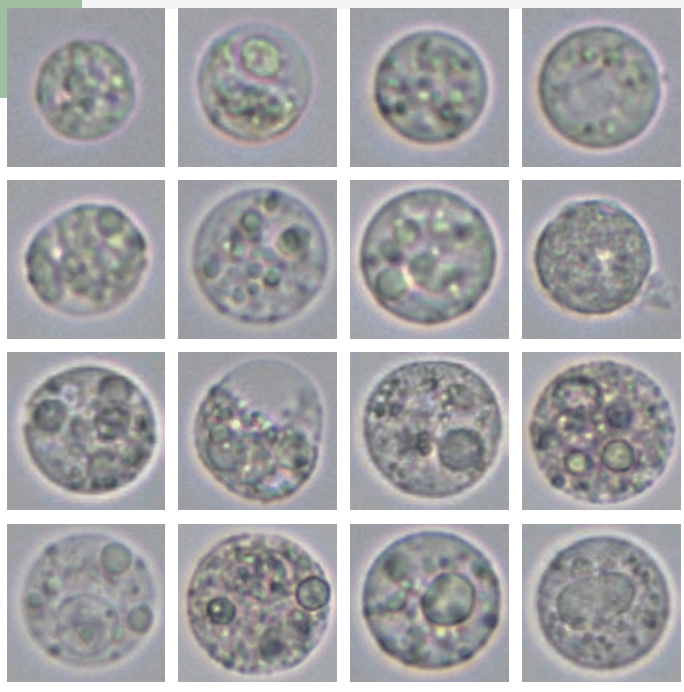




WBC Clumps

Morphology features:

Neutrophils for their phagocytic function can phagocytize bacteria, fungi and other foreign matters. In the urine specimen of some patients with pyuria and/or other serious inflammation, neutrophils are featured by indistinct cytoplasm boundary and conglobation. In urine specimen of patients with pyuria, the neutrophils tend to agglomerate. If the specimen is smeared to a glassslide with a coverslip, the cytomembrane may be damaged. As a result, the WBCs will spread or expose their naked nucleuses.



Phagocytes

Morphology features:

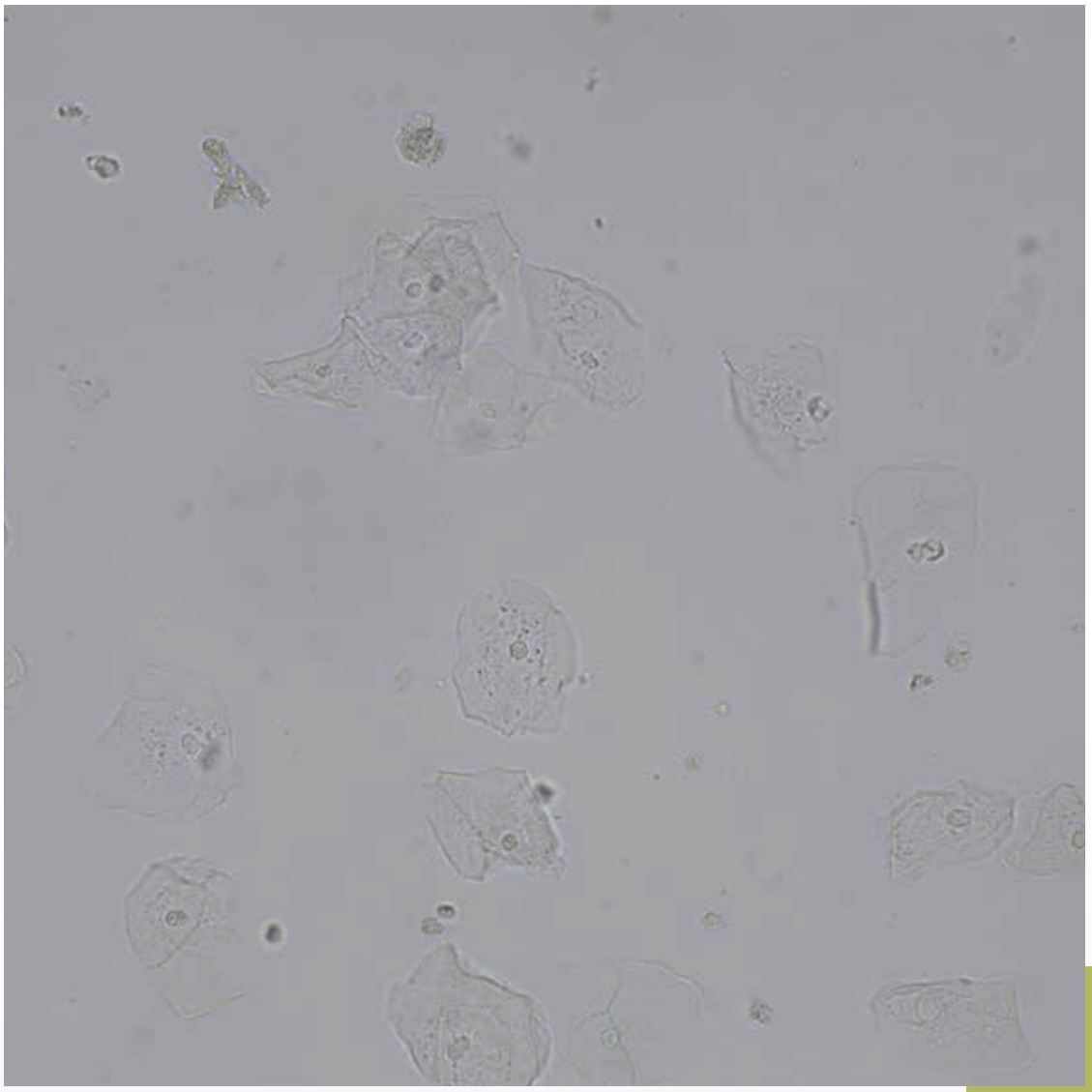
Round or elliptical shaped, 20~100 μm in size; the nucleuses are large and distinct, mostly round, oval or U shaped and generally distributed on the same side in the cells, or in the center of the cells. The cells are rich in cytoplasma and generally contain vacuoles and, in most cases, phagocytized debris.

Origins and mechanisms:

In urine specimen from patients with tissue injury or infection, monocytes may leave the blood stream and enter the affected tissues or organs, where they undergo a series of differentiation and transformation, thus being converted into phagocytes.

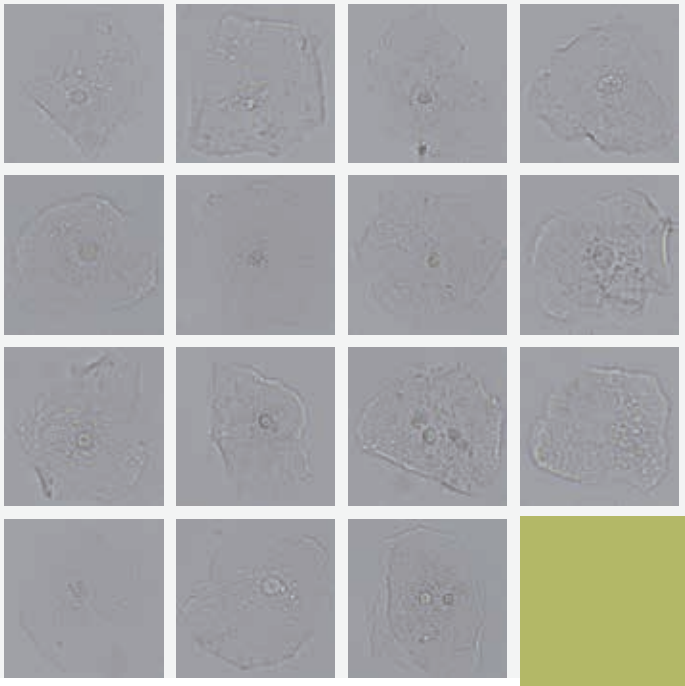
Clinical significance:

Generally seen in specimen from patients with urinary infection, glomerulonephritis (e.g., proliferative glomerulonephritis), IgA nephropathy, pyelonephritis, etc.



Epithelial cells

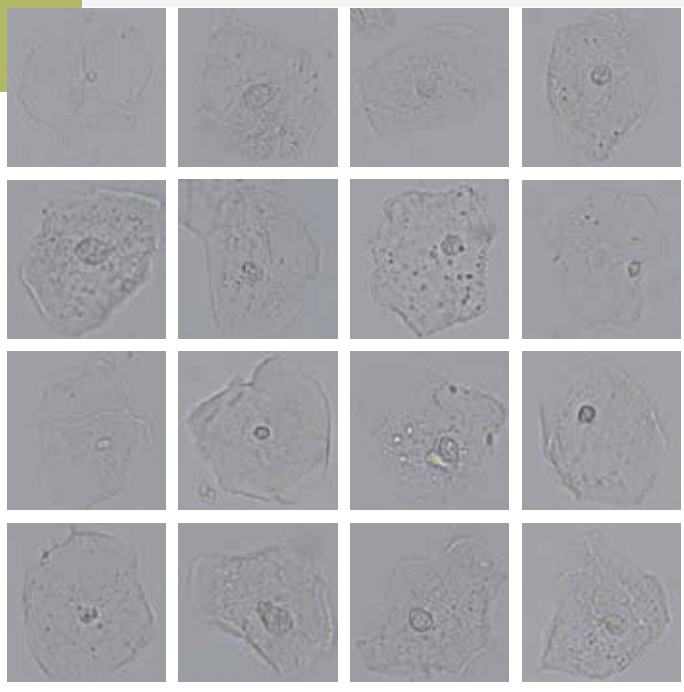
Squamous epithelial cells
Transitional epithelials
Transitional epithelials
Decoy cells



Squamous epithelial cells

Morphology features:

- Size: 40~60 μm
- Shape: Flat, irregular-shaped, with distinct margin
- Nucleus: Small, round or oval, positioned in center, might be acaryotic or occasionally polycaryotic after cornification
- Cytoplasm: Abundant in cytoplasm, with small particles in dotted distribution.

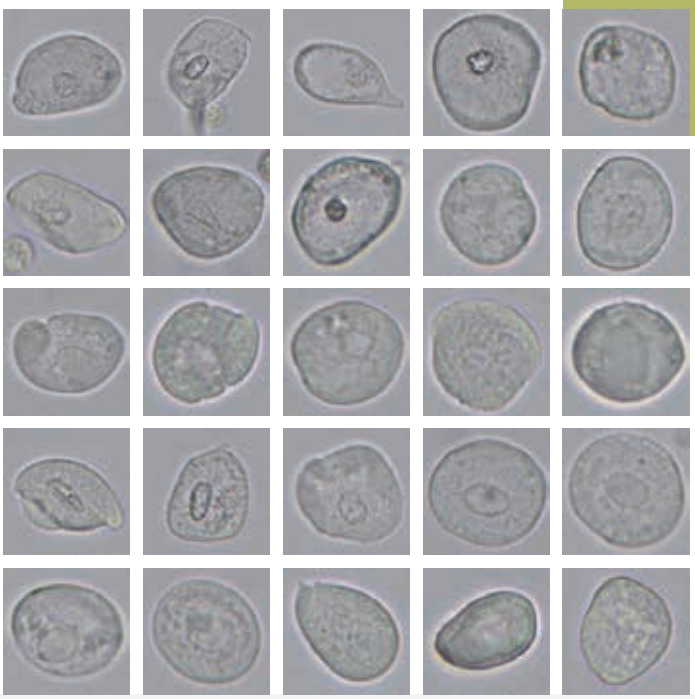


Origins and mechanisms:

Originated from trigone of urinary bladder and external orifice of urethra in female patients and from fossa navicularis to external orifice of urethra in male paztients;

Clinical significance:

The detection of these cells in great quantity and concomitant leukocytes is indicative of urethritis; an additional concomitant increase in urothelial cells points to chronic cystitis.



Transitional epithelials (From superficial urothelium)

Morphology features:

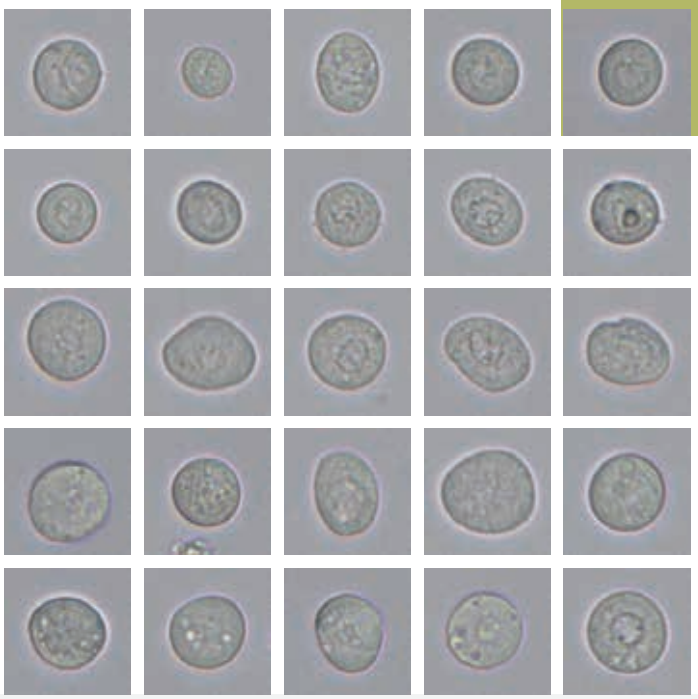
- Size: 15~40 μm
- Shape: Large cell body, generally round-shaped or irregular-shaped.
- Nucleus: Small, round or oval shaped, positioned in center
- Cytoplasm: moderately abundant, thick, with particles or meshes, cell boundary distinct

Origins and mechanisms:

From bladder, and/or the urethra segment adjacent to bladder.

Clinical significance:

The finding of a few exfoliated urothelial cells in urine specimen from healthy human is alright. An increase in exfoliated urothelial cells is generally indicative of cystitis.



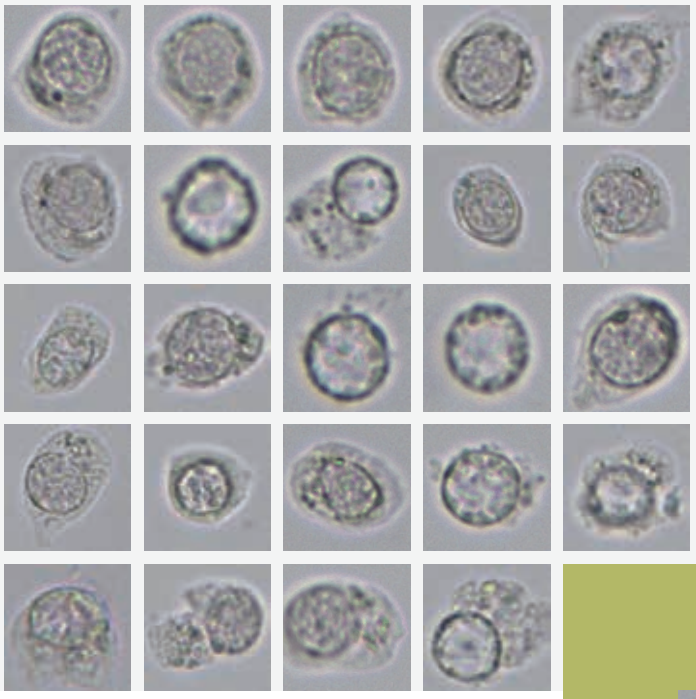
Transitional epithelials (From underlying urothelium)

Morphology features:

- Size: 15~30 μm
- Shape: Round or rectangular shaped
- Nucleus: A bit large, round or oval, positioned in center or off-center
- Cytoplasm: Abundant, cell boundary distinct

Origins and mechanisms:
Renal pelvis, ureter, bladder, urethra.

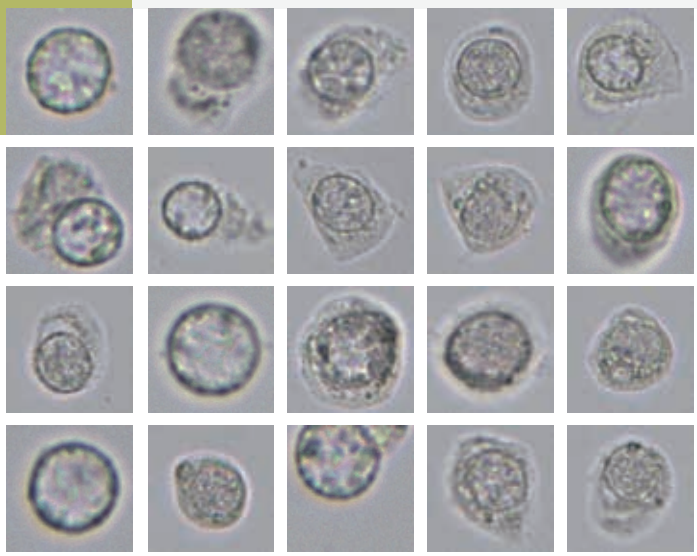
Clinical significance:
Generally seen in pyelonephritis, cystitis, etc.



Decoy cells

Morphology features:

Cells infected with human polyomavirus, cells infected with human circo-like polyomavirus, suborbicular or irregular shaped, nuclear-cytoplasmic ratio, nucleus positioned off-center; nucleus enlarged, nuclear membrane thickened, with visible large inclusion bodies inside nucleus.



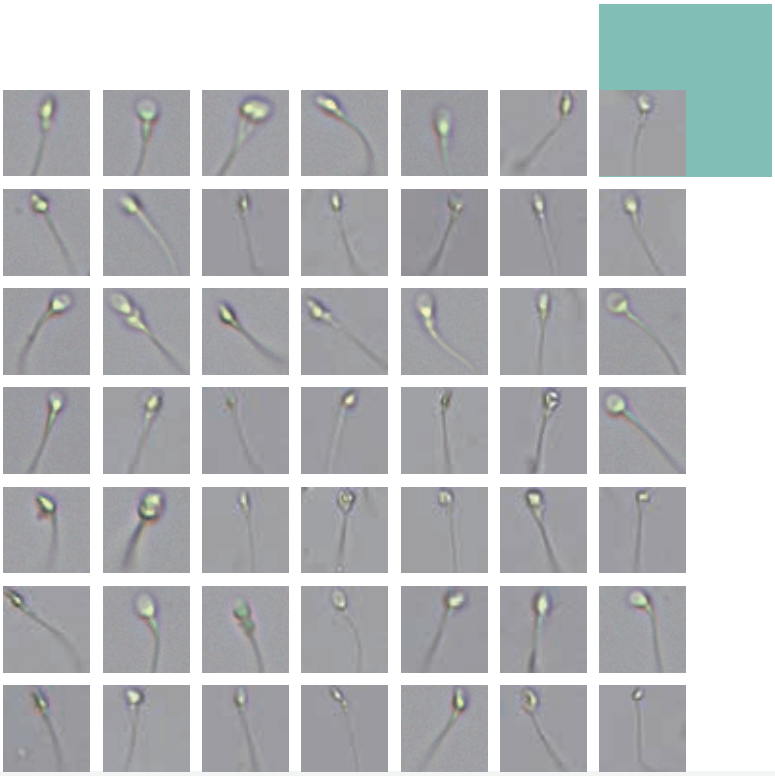
Origins and mechanisms:

Originated from renal tubular epithelial cells or urothelial cells.

Clinical significance:

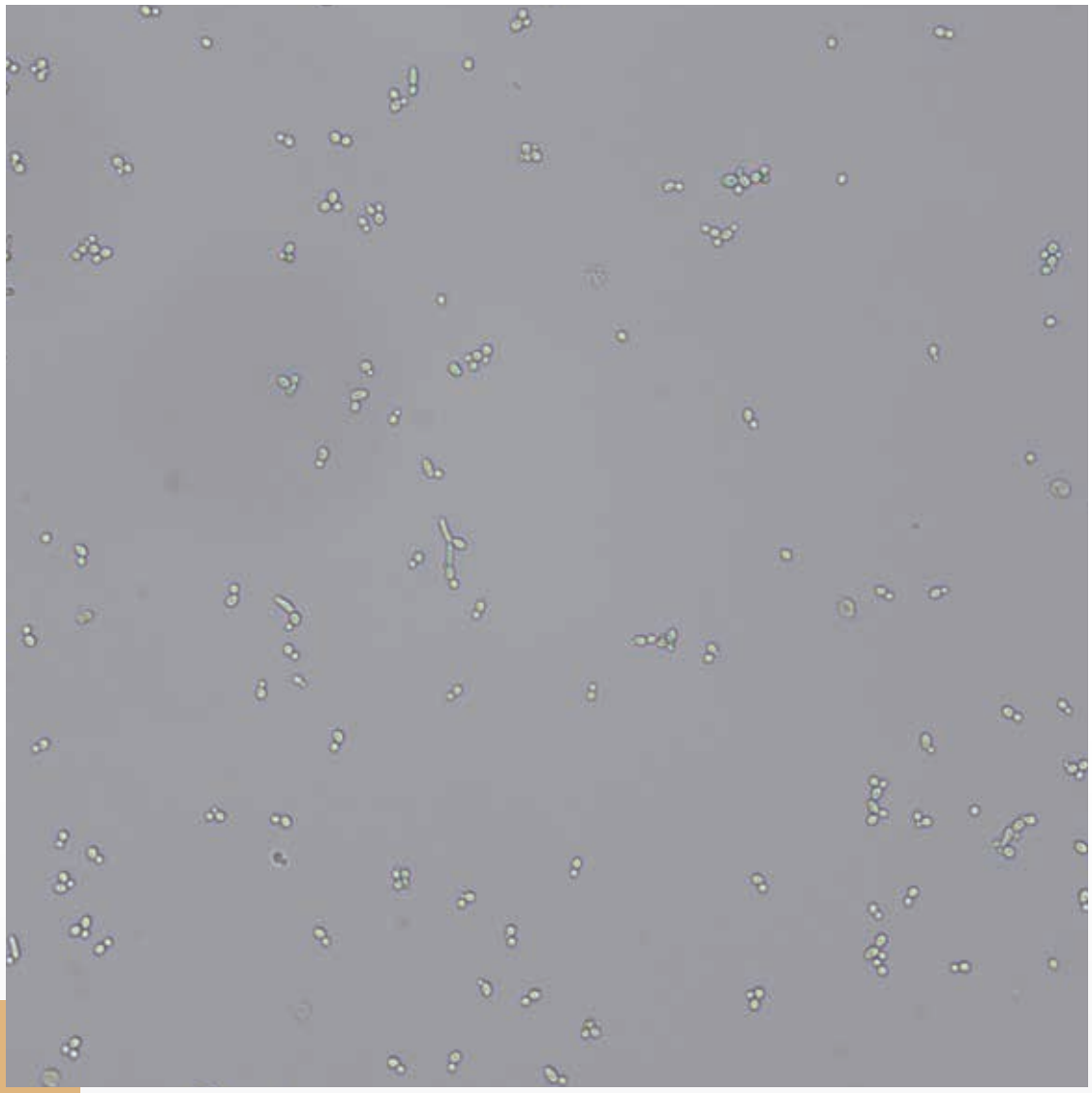
Generally seen in patients on prolonged immunosuppressant treatment after renal transplant.

Sperm



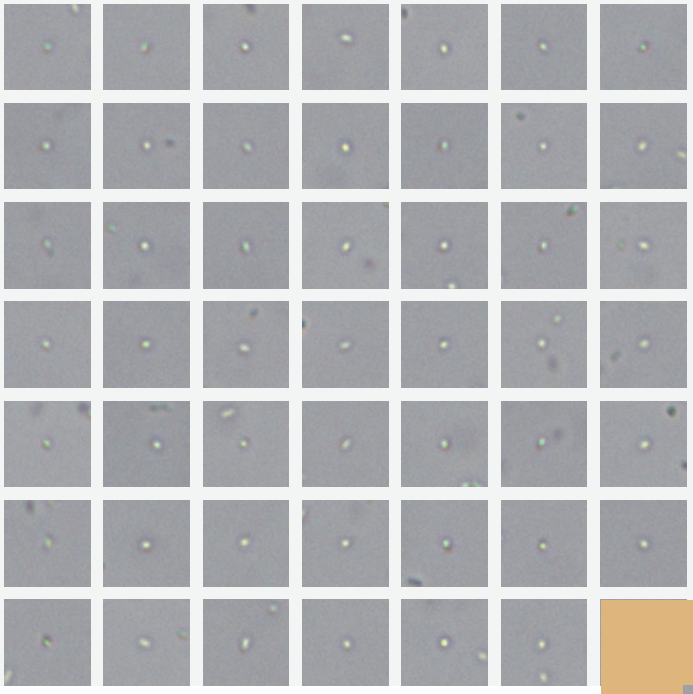
Spermatoblasts or sperm

- **Morphology features:**
  - Size: About 4~5 μm in head, 2~3 μm in width, with a thin and 50~55 μm long tail
  - Morphology: Spermatoblasts in urine are morphologically the same with spermatoblasts in semen; A normal tadpole like spermatoblast consists of head, body and tail. The head is oblong, the body is short and hard to be observed when not stained.
- **Origins and mechanisms:**
  Spermatoblasts can be found in urine after spermatorrhea, retrograde ejaculation, and sexual intercourse
- **Clinical significance:**
  Seen occasionally, not clinically significant



Microorganisms and others

Bacteria Coccus
Bacteria Rods
Yeast
Mucous strands



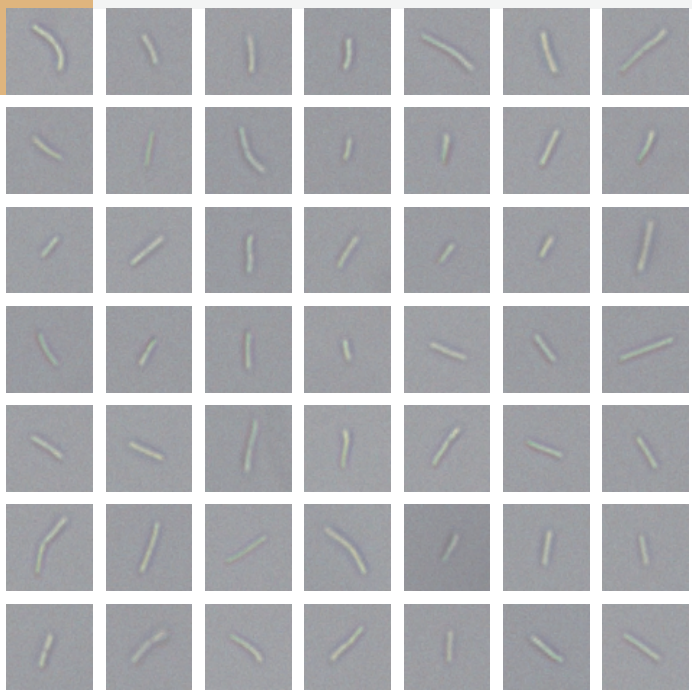
Bacteria Coccus

Morphology features:

Round or almost oblong. Neisseria gonorrhoeae is kidney-shaped and aligned in pairs.

Clinical significance:

Seen in urine specimen from patients with bacterial infection of urinary system. Neisseria gonorrhoeae are seen in urine specimen from patients with sexually transmitted disease.



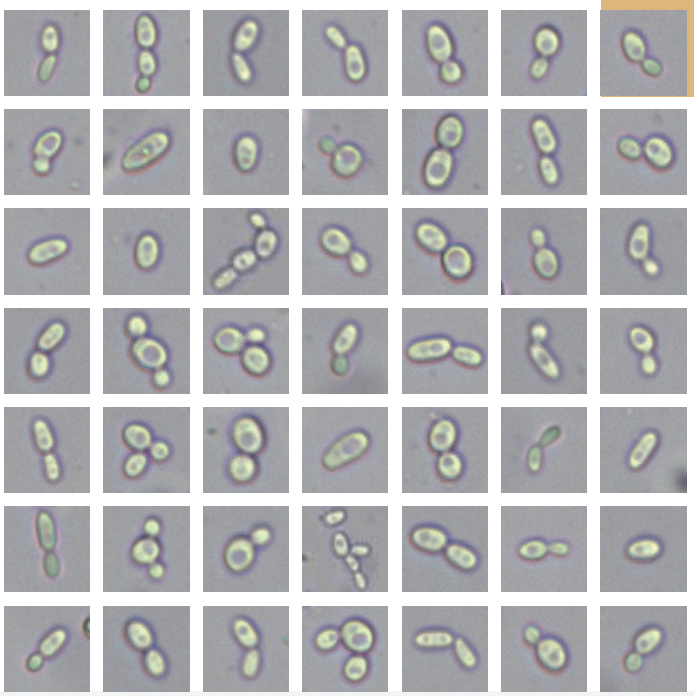
Bacteria Rods

Morphology features:

Rod-shaped

Clinical significance:

Seen in urine specimen from patients with bacterial infection of urinary system.



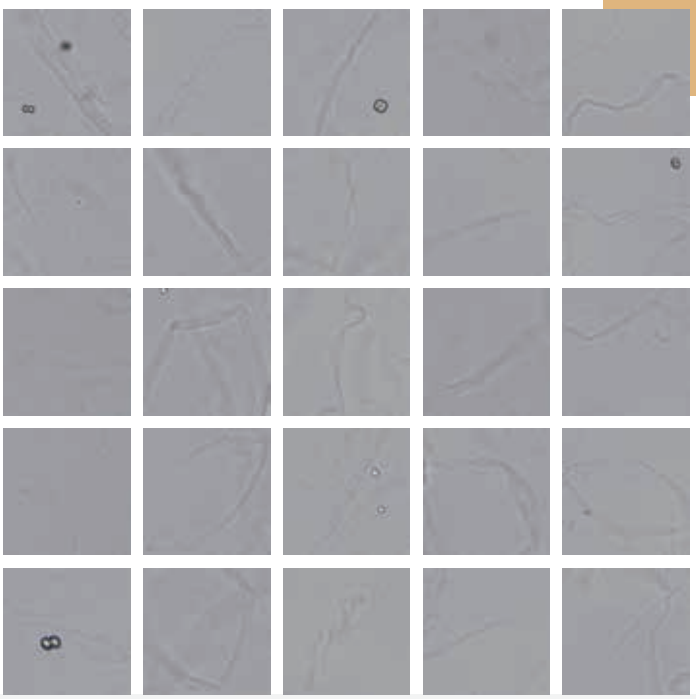
Yeast

Morphology features:

Colorless elliptic yeast-like spores, highly refractive, 3~6 μm in diameter, with nodus nelumbinis rhizomatis like pseudohypha.

Clinical significance:

Seen in urine specimen from patients with diabetes mellitus and patients with fungal infection of urinary system.



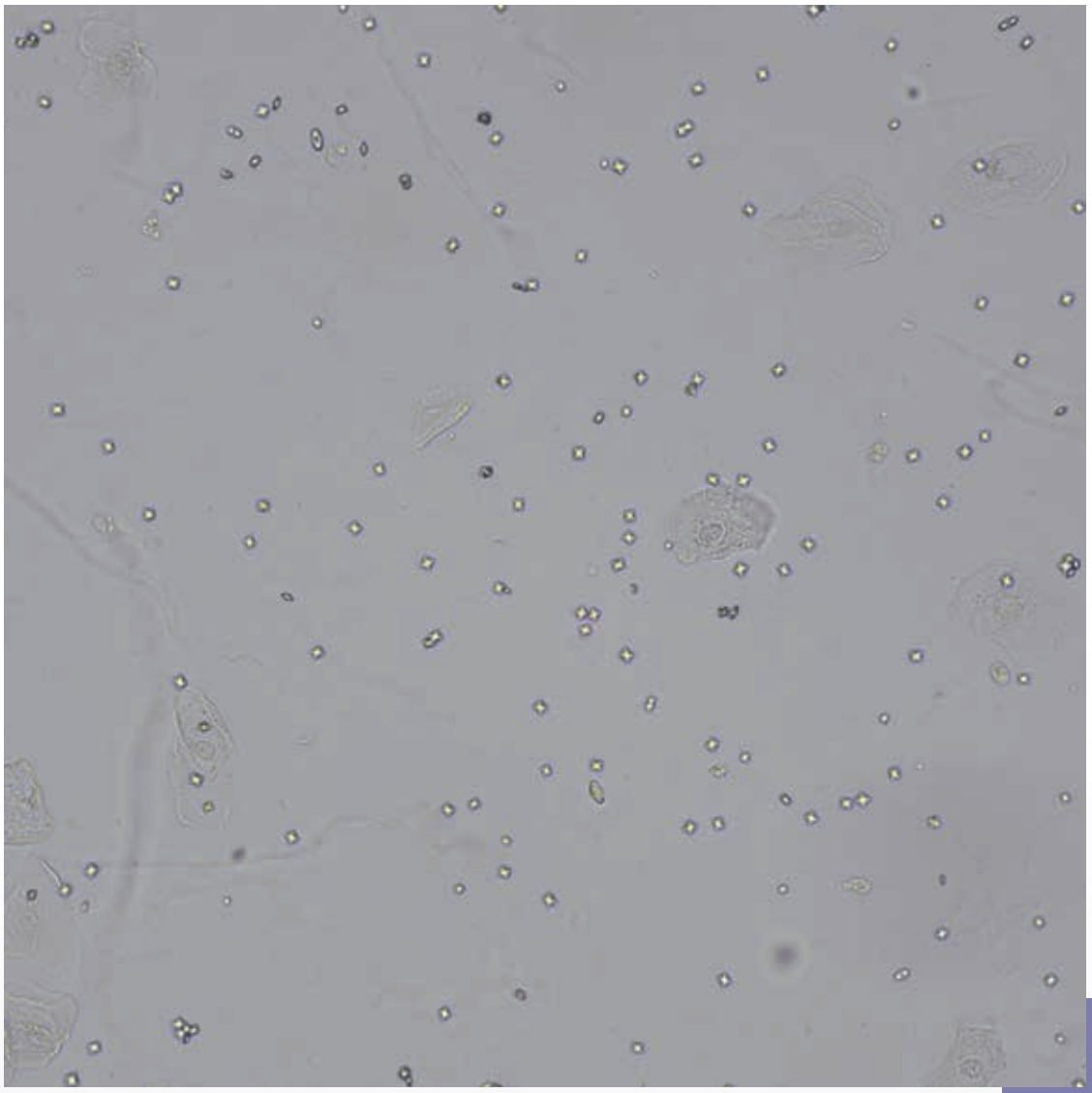
Mucous strands

Morphology features:

Long strands, with indistinct margin, tapered and curled in tail; of varied size, generally with dark pale stria.

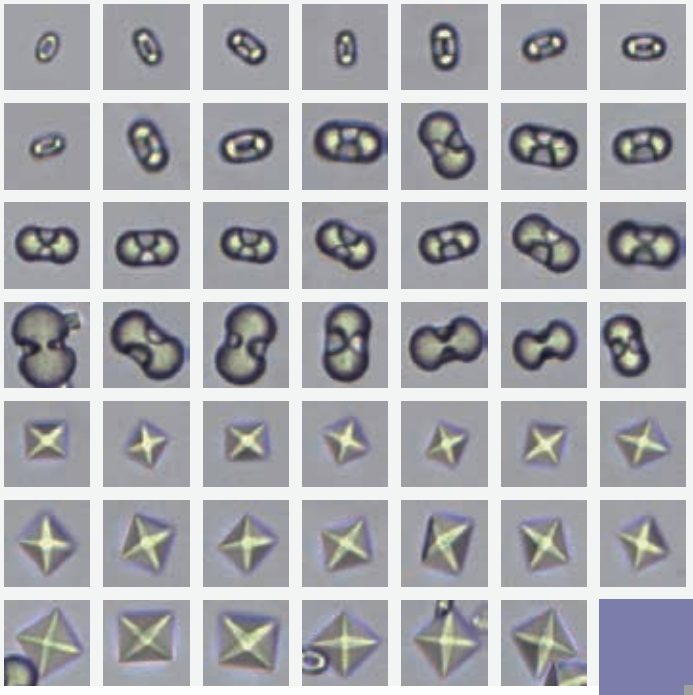
Clinical significance:

Seen in normal urine specimen, especially in urine specimen from women; presence in large quantity is generally indicative of stimuli in urethra or inflammation of urethra.



Crystals

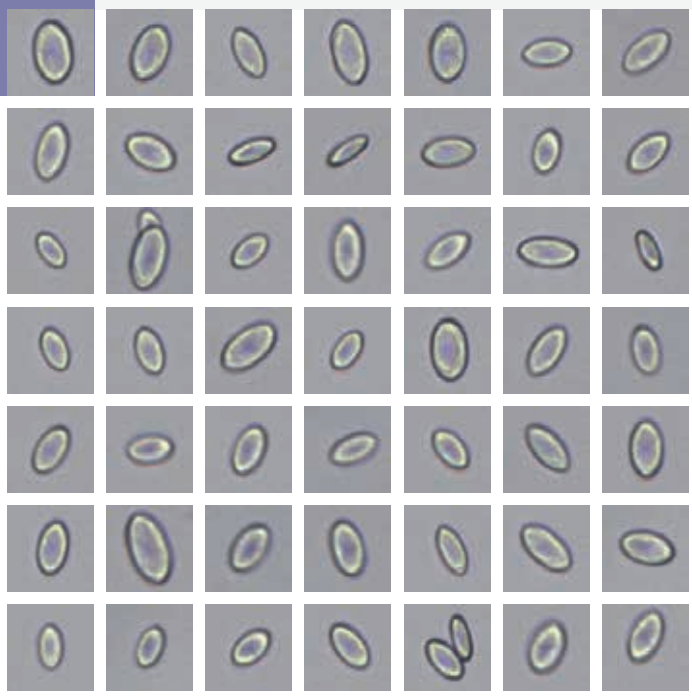
Calcium Oxalate Crystals
Uric Acid Crystals
Sodium urate crystals
Magnesium ammonium phosphate crystals
Cystine Crystals
Calcium Phosphate Crystals
Platy calcium phosphate crystals
Amorphous phosphate crystals



Calcium Oxalate Crystals

Morphology features:

Generally colorless or pale yellow; seen in the forms of calcium oxalate monohydrate and dihydrate crystals. Calcium oxalate monohydrate crystals are generally elliptic, dumb bell shaped or other irregular shaped. calcium oxalate dihydrate crystals are generally Octahedral whose corners are connected by intersecting lines(resembling an envelope).

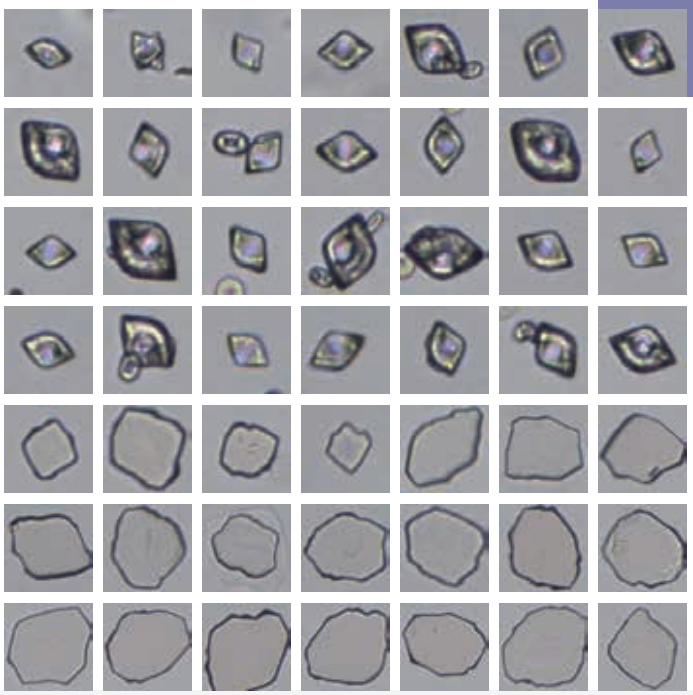


Origins and mechanisms:

Generally seen in acid, neutral and weak alkaline urine.

Clinical significance:

Presence in small amount in urine is not clinically significant. Presence in the form of calcium oxalate crystals in large amount with concomitant RBCs and symptoms of bladder irritation is generally a sign of renal or bladder calculus.



Uric Acid Crystals

- **Morphology features:**

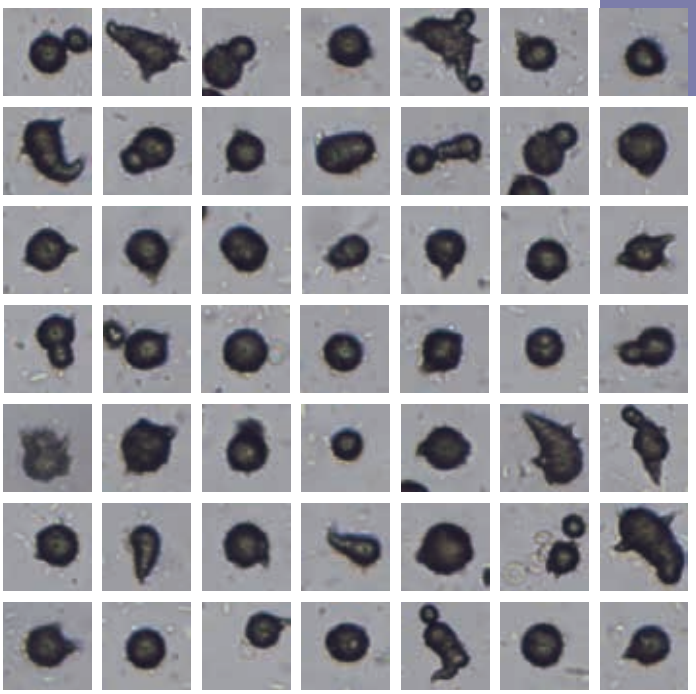
  Urate crystals are pale yellow, dark yellow or tawny. They are polymorphic and can be diamond shaped, hexagonal shaped, cubic, strand like, dumb bell shaped, waist drum shaped, petal like, rosette and irregular shaped. The tend to cluster.

- **Origins and mechanisms:**

  Generally seen in acid urine specimen with pH<5.7; When pH>5.7, they appear in the forms of amorphous urate or sodium urate crystal. Uric acid is a metabolite of purines, generally crystallizes in urine in the forms of uric acid or urate.

- **Clinical significance:**

  Generally seen in patients who ate high purine food, or who suffer from gout, lymphoma, and calculus.



Ammonium urate crystals

- **Morphology features:**

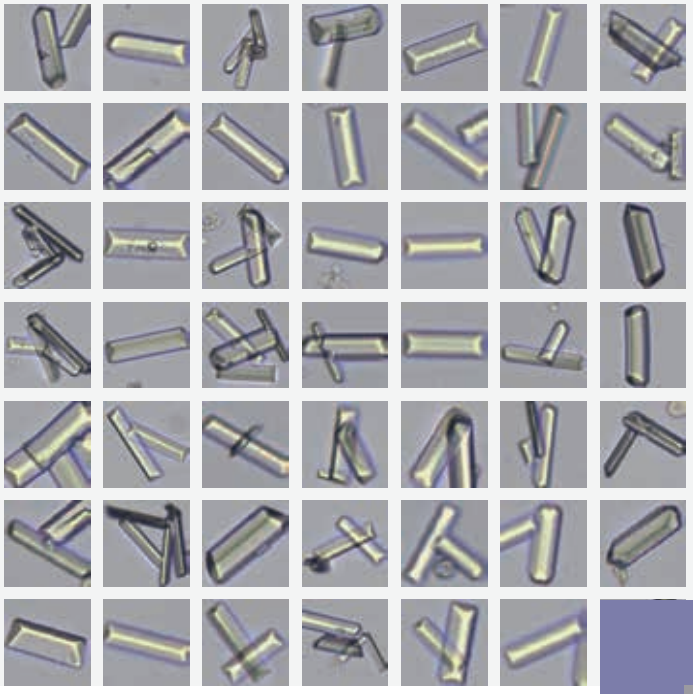
  Sodium urate is colorless to pale yellow pencil-like or prismatic crystals with flat ends. The crystals may appear separately or in small clusters.

- **Origins and mechanisms:**

  Generally seen in acid urine. It occurs as a unique form of urate arising from the binding of uric acid to sodium ion.

- **Clinical significance:**

  Generally clinically not significant; seen in urine of patients who frequently eat high purine food.



Triple phosphate crystals

- **Morphology features:**

  Colorless polymorphic crystals in the forms of "coffin lid" or "roof", envelop, prism, feathery shapes.

- **Origins and mechanisms:**

  Generally seen in urine with pH >6.5 These crystals are formed as a result of the reaction of ammonia, which is generated by the decomposition of urea by bacteria, with trivalent phosphate in in ammonia alkalinized urine.

- **Clinical significance:**

  Excessive magnesium ammonium phosphate crystals and concomitant bacteria in freshly sampled morning urine are indicative of urinary infection. It is advised that patients detected these crystals take a bacterial culture test of urine. The detection of such crystals in old urine is not clinically significant.

Cystine Crystals

- **Morphology features:**

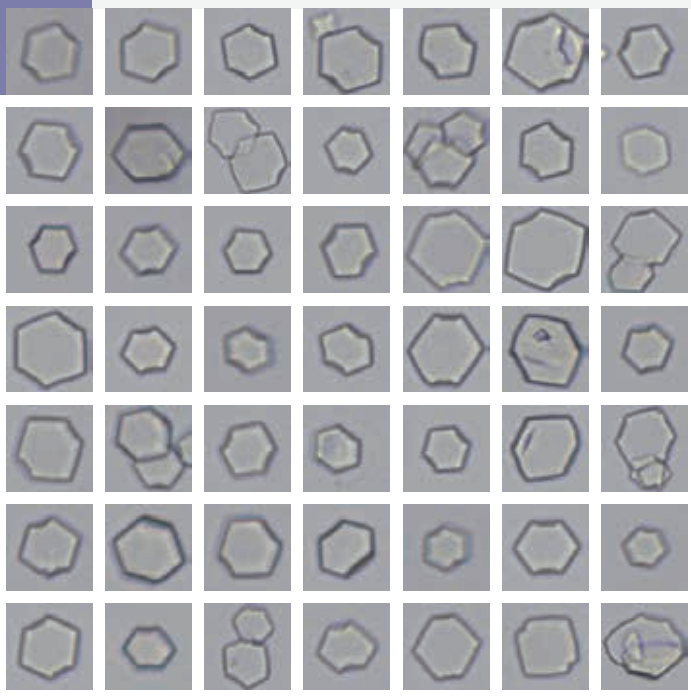
  Colorless, asymmetric flaky hexagonal crystals of varied sizes and with clear edge and high refractivity. They may occur separately or in clusters, generally in urine of pH <8.3.

- **Origins and mechanisms:**

  These crystals are the product of protein decomposition.

- **Clinical significance:**

  Generally seen in urine specimen from patients with hereditary cystinuria, serious hepatopathy, rheumatic disorder or syphilis; they can lead to renal or bladder calculus when present in excessive amount.



Calcium Phosphate Crystals



- **Morphology features:**

  Colorless. Typically calcium phosphate occurs in the form of thin and long prismatic crystals with wedged ends. The crystals may form separately or in cluster or in chrysanthemum-like pattern. It may also occur in the form of flaky calcium phosphate crystals, which are flat and irregular in shape and may adsorb phosphate particles.

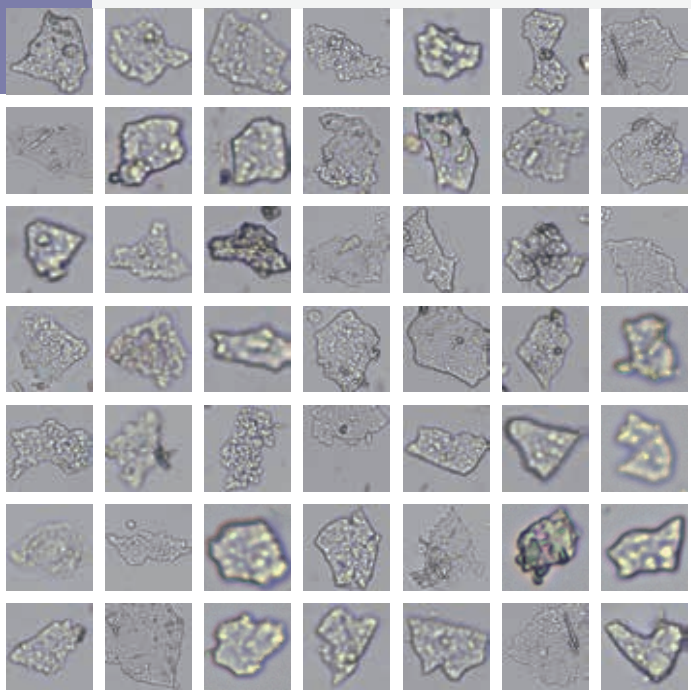
- **Origins and mechanisms:**

  Generally seen in alkaline urine. It is the product from the reaction of phosphate with calcium ion in urine.

- **Clinical significance:**

  Rarely seen; if the crystals persist, the patients should be examined for hyperparathyroidism, renal tubular acidosis or bone demineralization (for bedridden patients).

Platy calcium phosphate crystals



- **Morphology features:**

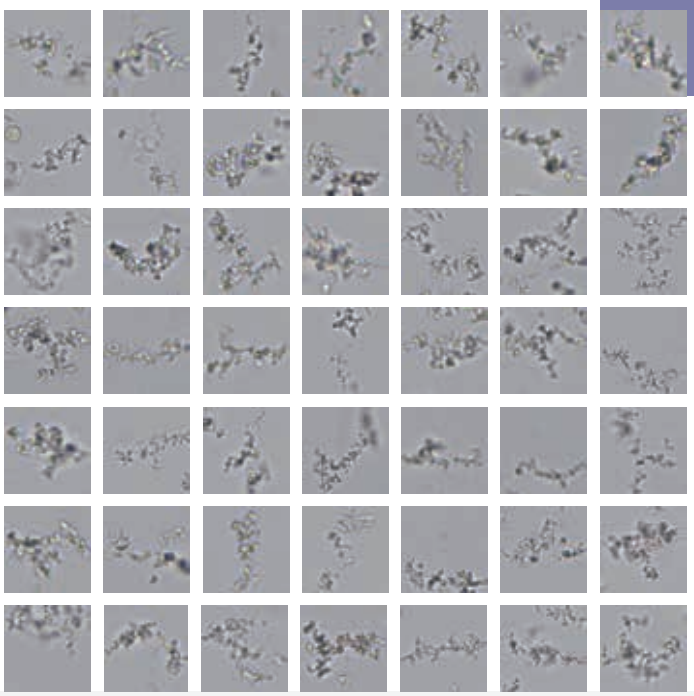
  Colorless. Typically calcium phosphate occurs in the form of thin and long prismatic crystals with wedged ends. The crystals may form separately or in cluster or in chrysanthemum-like pattern. It may also occur in the form of flaky calcium phosphate crystals, which are flat and irregular in shape and may adsorb phosphate particles.

- **Origins and mechanisms:**

  Generally seen in alkaline urine. It is the product from the reaction of phosphate with calcium ion in urine.

- **Clinical significance:**

  Rarely seen; if the crystals persist, the patients should be examined for hyperparathyroidism, renal tubular acidosis or bone demineralization (for bedridden patients).

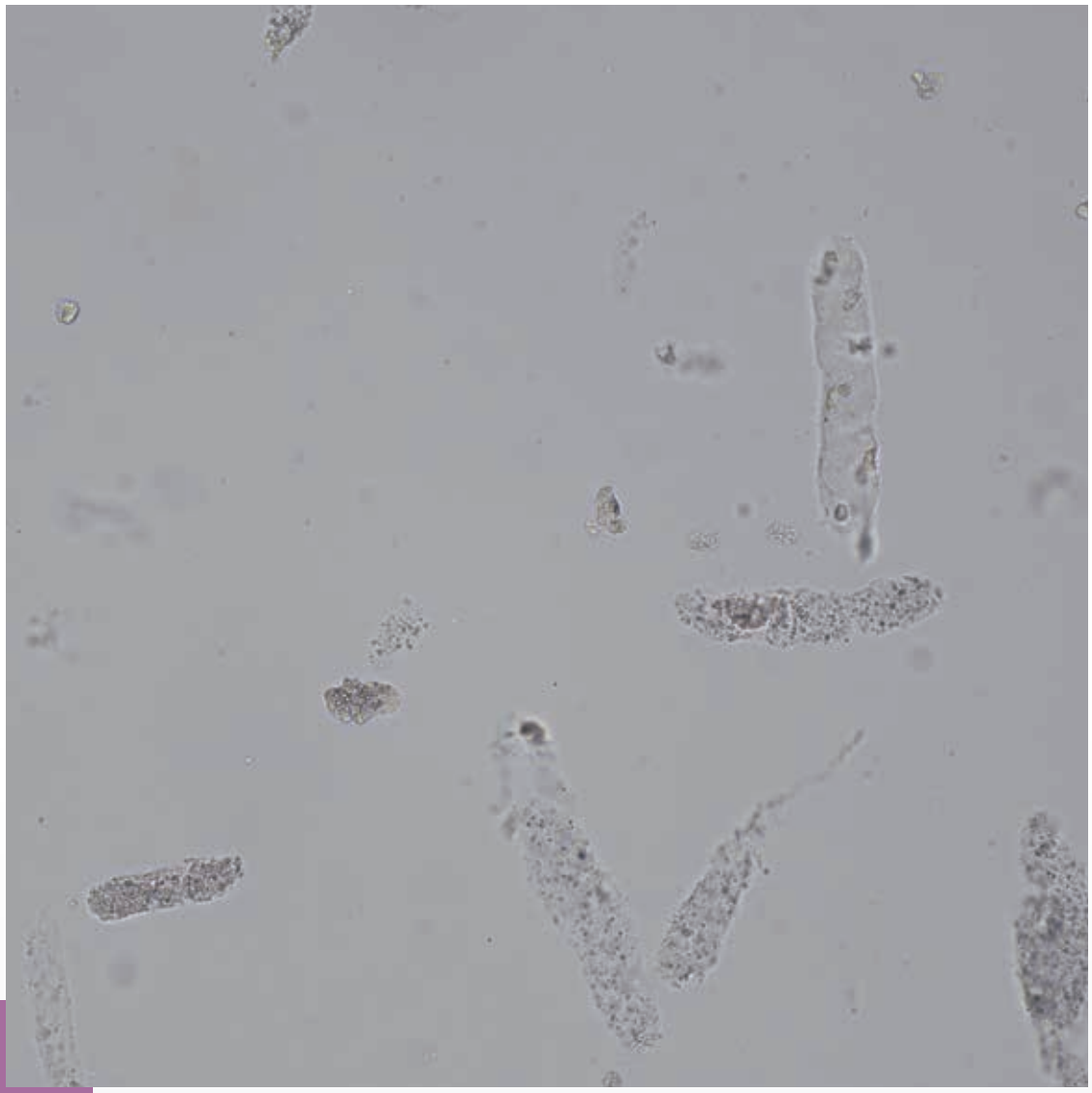


Amorphous phosphate crystals

- **Morphology features:**
  Fine particles, with off-white turbid precipitate visible to unaided eyes.

- **Origins and mechanisms:**
  Generally seen in alkaline urine; the crystals form when the solubility of calcium phosphate is decreased as a result of the increase of urine pH. It is the most common cause of turbid alkaline urine.

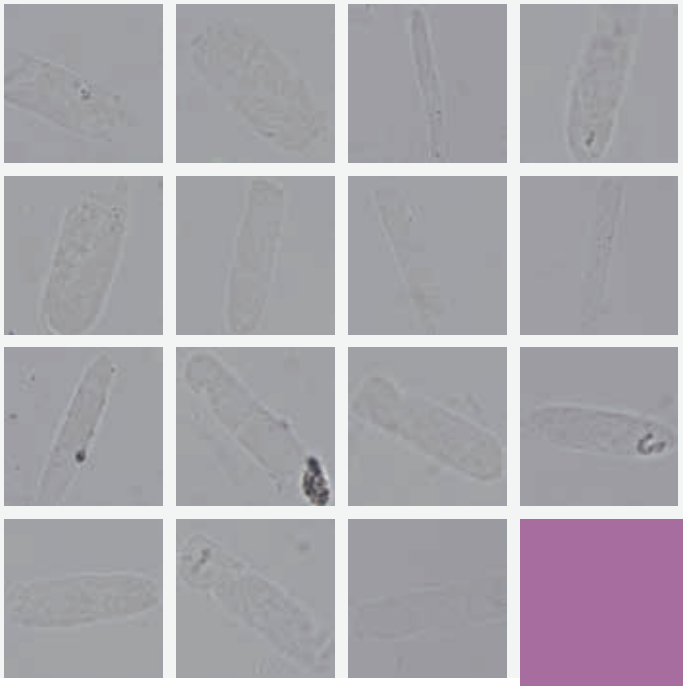
- **Clinical significance:**
  Generally not clinically significant; mostly seen in vegetarians. Excessive and repetitive occurrence of this crystal is susceptible to give rise to calculus.



Casts

Hyaline casts
Cellular casts
Granular casts
Waxy casts
Myoglobin casts
Other casts

Hyaline casts



Morphology features:

Colorless, transparent, thin, low refractive cylindrical crystals; with parallel sides, blunt ends, flat, curved or twisted morphology. Containing a few particles occasionally.

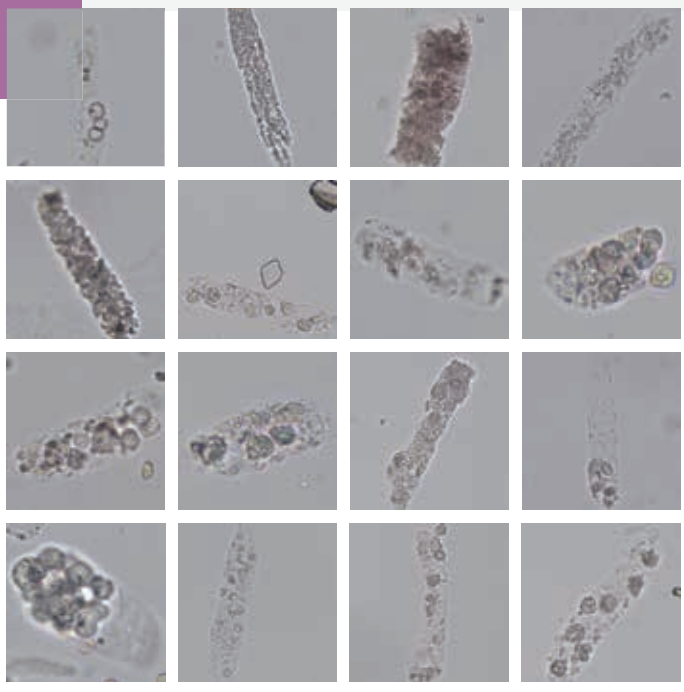
Origins and mechanisms:

Mainly formed by T-H glucoproteins, albumin and sodium chloride in acidic and concentrated urine environment in renal tubules as a result of precipitation and solidification.

Clinical significance:

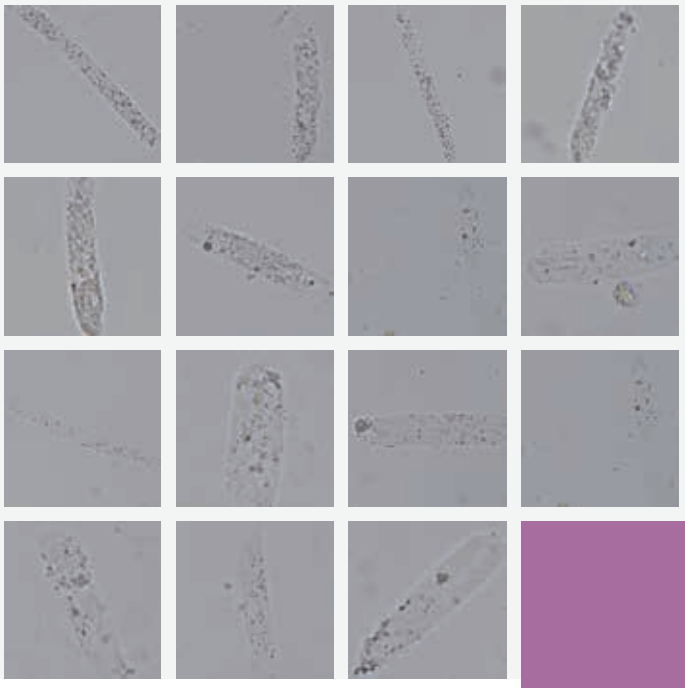
Occasionally seen in concentrated urine of adults after heavy exercise. May form in excessive in patients with malignant hypertension, acute or chronic glomerulonephritis, acute pyelonephritis, chronic renal failure, nephrotic syndrome, etc.

Cellular casts



Morphology features:

Casts formed by the adhering of exfoliated cells to or the containment of exfoliated cells in hyaline casts. These casts can be divided into RBC casts, WBC casts and renal tubular epithelial casts according to the type of cells in the casts. Sometimes more than two types of cells may be contained in the same cast, which is referred to as composite cell cast.



Granular casts

- **Morphology features:**

  These casts are mainly particles of varied size and density and the volume of particles taking up more than 1/3 of the volume of the casts.

- **Origins and mechanisms:**

  The particles in the casts are disintegrated and denatured cell debris, aggregated plasma proteins and other substances.

- **Clinical significance:**

  These casts are indicative of substantial pathological changes. Commonly seen in acute or chronic glomerulonephritis, nephrotic syndrome, glomerulosclerosis, drug intoxication, etc., however, they could also been seen occasionally after fever and heavy exercise.

Waxy casts

- **Morphology features:**

  Semitransparent, thick, homogeneous, light gray or pale yellow waxy casts of distinct profile and varied size and length; witch notch at edge and susceptible to fracture; generally slight curved and non-flush on both ends; containing a few particles or impurities.

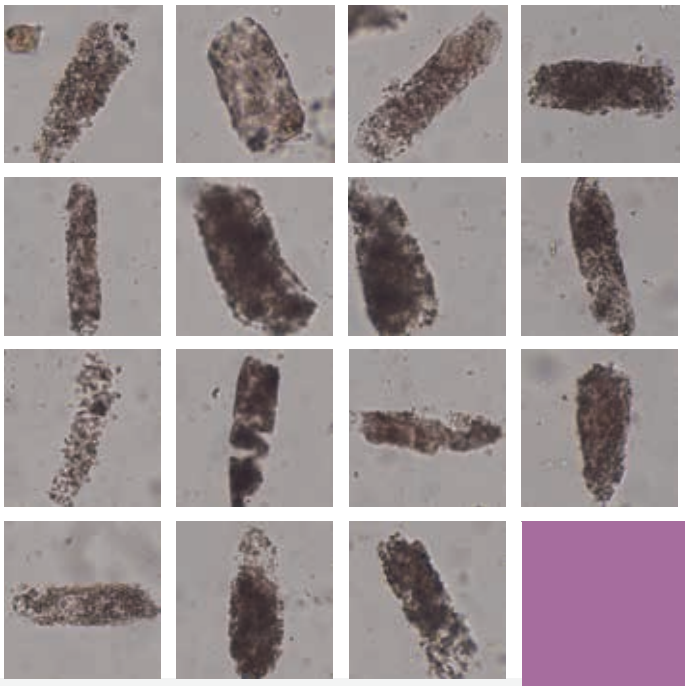
- **Origins and mechanisms:**

  Final product from the degradation of cellular casts.

- **Clinical significance:**

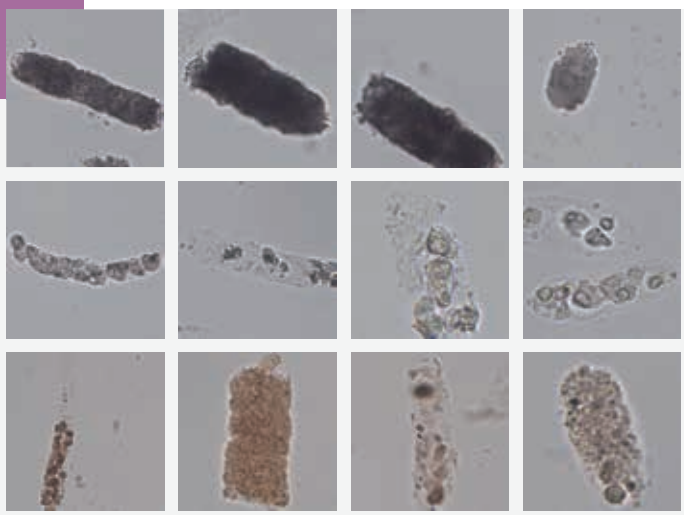
  Indicative of serious renal tubular necrosis or chronic nephron injury. Mostly seen in advanced chronic glomerulonephritis, chronic renal failure, renal amyloidosis, chronic renal allograft rejection, malignant hypertension, etc.





Myoglobin casts

- **Morphology features:**
  Under the microscope, these casts are pale tangerine and hard to be distinguished from amorphous casts.
- **Origins and mechanisms:**
  Myoglobin casts are formed by a large amount of myoglobin in renal tubules due to muscle tissue injury and/or extensive burns.



Other casts

- **Sanguineous casts:**
  These casts are mainly broken erythrocyte fragments of varied size, mostly of sanguine, salmon pink, brown and coffee colors.
- **Renal tubular epithelial casts:**
  These casts are mainly renal tubular epithelial cells, taking up more than 1/3 of the volume of the casts. The casts are separated or tiled up;
- **Bilirubin casts:**
  These casts contain inaurate bilirubin particles or are stained by bilirubin. Under phase contrast microscope, it can be seen that these casts consist of refractive non-crystalline bilirubin particles and low refractive transparent matrix and mucus.

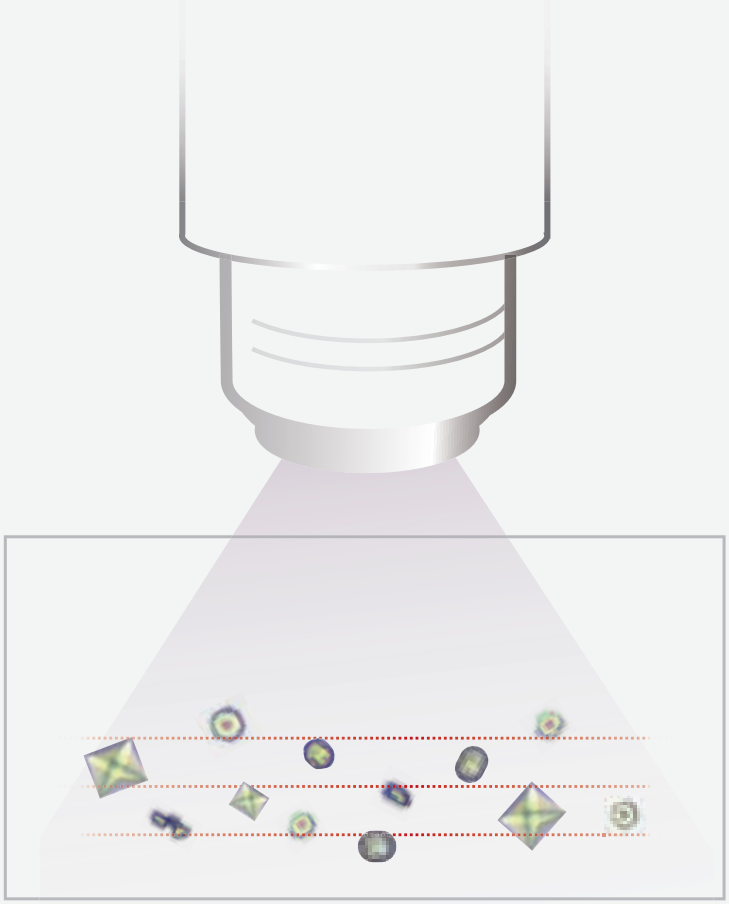
EU 8600

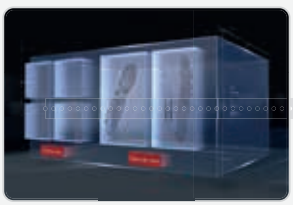
Automatic Urinalysis Processing Line

EU-5600 Pro

Automatic Urinalysis System

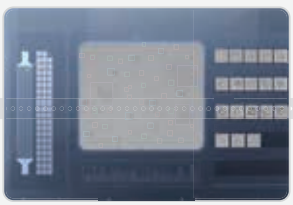






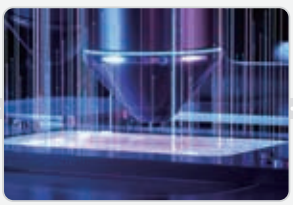
High Clarity

Multi-depth-of-field fusion technology



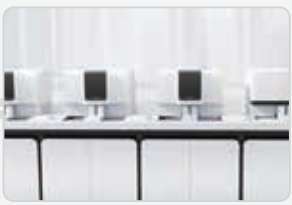
High Volume

Automatic multi-fold counting



High Efficiency

Vibration-proof system



High Accuracy

Multi-agent system



EU 8600



EU-5600 Pro

High efficiency
Flexible configurations to meet various needs with

maximum throughout of 480T/H

EU 8600 1+1 Benchtop design



· 1 Sediment module + 1 Dry chemistry module
· General throughput: 120T/H

EU-5600 Pro All-in-one design



· Hybrid system (Dry chemistry + Sediment)
· General throughput: 100t/h

EU 8600 GT 2+1 Cabinet design



· 2 Sediment module + 1 Dry chemistry module
· General throughput: 240T/H

EU 8600 GT 4+2 Cabinet design



· 4 Sediment module + 2 Dry chemistry module
· General throughput: 480T/H

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