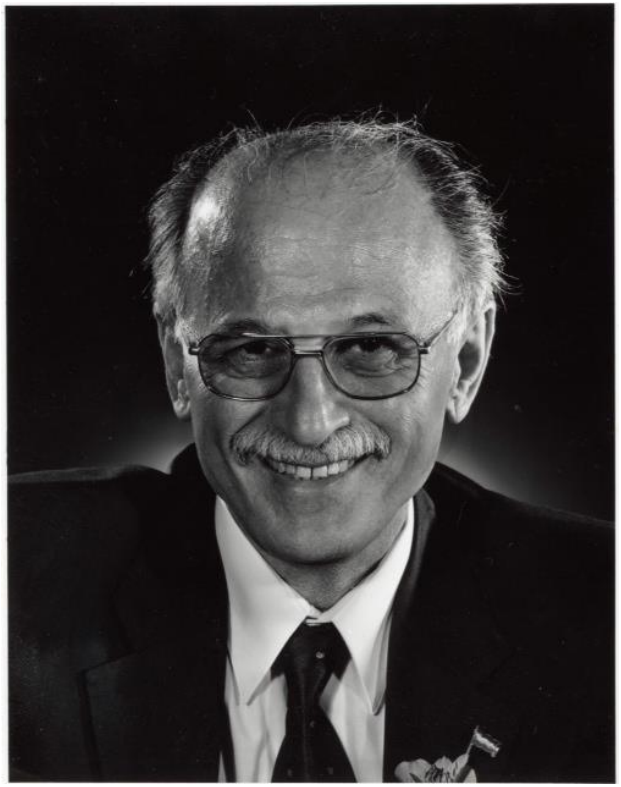
Urinalysis in Medicine



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A poem by Roomi

- I went to a physician(Jorjani) and asked ,
- feel my pulse and do a urinalysis
- Diagnosis was due to retention of toxin

  patient developed madness
- My response was excellent I hope it is so.

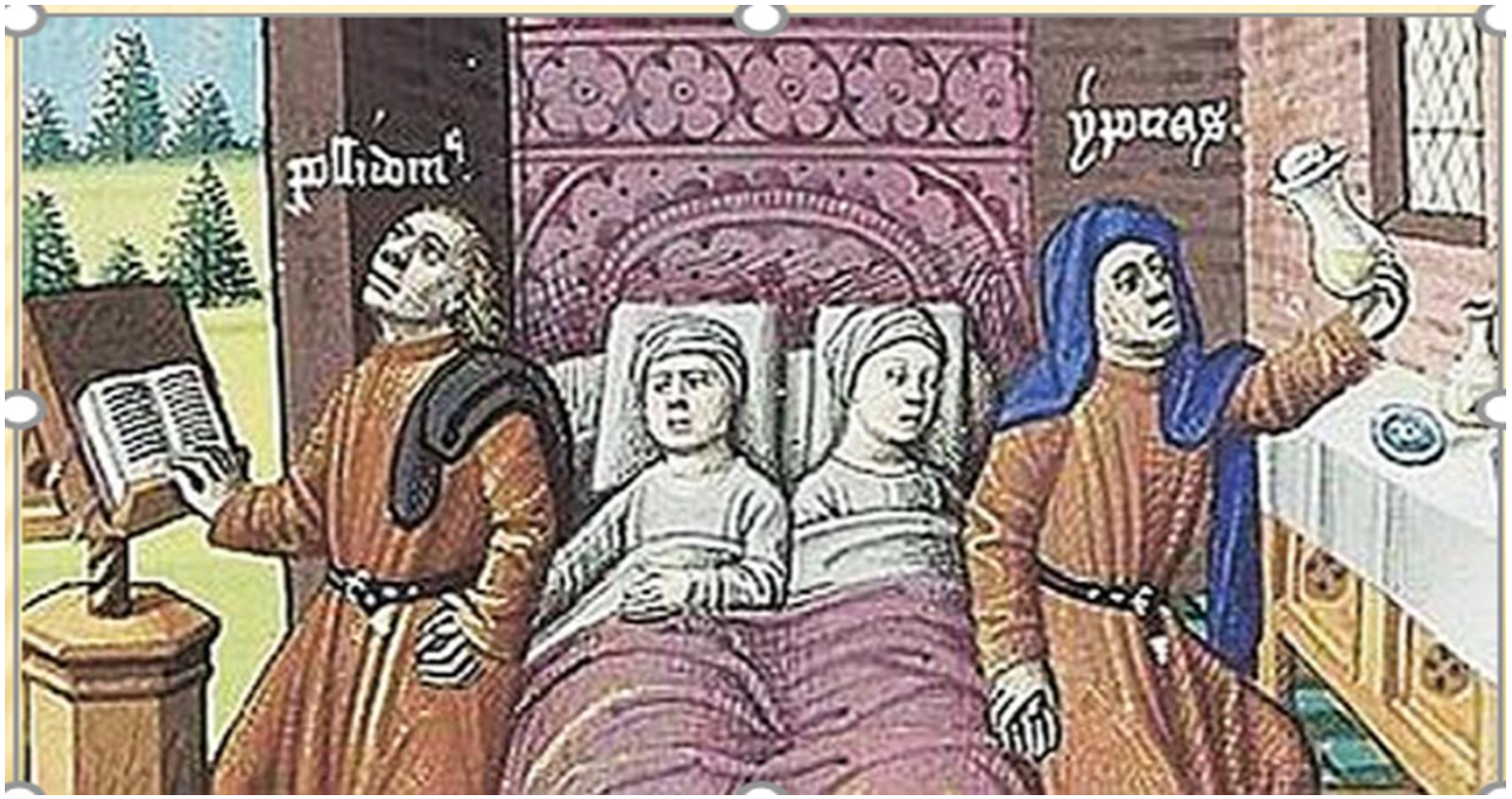
رفتم به طبیب و گفتم ای زین‌الدین

این نبض مرا بگیر و قاروره ببین

گفتا با دست با جنون گشته قرین

گفتم هله تا باد چنین باد چنین

Pee Prophet & Urinoscopy

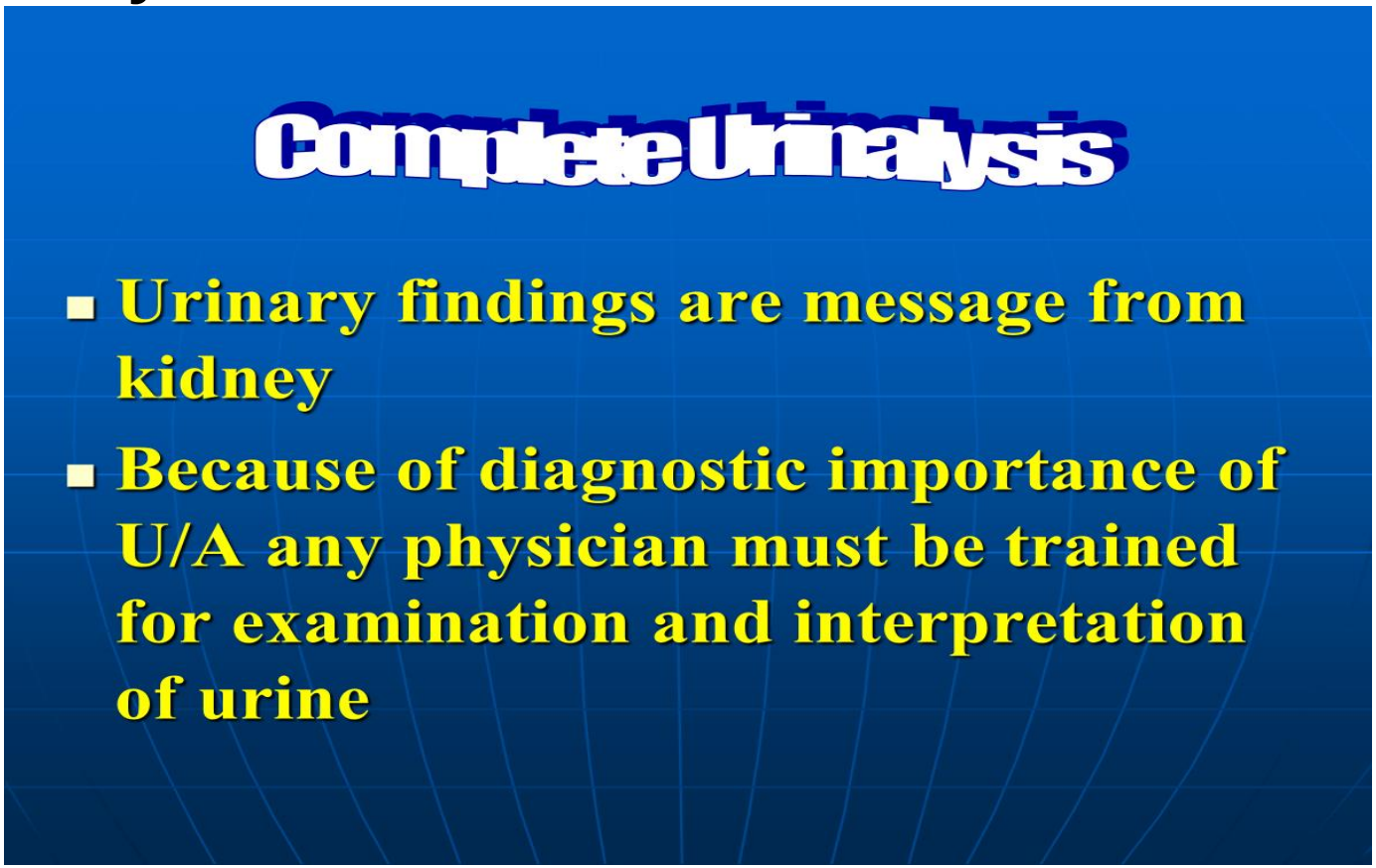


Urine Analysis after History & Physical Examination

- Urinalysis is a basic requirement in diagnosis and management of renal disease and many other diseases. It is cheap and available everywhere.
- Does not have any harm to the patients.
- Does not need advanced equipment.
- Urine has no bacteria or virus is more sterile than tap water.

The reason that I suggested UA

- Why Urinalysis



Introduction

- Urine is formed in the kidneys, is a product of ultrafiltration of plasma by the renal glomeruli & processed by collecting ducts.
- Similarity between urine & tear? Both the production of tears and the passing of urine are under the control of a brain region called the pons.

Collection of urine

- Early morning sample-qualitative
- Random sample- routine
- 24hrs sample- quantitative
- Midstream sample-for infections
- Post prandial sample- in D.M
- Urine should be analyzed as early as possible not later than 2 Hours post void.

Name&

Urine examination

- Macroscopic examination
- Microscopic examination
- Chemical examination
- Dipstick which is highly specific but not very sensitive for proteinuria.
- Hydrogen Ion Concentration , Urinary Ph.
- Osmolality. Freezing point & osmoreceptor .

Macroscopic examination

- Volume
- Color
- Odor
- Reaction or urinary pH
- Specific gravity & Osmolality
- Touch and taste!?

Urinary volume need document

- Usually = 600-1550ml
- ***Polyuria-*** >2000ml
- ***Oliguria-***<400ml
- ***Anuria-***complete cessation of urine(<200ml)
- ***Nocturia-***excretion of urine by an adult of >500ml with a specific gravity of <1.018 at night (indicative of chronic renal disease)
- ***No urine at all indicate Obstructive outlet.***

Causes of polyuria

- Diabetes mellitus
- Diabetes insipidus
- Polycystic kidney
- Chronic renal failure(Diabetes Insipidus)
- Diuretics
- Intravenous saline/glucose

oliguria

- Dehydration
  - Vomiting
  - diarrhea
  - excessive sweating
- Renal ischemia
- Acute tubular necrosis
- Obstruction to the urinary tract
- Acute renal failure

Color & appearance

- Normal= clear & pale yellow

1. Colorless- dilution, diabetes mellitus, diabetes insipidus, diuretics
2. Milky-purulent genitourinary tract infection, chyluria
3. Orange-fever, excessive sweating
4. Red-due to beetroot ingestion, hematuria
5. Brown/ black- alkaptonuria, Melanin

Urinary pH/ reaction

- Reaction reflects ability of kidney to maintain normal hydrogen ion concentration in plasma & ECF
- Normal= 4.6-8
- Tested by- 1. Litmus paper
  2. pH paper
  3. dipsticks

Acidic urine

- Ketosis-diabetes, starvation, fever
- Systemic acidosis
- UTI- E.coli
- Acidification therapy

Alkaline urine

- Strict vegetarian
- Systemic alkalosis
- UTI- Proteus
- Alkalization therapy

Odor

- Normal= aromatic due to the volatile fatty acids
- Ammoniac – bacterial action or old urine Urea dissolve and release Ammoniac.
- Fruity- ketonuria

Specific gravity

- Depends on the concentration of various solutes in the urine.
- Measured by-urinometer

  - refractometer

  - dipsticks

High specific gravity(hyperosthenuria)

- Normal-1.016-1.022
- Causes

All causes of oliguria

Glycosuria

iodinated radiocontrast agents in urine

Low specific gravity(hyposthenuria)

- All causes of polyuria except glycosuria

- *Fixed specific gravity (isosthenuria)=1.010*

Seen in chronic renal disease when kidney has lost the ability to concentrate or dilute

Chemical examination

- Proteins
- Sugars
- Ketone bodies
- Bilirubin
- Bile salts
- Urobilinogen
- Blood

Causes of proteinuria

Prerenal causes of proteinuria-Heavy exercise, fever, hypertension, multiple myeloma, eclampsia

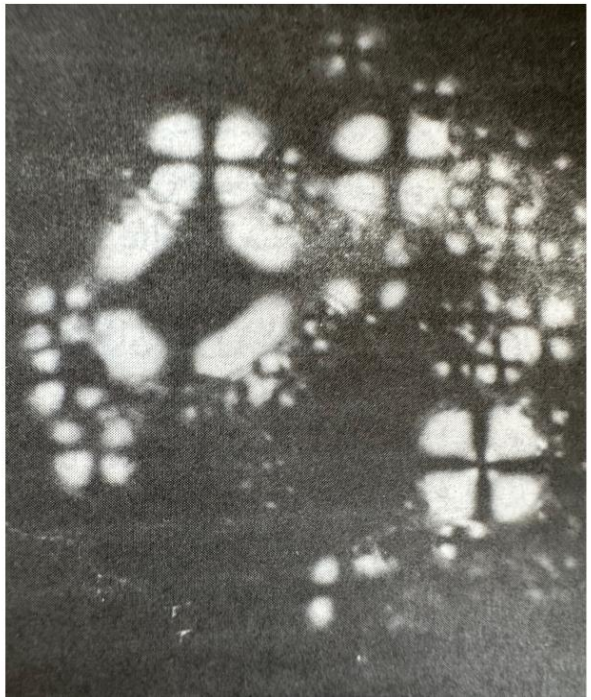
- Renal –acute & chronic glomerulonephritis, Renal tubular dysfunction, Polycystic kidney, nephrotic syndrome
- Post renal- acute & chronic cystitis, tuberculosis
- The most harmful heavy metals for the kidney are lead, mercury, cadmium, and arsenic.
- False positive proteinuria following iodinated radiocontrast agents and antibiotics such as Cephalosporines and Co-Trimoxazole.

Different type of proteinuria

- Selective proteinuria
- Nonselective proteinuria
- Protein in the urine can be detected by dipstick which is highly specific but not very sensitive, positive if Albumin excretion exceeds 300 to 500mgm/day .
- Lipid urea, indicate heavy proteinuria evidenced by oval fat bodies and Maltese Cross.

Suggestive of heavy proteinuria

- Maltese Cross



microalbuminuria

- The level of albumin protein produced by microalbuminuria cannot be detected by urine dipstick methods. In a properly functioning body, albumin is not normally present in urine because it is retained in the bloodstream by the kidneys. Microalbuminuria is diagnosed from a 24-hour urine collection. the rate of urine albumin excretion (UAE) in microalbuminuria is 30 to 300 mg/d.

Significance of microalbuminuria

- an indicator of subclinical cardiovascular disease
- an important prognostic marker for kidney disease
- in diabetes mellitus
- in hypertension
- increasing microalbuminuria during the first 48 hours after admission to an intensive care unit predicts elevated risk for acute respiratory failure , multiple organ failure , and overall mortality

Bence Jones proteins

- These are light chain globulins seen in multiple myeloma, Polycystic, lymphoma.
- Test- Thermal method:

Bence Jones ***Proteins has unusual property of precipitating at 40^0 -60^0c & then dissolving when the urine is brought to boiling(100^0c) & reappears when the urine is cooled.***

Causes of glycosuria

- ***Glycosuria with hyperglycemia***- diabetes, acromegaly, Cushing's disease, hyperthyroidism, drugs like corticosteroids.
- ***Glycosuria without hyperglycemia***- renal tubular dysfunction, occasionally pregnancy induced glycosuria.

Ketone bodies

- 3 types
  - Acetone
  - Acetoacetic acid
  - β-hydroxy butyric acid

  - They are products of fat metabolism

Causes of ketonuria

- Diabetes
- Non-diabetic causes- high fever, starvation, severe vomiting/diarrhea
- Hunger strike

Bilirubin

- **Test**- Fouchet's test.
- **Causes**
  - Liver diseases-injury, hepatitis
  - Obstruction to biliary tract

Urobilinogen

- Test- Ehrlich test
- Causes are hemolytic anemia's

- Bile salts-

Hay’s test detect bile salt in urine

Cause- obstruction to bile flow (obstructive jaundice)

Blood in urine

- **Test**- BENZIDINE TEST
- **Principle**-The peroxidase activity of hemoglobin decomposes hydrogen peroxide releasing nascent oxygen which in turn oxidizes benzidine to give blue color.
- **Method**- mix 2ml of benzidine solution with 2ml of hydrogen peroxide in a test tube. Take 2ml of urine & add 2ml of above mixture. A blue color indicates + reaction.

Contents of normal urine m/s

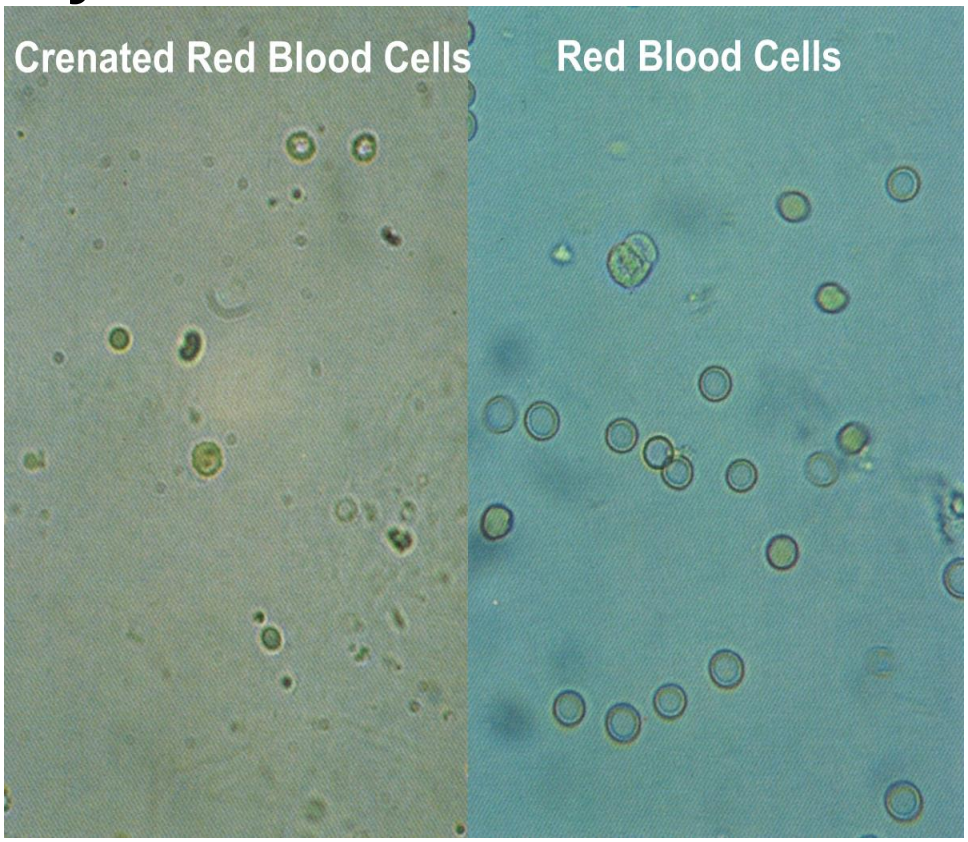
- Contains few epithelial cells, occasional RBC's (less than 4 RBCs/Hpf), few crystal. Important question is history of anticoagulation drugs.
- Transient hematuria in young patients is fairly common and is typically benign
- Occasional few Hyaline Cast.

Microscopic examination

- Microscopic urinalysis is done simply pouring the urine sample into a test tube and centrifuging it (spinning it down in a machine) for a few minutes. The top liquid part (the supernatant) is discarded. The solid part left in the bottom of the test tube (the urine sediment) is mixed with the remaining drop of urine in the test tube and one drop is analyzed under a microscope

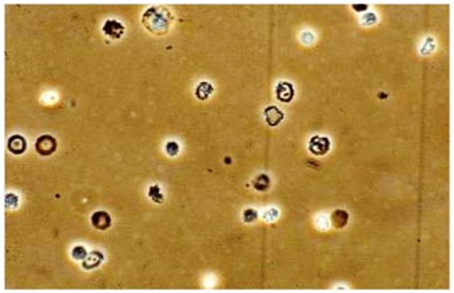
Shape of Red Blood cells in U/A

- Acanthocyte

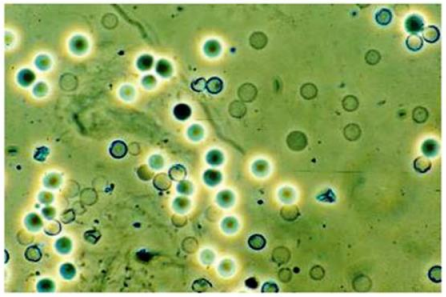


Normal RBC Dysmorphic RBC

- Crenated RBC



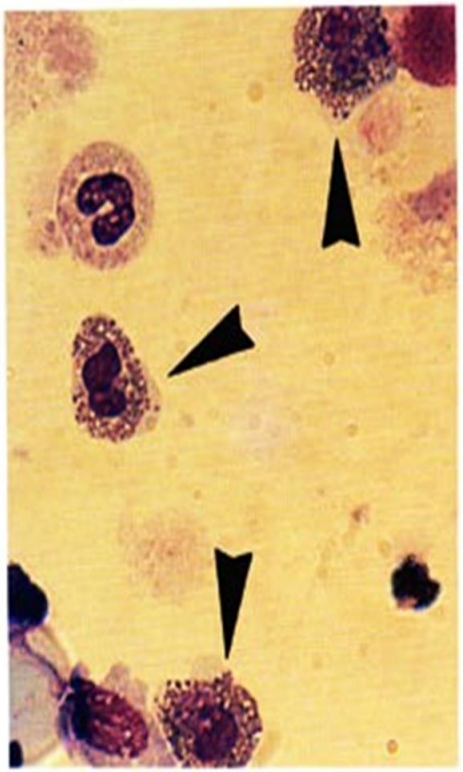
GLOMERULAR OR DYSMORPHIC ERYTHROCYTES



NON GLOMERULAR OR ISOMORPHIC ERYTHROCYTES

Eosinophils in Urinalysis

- Eosinophils



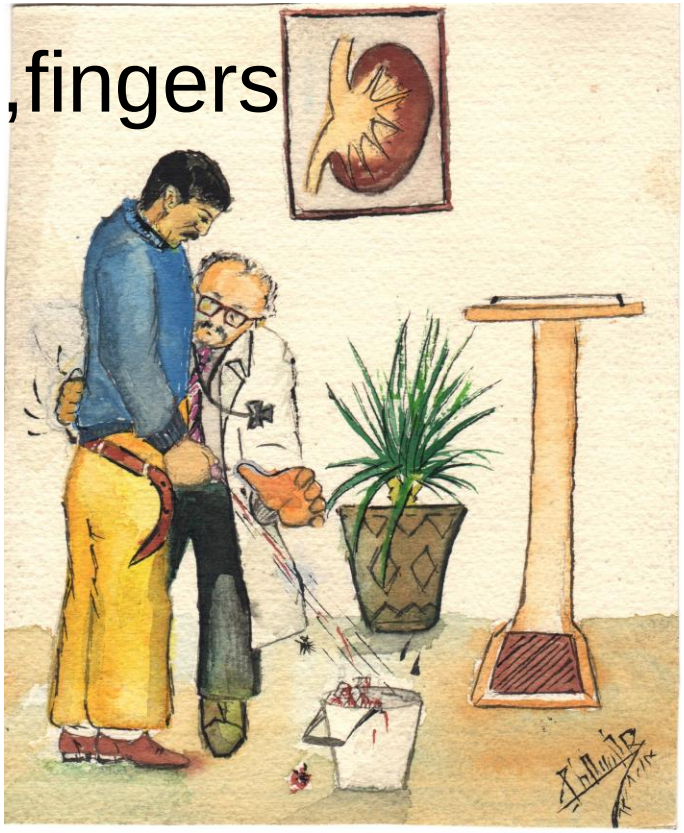
EOSINOPHILS (BY MGG)

Causes of hematuria

- **Pre renal**- bleeding diathesis, hemoglobinopathies, malignant hypertension.
- **Renal**- trauma, calculi, acute & chronic glomerulonephritis, renal TB, renal tumors
- **Post renal** – severe UTI, calculi, trauma, tumors of urinary tract
- Factitious Hematuria- Munchausen syndrome need direct observation,

Direct observation for factitious

Observe ,fingers

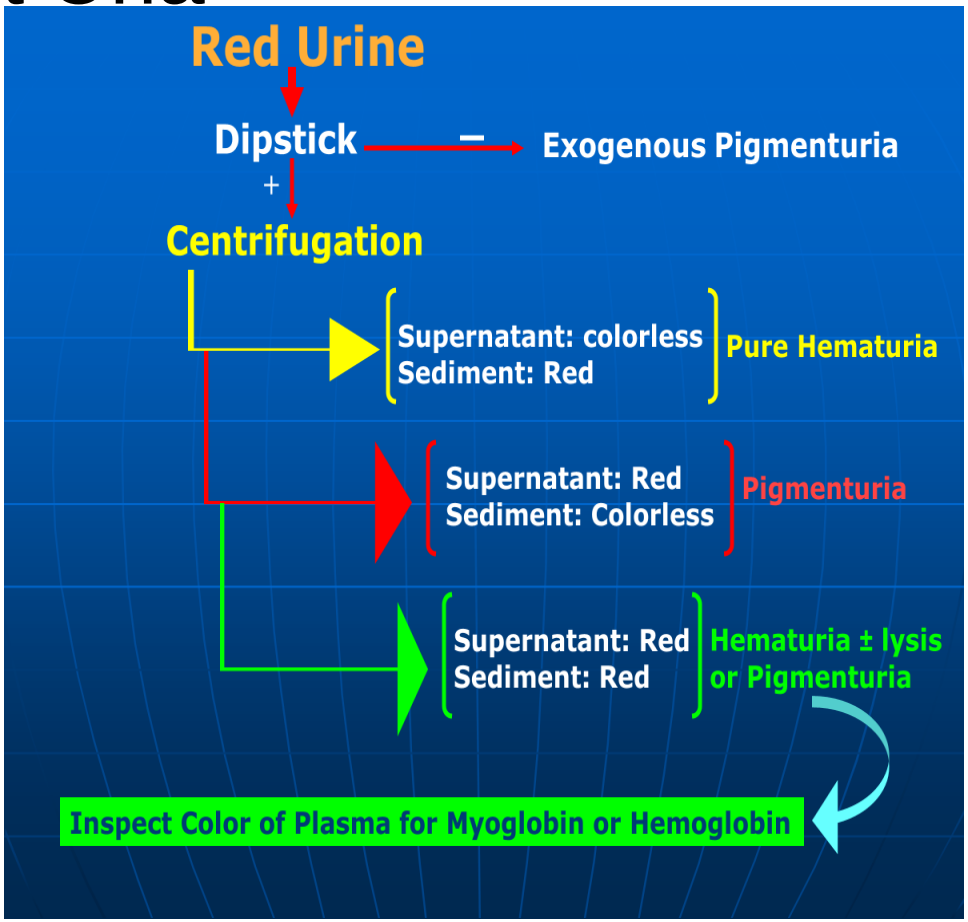


Compare plasma with urine

	Plasma color	Urine color
Hematuria	normal	Smoky red m/s-plenty of RBC's
hemoglobinuria	Pink, haptoglobin reduced	Red , occasional RBC's
Myoglobinuria	Pink, normal haptoglobin	Red, occasional RBC's

Red Urine due to pigment uria

- Pigment Uria



Crystals in urine

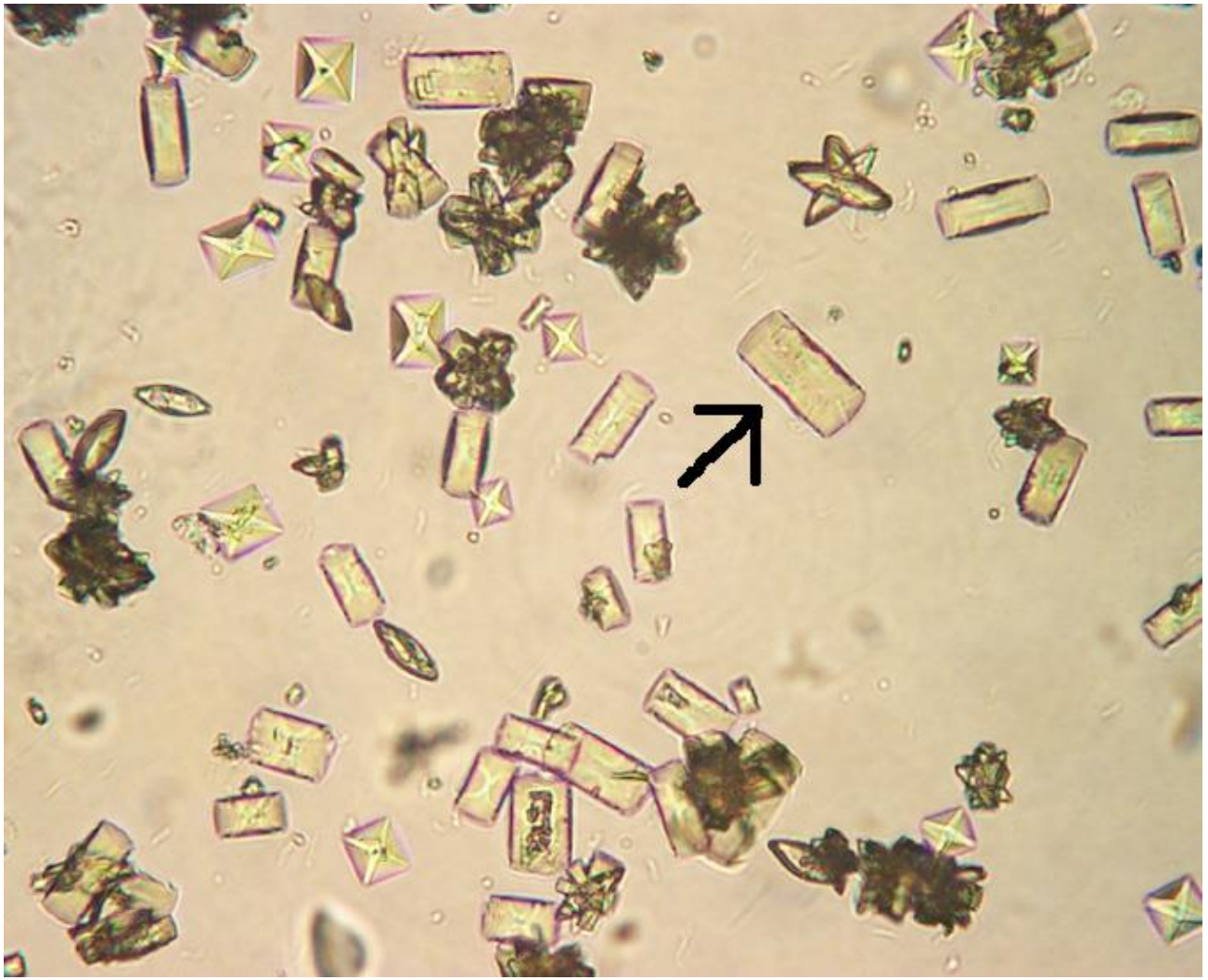
Crystals in acidic urine

- Uric acid
- Calcium oxalate
- Cystine
- Leucine

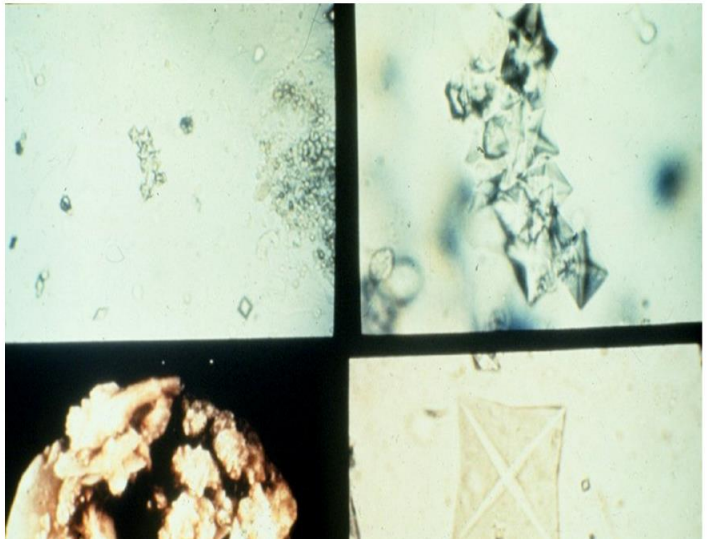
Crystals in alkaline urine

- Ammonium magnesium phosphates(triple phosphate crystals)
- Calcium carbonate

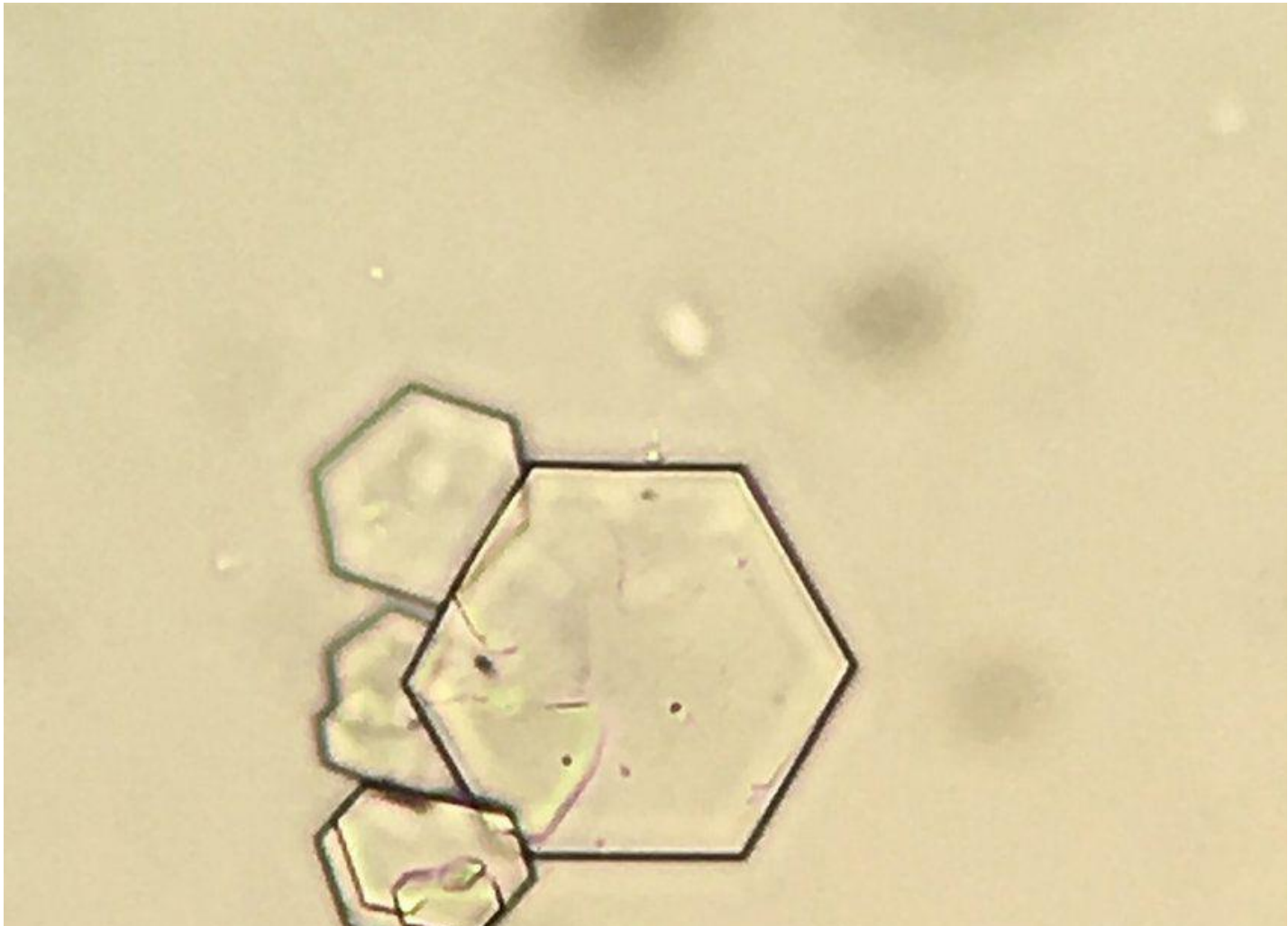
crystals



Calcium oxalate crystals

- Calcium Oxalate Cristal
  - 

Cystine Crystals

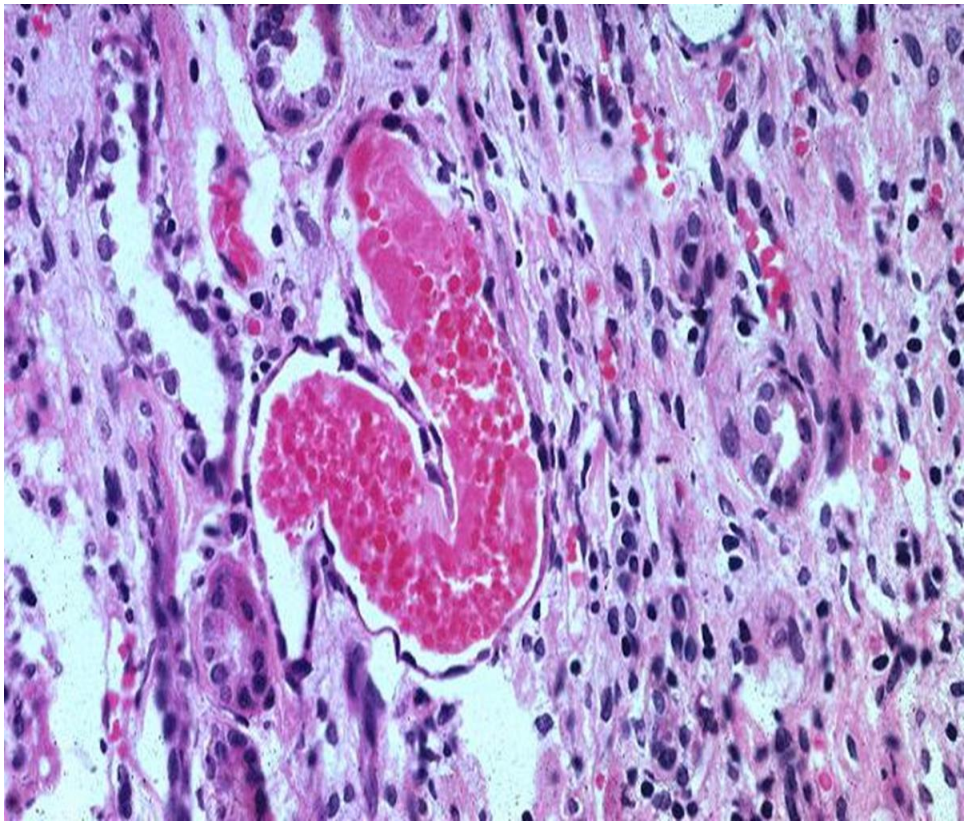


casts

- **Urinary casts** are cylindrical aggregations of particles that form in the distal nephron, dislodge, and pass into the urine. In urinalysis casts **indicate kidney disease**. Casts form via precipitation of Tamm-Horsfall mucoprotein which is secreted by renal tubule cells.

Formation of casts in kidney

- Renal Tubule



Types of casts

- **Acellular casts**

Hyaline casts

Granular casts

Waxy casts

Fatty casts

Pigment casts

Crystal casts

- **Cellular casts**

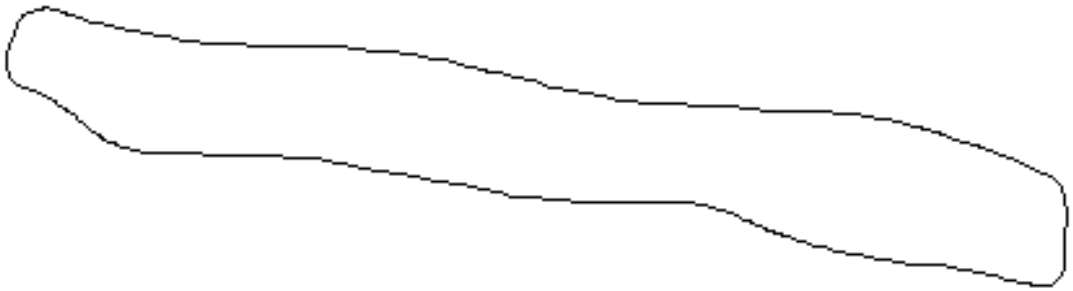
Red cell casts

White cell casts

Epithelial cell cast

Hyaline casts

- The most common type of cast, hyaline casts are solidified Tamm-Horsfall mucoprotein secreted from the tubular epithelial cells
- Are only slightly more refractile than water, with diuretic therapy up to 10 hyaline casts per high power field may occur in healthy individuals.
- Seen in fever, strenuous exercise, damage to the glomerular capillary



Hyaline Cast

Crystal casts

- Crystallized urinary solutes, such as oxalates, urates, or sulfonamides, may become enmeshed within a hyaline cast during its formation.
- The clinical significance of this occurrence is not felt to be great.

Granular casts

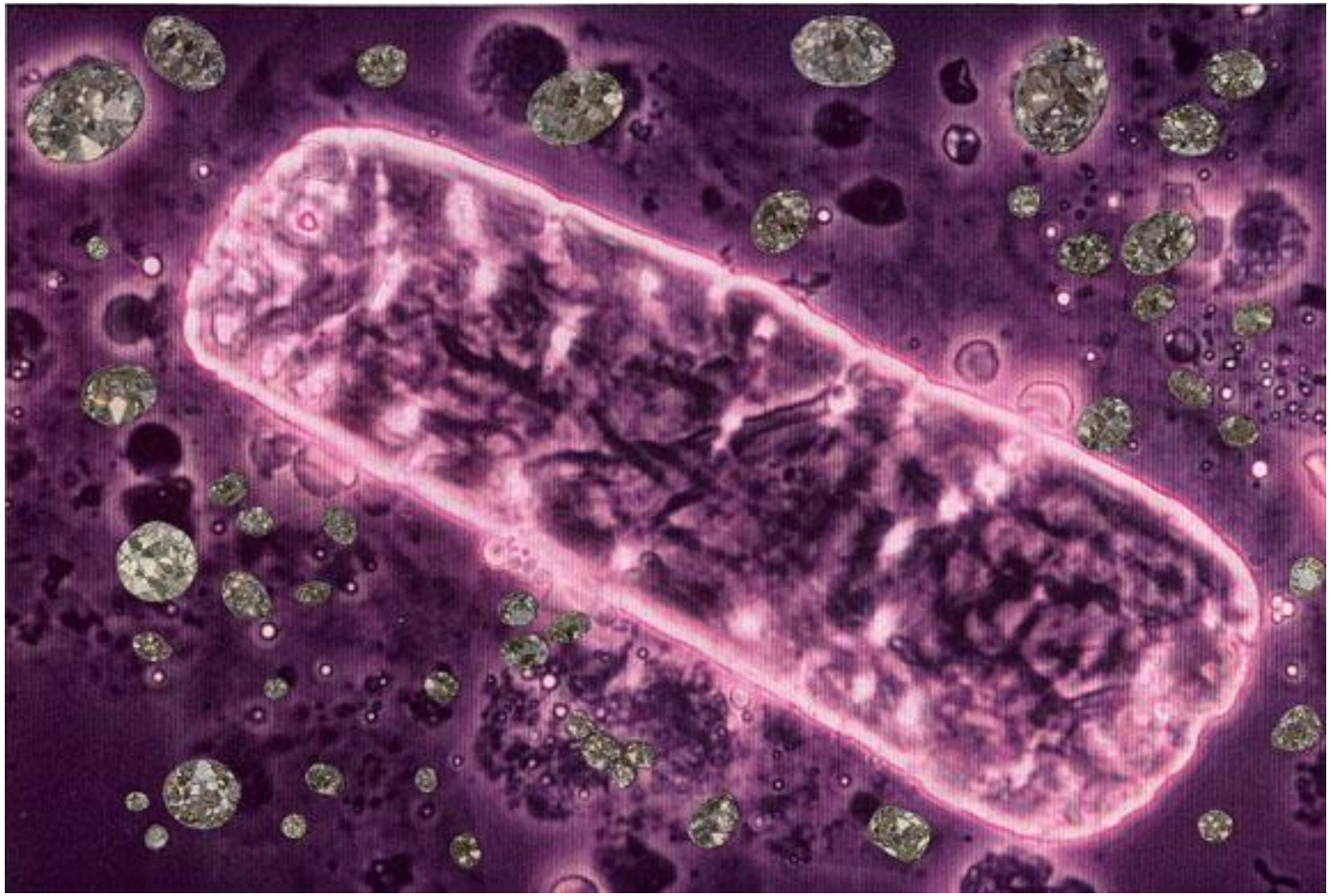
- Granular casts can result either from the breakdown of cellular casts or the inclusion of aggregates of plasma proteins (e.g., albumin) or immunoglobulin light chains
- indicative of chronic renal disease

Granular Cast

Waxy casts

- waxy casts suggest **severe, longstanding kidney disease** progressed to renal failure(end stage renal disease).
- Waxy cast are thought to be the last stage of degeneration of granular cast.
- Oval Fat bodies indicate heavy proteinuria

Waxy casts

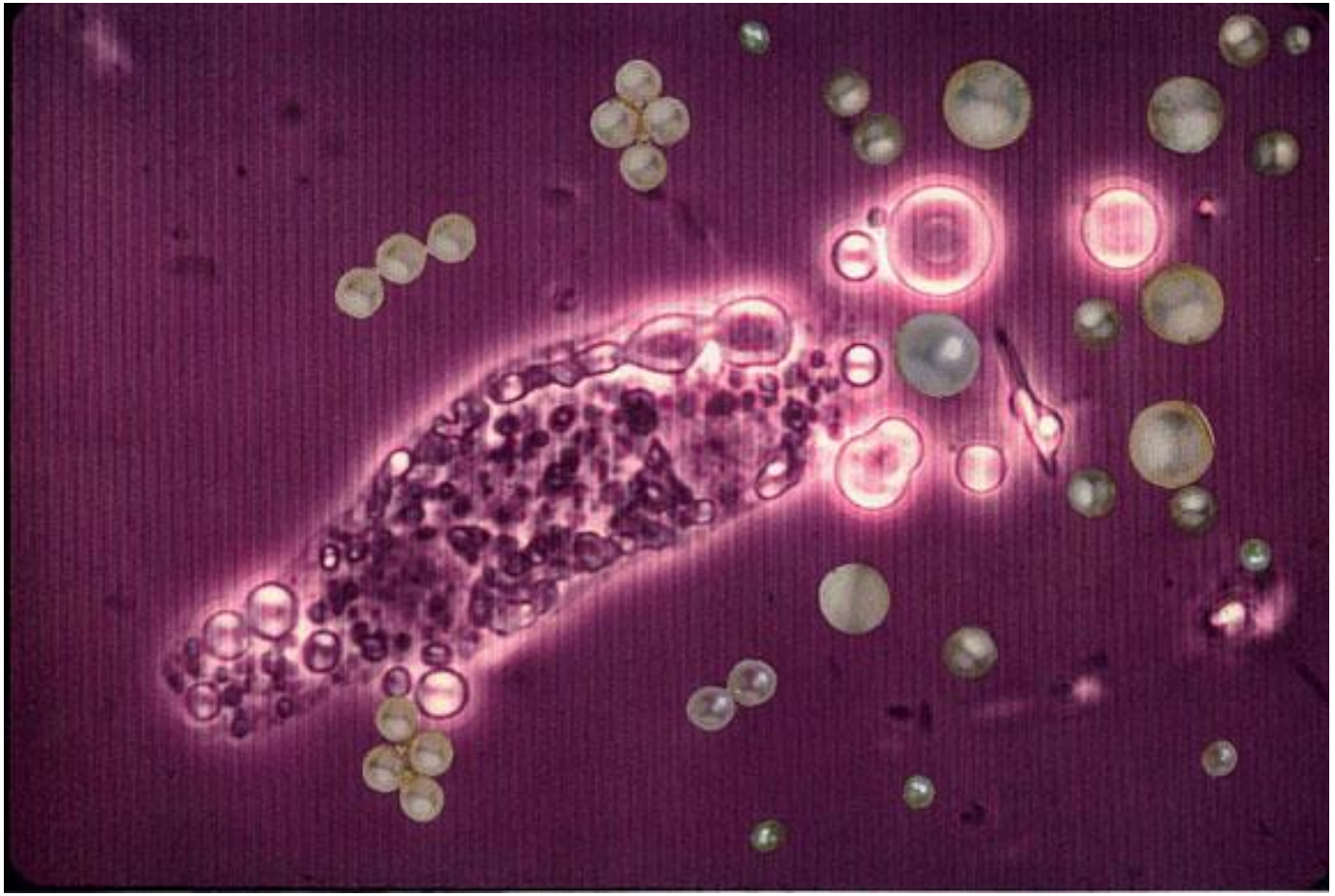


Fatty casts

- Formed by the breakdown of lipid-rich epithelial cells, these are hyaline casts with fat globule inclusions

  Fatty casts can be present in various disorders, including
- Nephrotic syndrome,
- Diabetic or lupus nephropathy,
- Membranous nephropathy

Fatty casts



Under Polarize light

- Fatty Cast

Maltese Cross

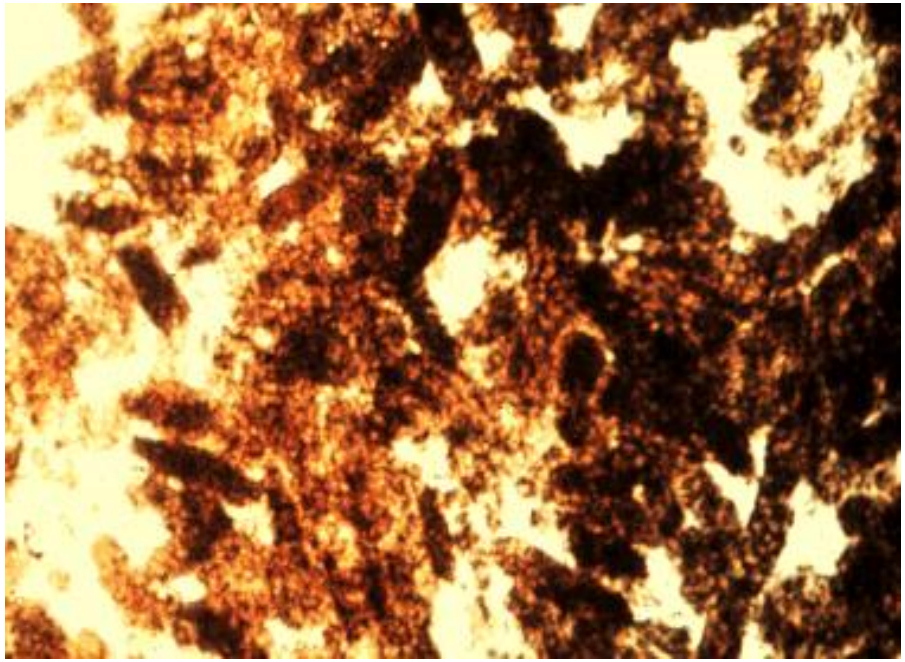
- Fat Body

Pigment casts

- Formed by the adhesion of metabolic breakdown products or drug pigments
- Pigments include those produced endogenously, such as
- hemoglobin in hemolytic anemia,
- myoglobin in rhabdomyolysis, and
- bilirubin in liver disease.

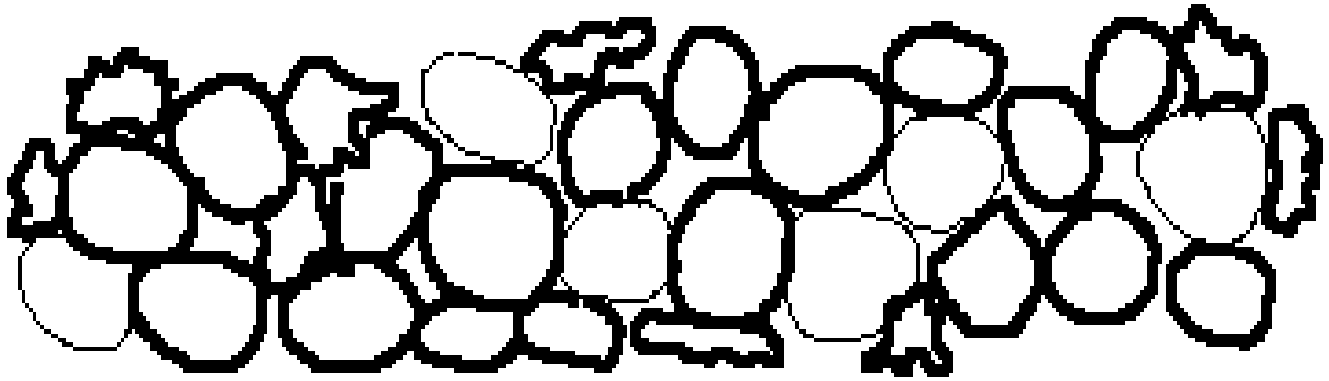
Cast in Acute Renal Failure

- Muddy brown granular Cast

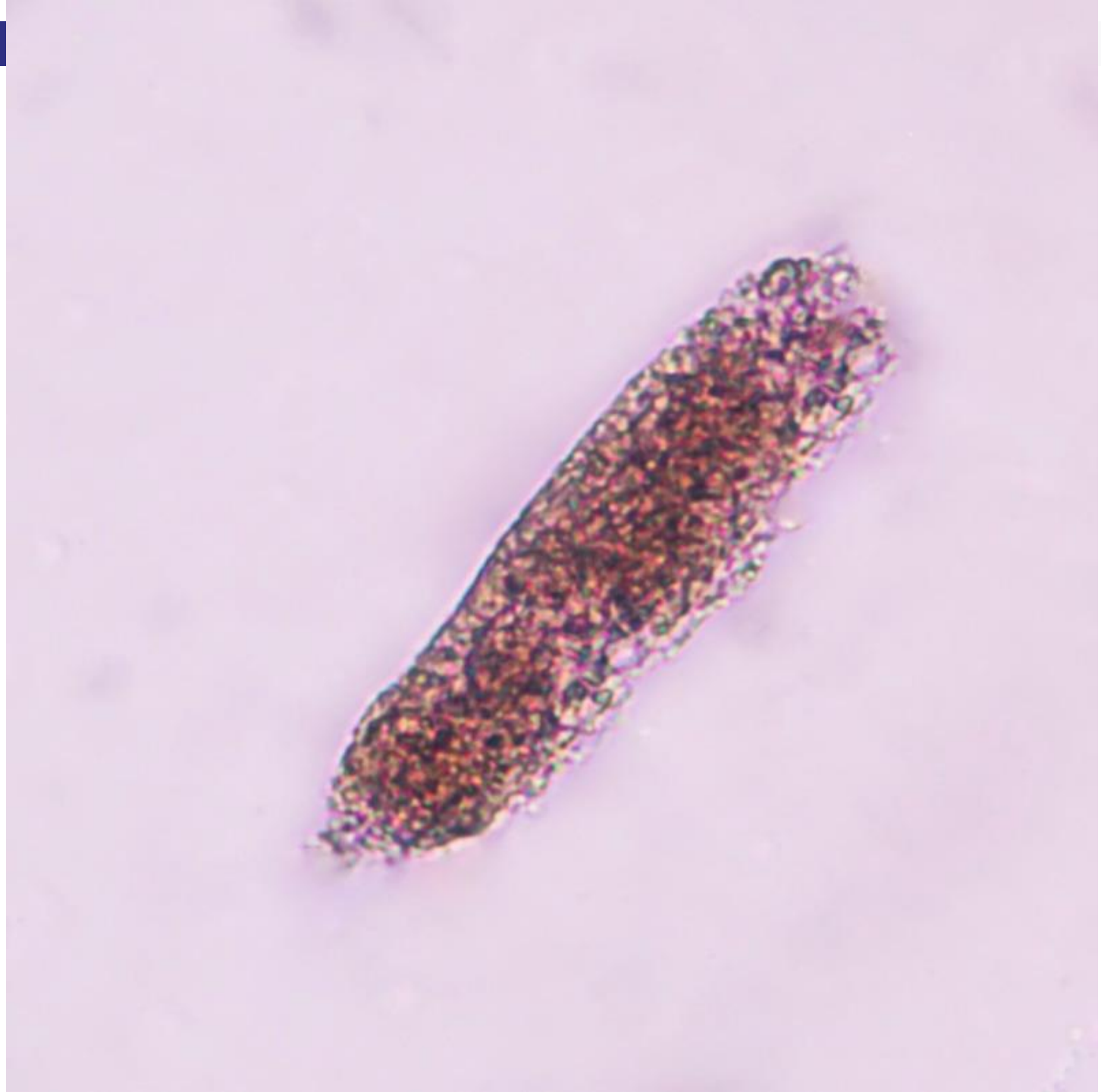


Red cell casts

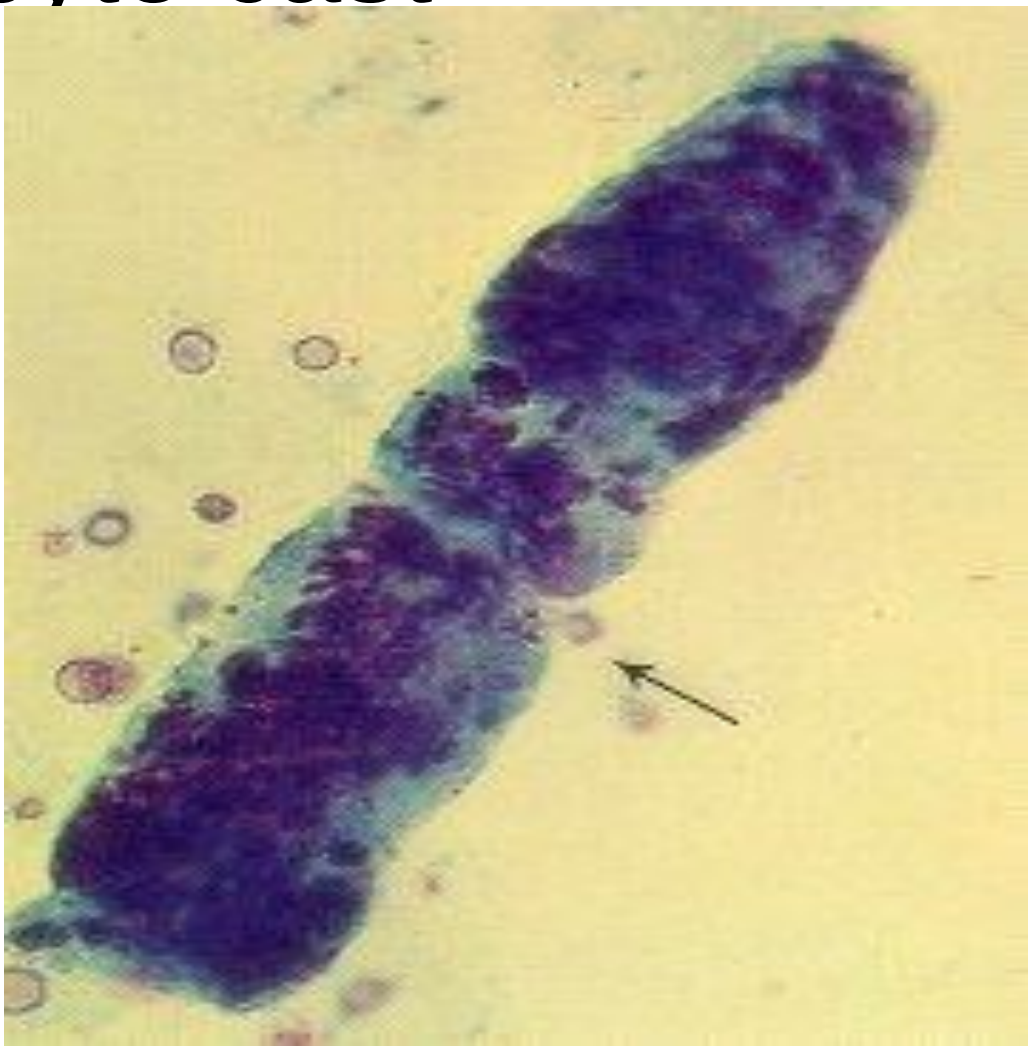
- The presence of red blood cells within the cast is always pathologic, and is strongly indicative of ***glomerular damage.***
- They are usually associated with nephritic syndromes.Even one RBC cast is Diagnostic
- Along with RBC cast usually red cells have a dysmorphic appearance .This changes in morphology is manifested by budding, blebs, and segmental loss of membrane.



Red Blood Cell Cast



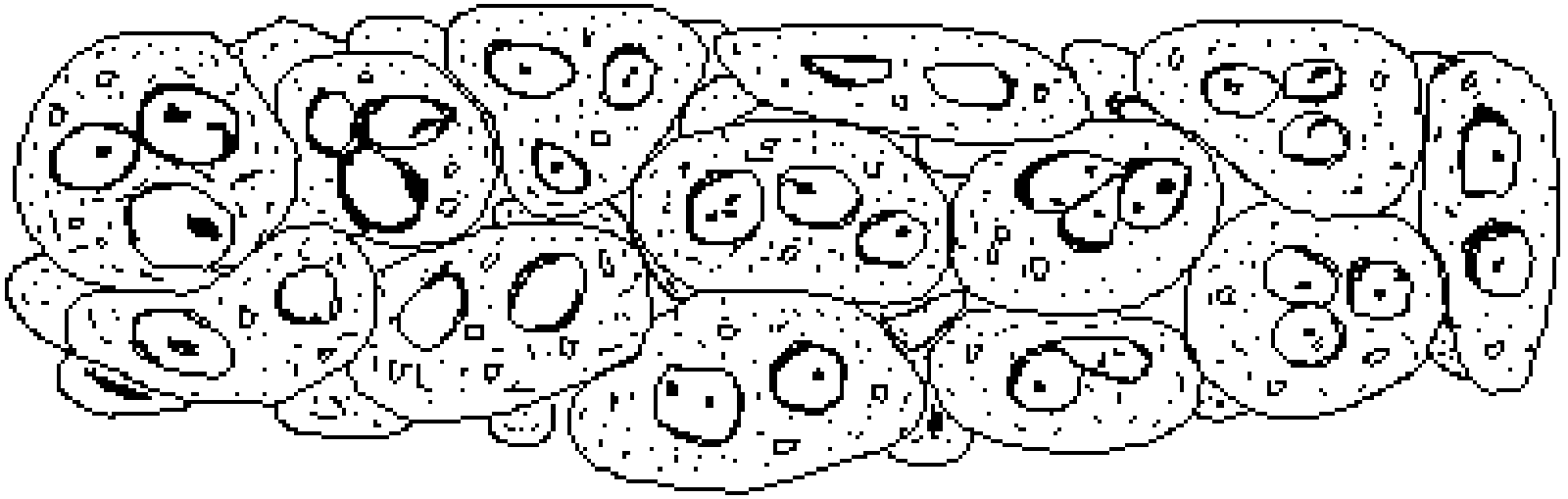
Erythrocyte cast



White blood cell casts

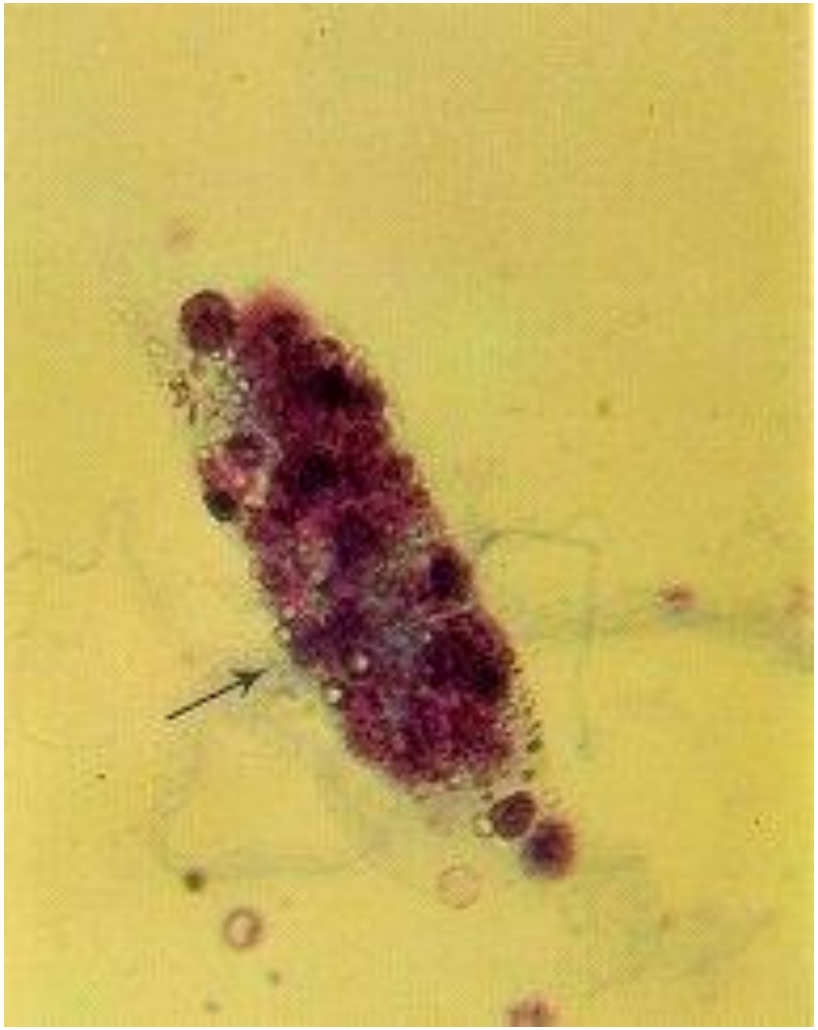
- Indicative of inflammation or infection,
- pyelonephritis along with Pyuria.

- acute allergic interstitial nephritis,
- nephrotic syndrome, or
- acute post-streptococcal glomerulonephritis



White Blood Cell Cast

Leucocyte cast



Epithelial casts

- This cast is formed by inclusion or adhesion of desquamated epithelial cells of the tubule lining. Renal tubular cells are 1.5 to 3 times larger than white cells.

These can be seen in

- acute tubular necrosis and
- toxic ingestion, such as from mercury, diethylene glycol, or NSAID,salicylate.

Dipsticks' Advantages & Disadvantages

- The main advantage of dipsticks is that they are

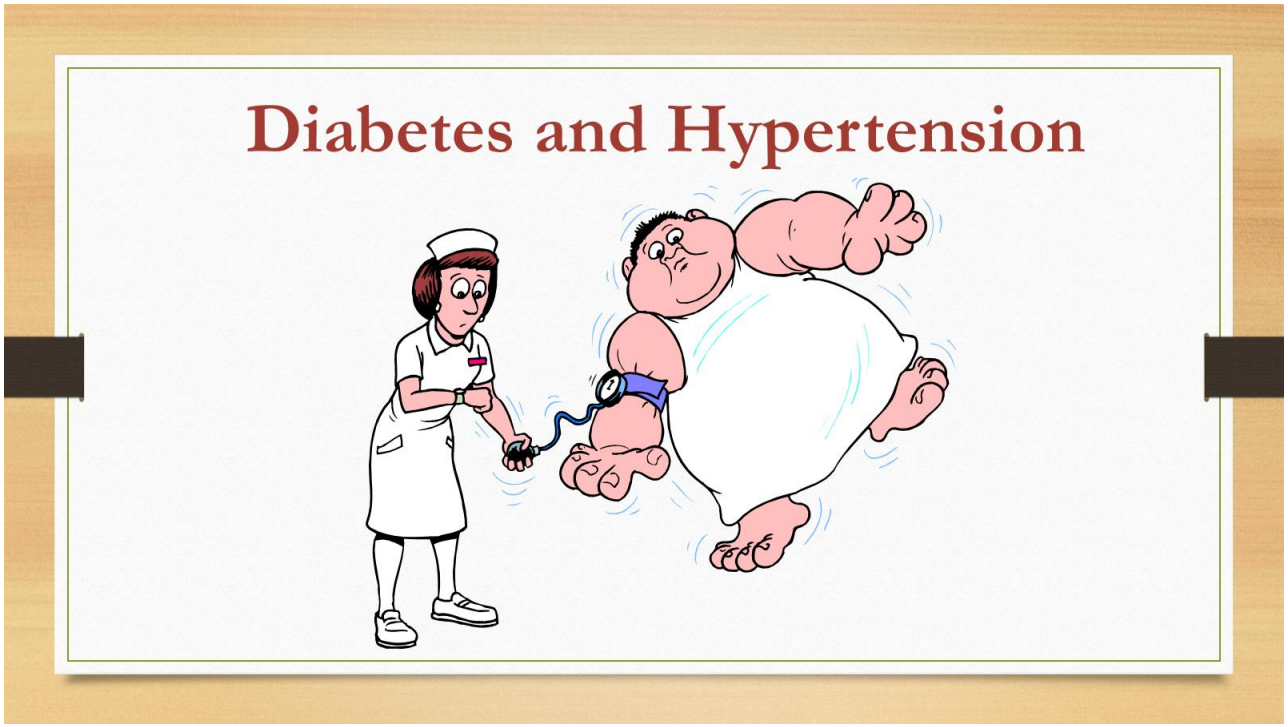
1. convenient,
2. easy to interpret,
3. and cost-effective

The main disadvantage of Dip.

The main disadvantage is that the

1. Information may not be very accurate as the test is time-sensitive.
2. It also provides limited information about the urine as it is a qualitative test and not a quantitative test (for example, it does not give a precise measure of the quantity of abnormality).

Urinalysis is the first step in:

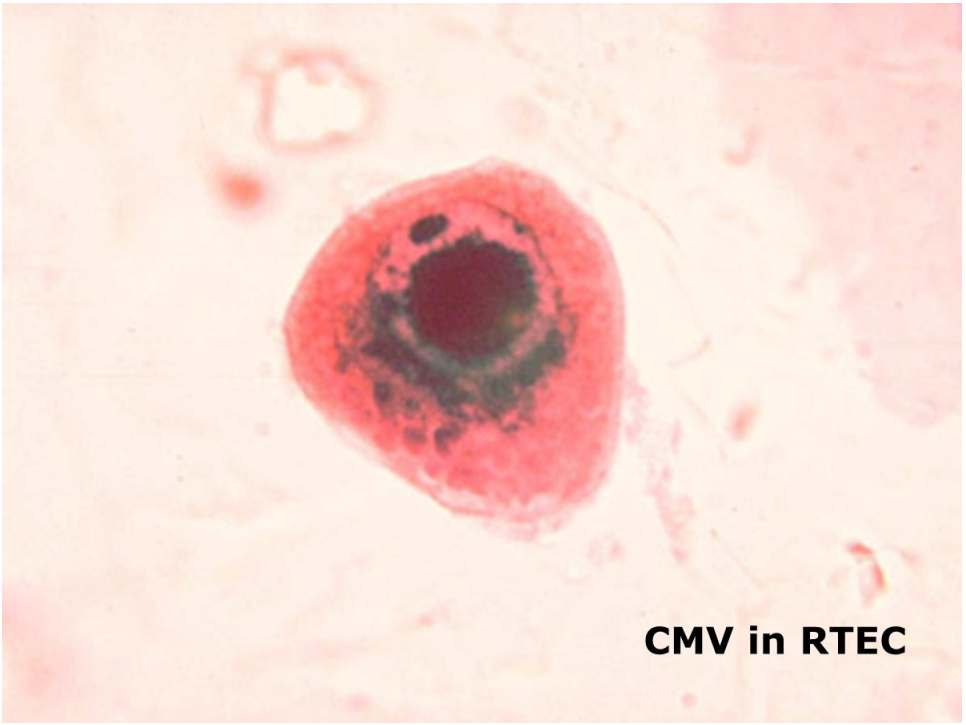


Urinary Enzymes

- N-acetyl-β-d-glucosaminidase (NAG,) is a high molecular weight lysosomal enzyme found in many tissues of the body damage NAG cannot pass into glomerular ultrafiltrate due to its high molecular Wt. Thus, urinary NAG is of renal origin.. Other urinary enzymes such as ALT, AST, and ALP are also sensitive indicators of kidney parenchymal damage compared to functional measurements. Urinary NAG remains the most widely used marker of

Urine in diagnosis of CMV

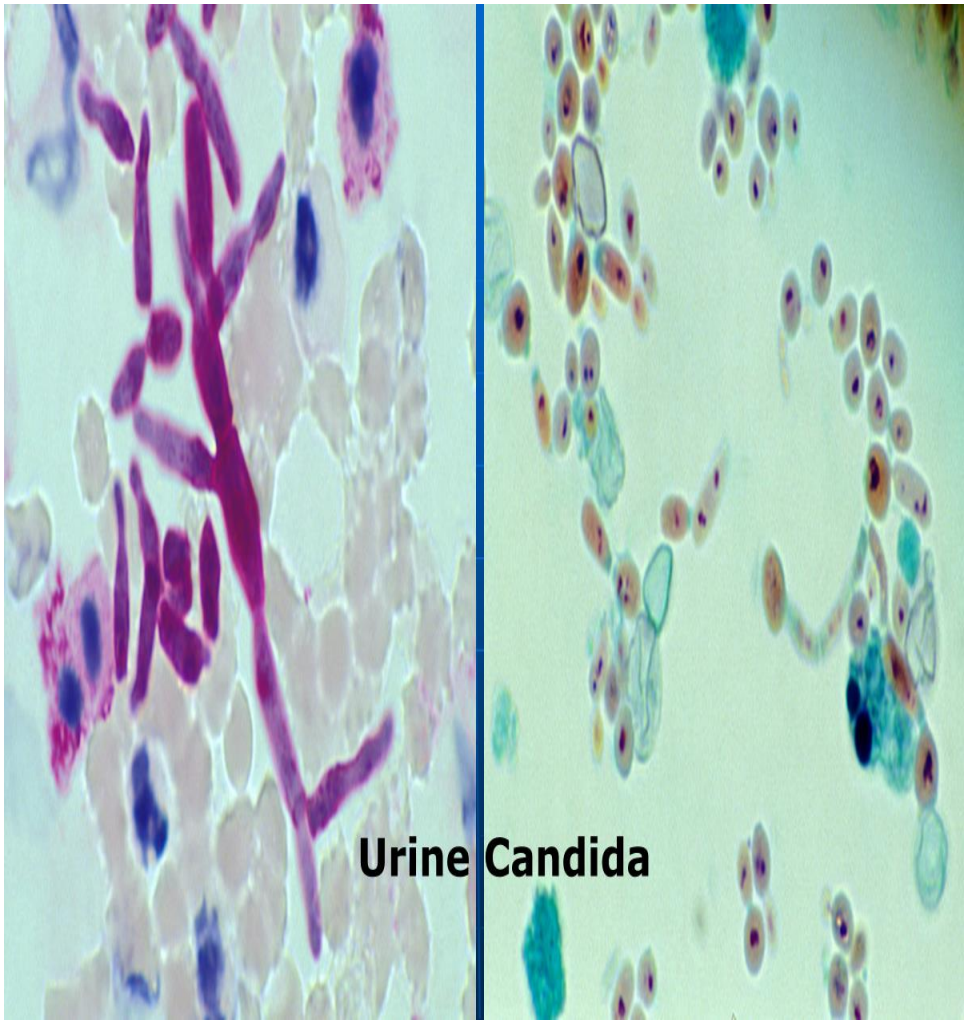
- Fever in Tx. Patients.



Urinary NAG in renal transplant

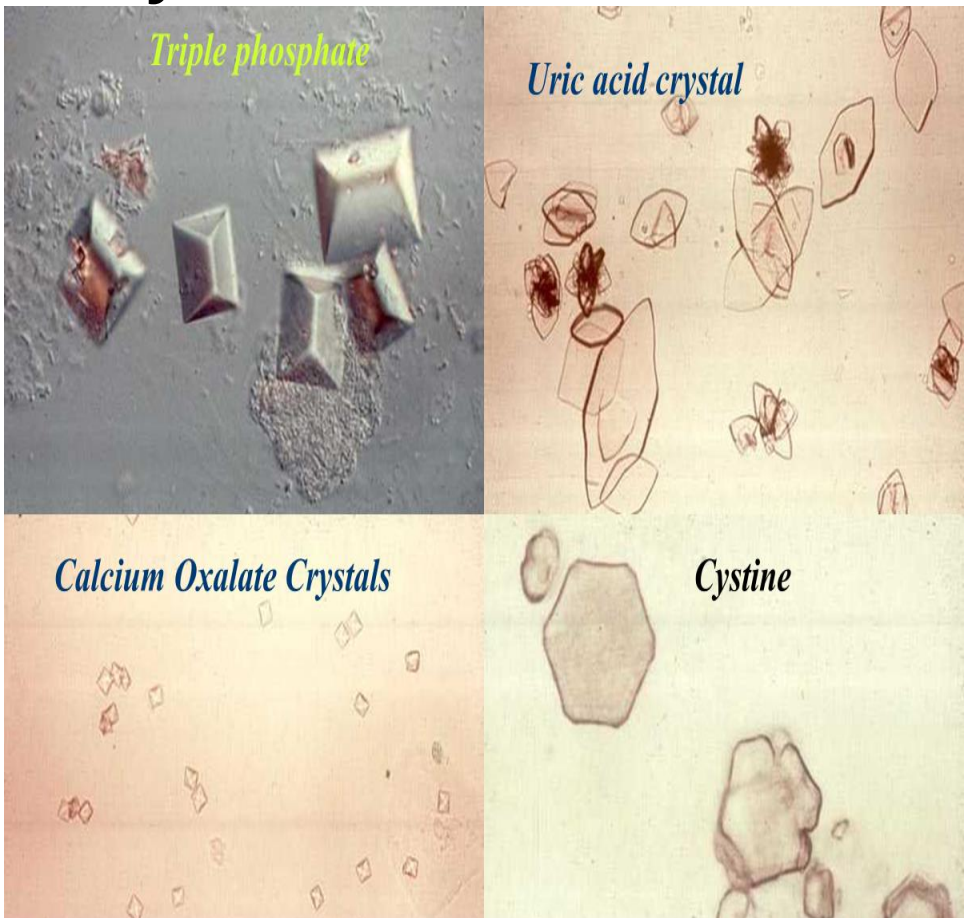
- NAG remains the most widely used marker of renal tubular impairment. three early kidney damage biomarkers. (N-acetyl-d-glucosaminidase, NAG; neutrophil gelatinase-associated lipocalin, NGAL;and kidney injury molecule-1,KIM-1) Increase of these enzymes are reliable indication of tissue injury in Renal Tx.

urine in female patients



Crystaluria

- Different Crystals



Death and physician

The End of Presentation

The end of presentation

- Urinalysis