Urinalysis

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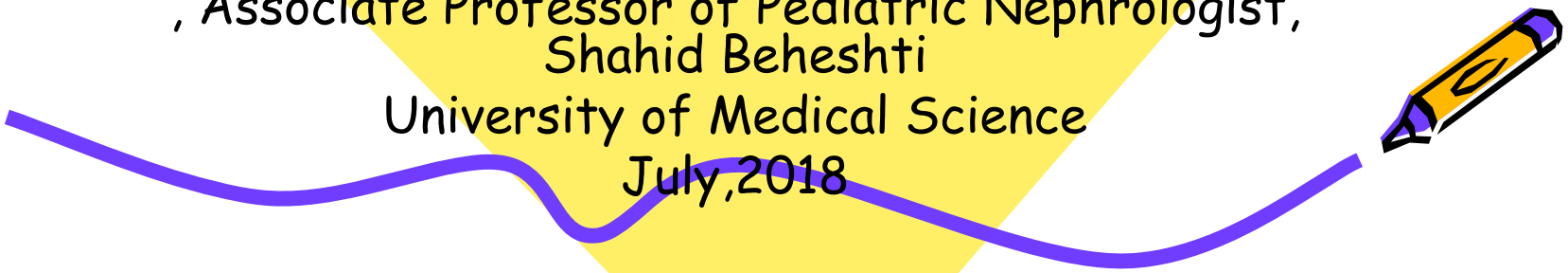
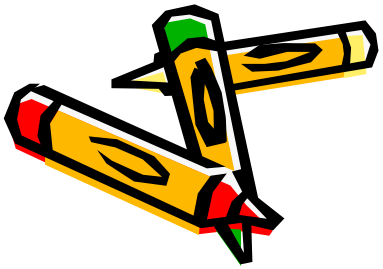


Urine collection techniques in children

- ***CLEAN VOIDED BAG SAMPLES:***
- According to the guidelines of American Academy of Pediatrics Subcommittee on UTI, clean voided bag urine samples are acceptable for urinalysis in infants and children between two months and two years of age who have unexplained fever and do not appear ill enough to require immediate antimicrobial therapy.

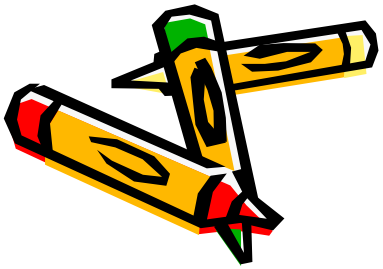
➢ Thus, another urine sample for urinalysis and culture should be collected by invasive means if the urinalysis from the bag sample suggests a UTI by any of the following:

- Positive leukocyte esterase or nitrite test
- Greater than 5 white blood cells per high-power field (spun urine)
- Presence of bacteria on Gram stained urine (unspun urine)



Urine collection techniques in children

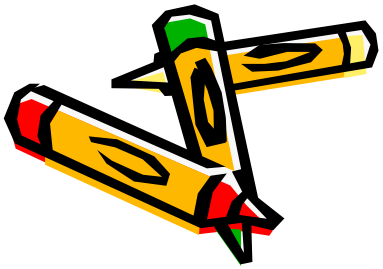
- **Mid stream urine SAMPLES**:
- No benefit to cleansing the introitus before obtaining the specimen
- Contact of the urinary stream with the mucosa should be minimized by pulling back the foreskin in boys who are uncircumcised and by spreading the labia in girls.
- The first voided specimen should be discarded because the initial urine flushes urethral contaminants. The second, midstream sample is the one that should be sent to the laboratory.

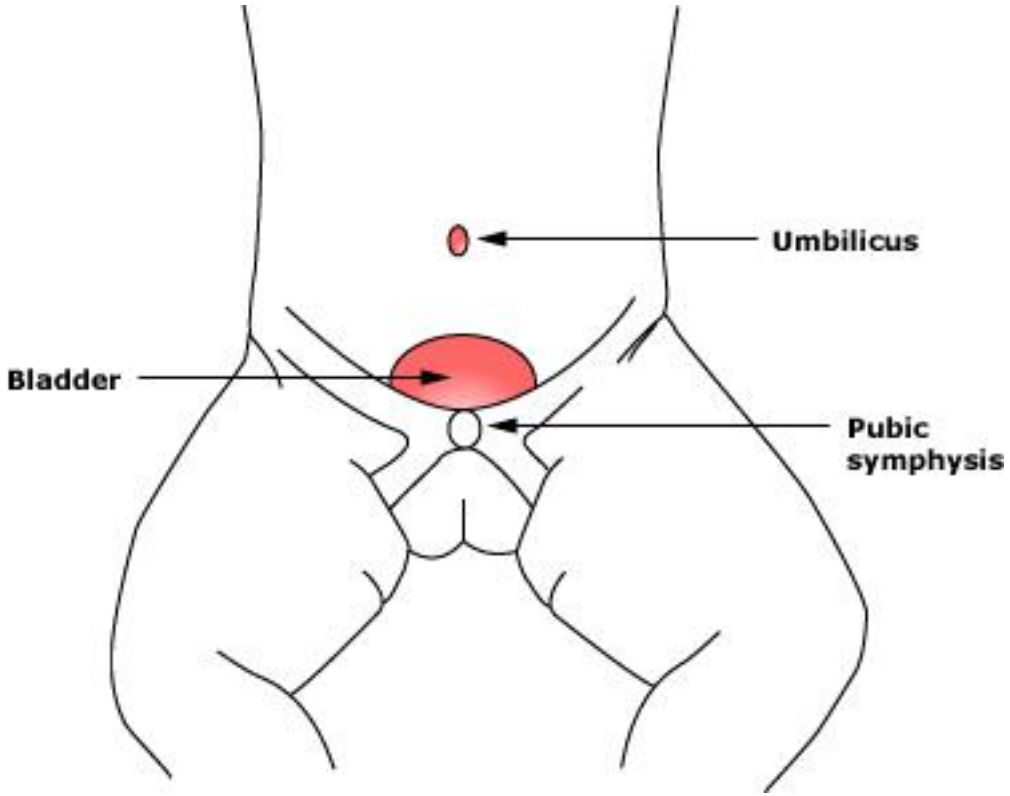


Urine collection techniques in children

- SUPRAPUBIC BLADDER ASPIRATION (SPA)

- This method represents the gold standard in the diagnosis of UTI
- not performed in children who are older than two years
- Complications :
  - Minor complications, such as microscopic hematuria, are common. gross hematuria
  - anterior abdominal wall abscess,
  - Intestinal perforation can occur if a loop of bowel overlies the bladder, but the small puncture rarely leads to peritonitis
  - Intestinal (or other viscus) perforation can be avoided if the procedure is not performed in children who have abdominal distension, organomegaly, volume depletion, or congenital anomalies of the gastrointestinal or genitourinary tract





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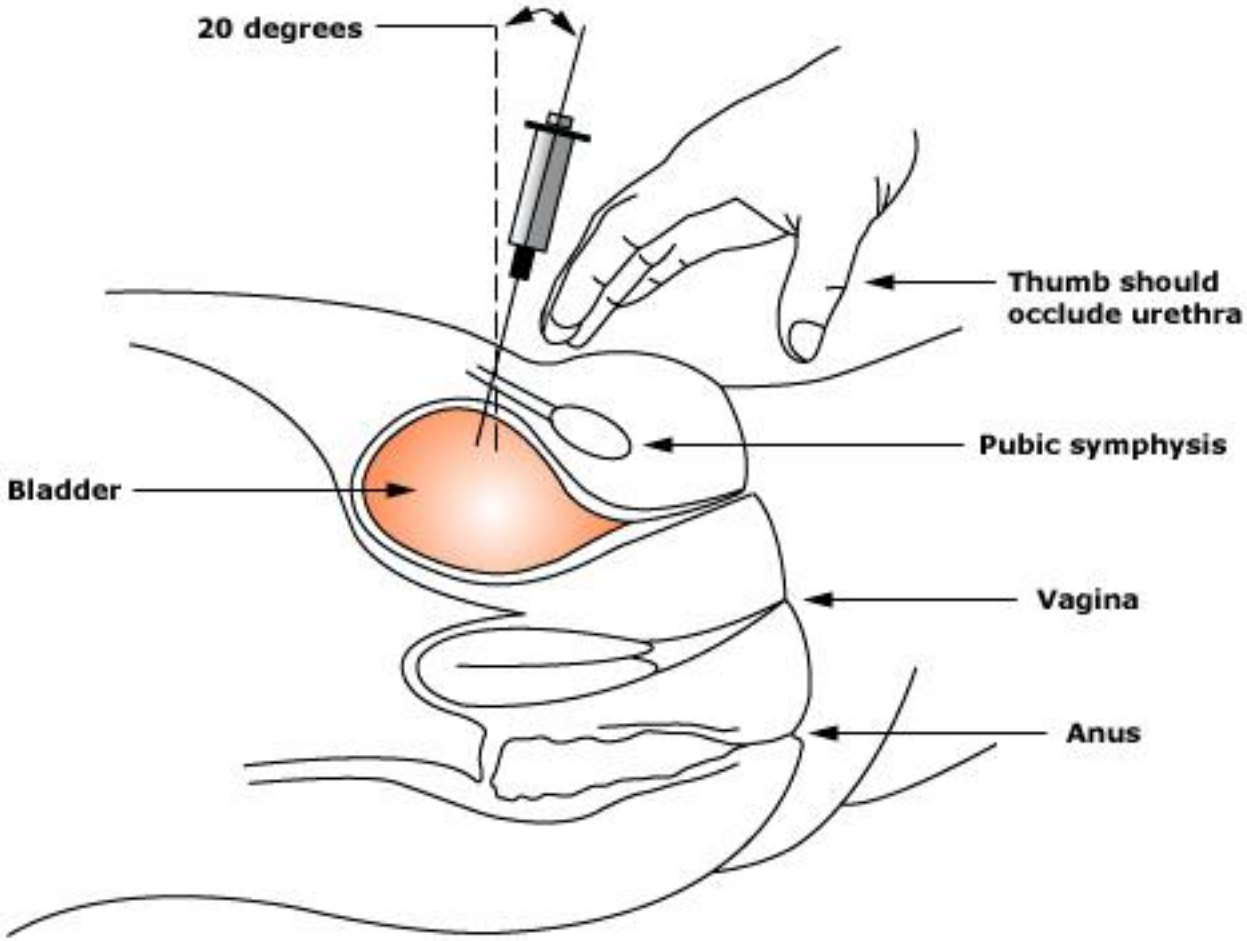

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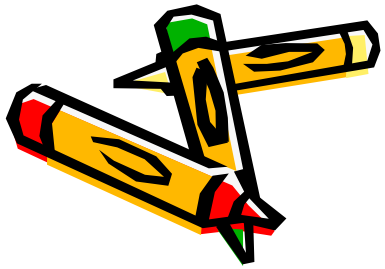
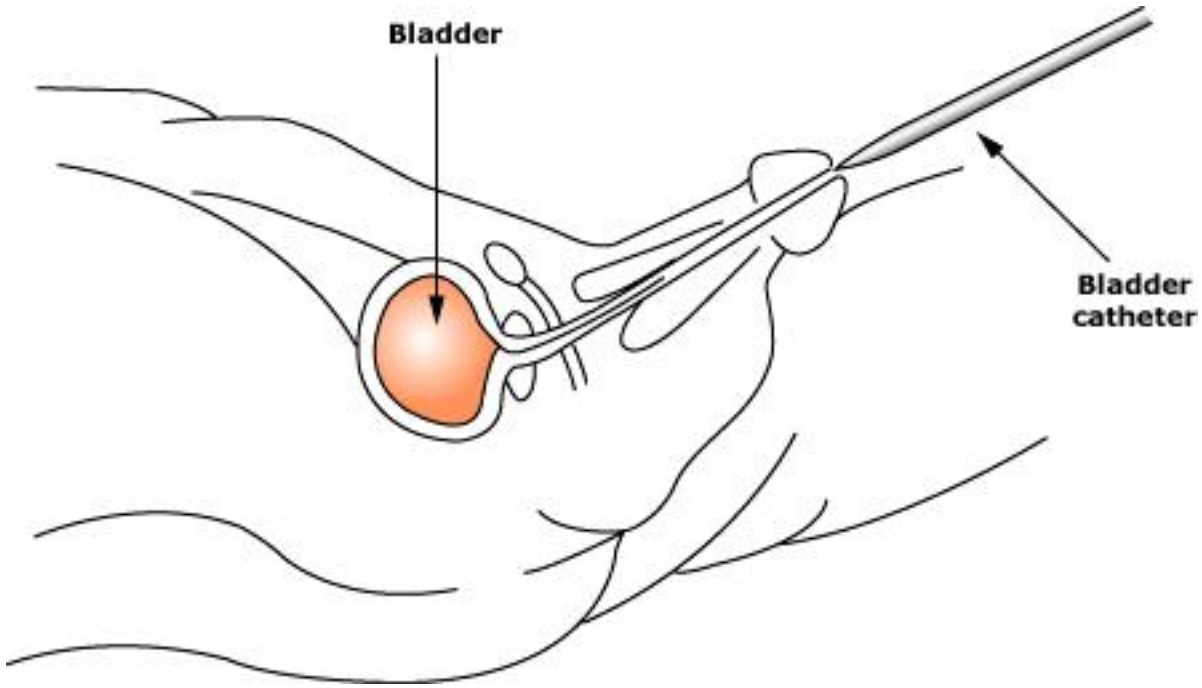
Urine collection techniques in children

- TRANSURETHRAL BLADDER CATHETERIZATION (TUBC)
- The child is restrained in the supine and frog leg position. This position permits adequate stabilization of the pelvis and complete visualization of the external genitalia.
- The anterior urethra is cleansed thoroughly with povidone-iodine solution.
- A sterile lubricant jelly is applied to the end of an appropriately sized catheter (5 French for children younger than 6 months; 8 French for those between 6 months and adolescence, and 10 French for adolescents)

- **Complications** :urethral trauma and microscopic hematuria. iatrogenic infection.





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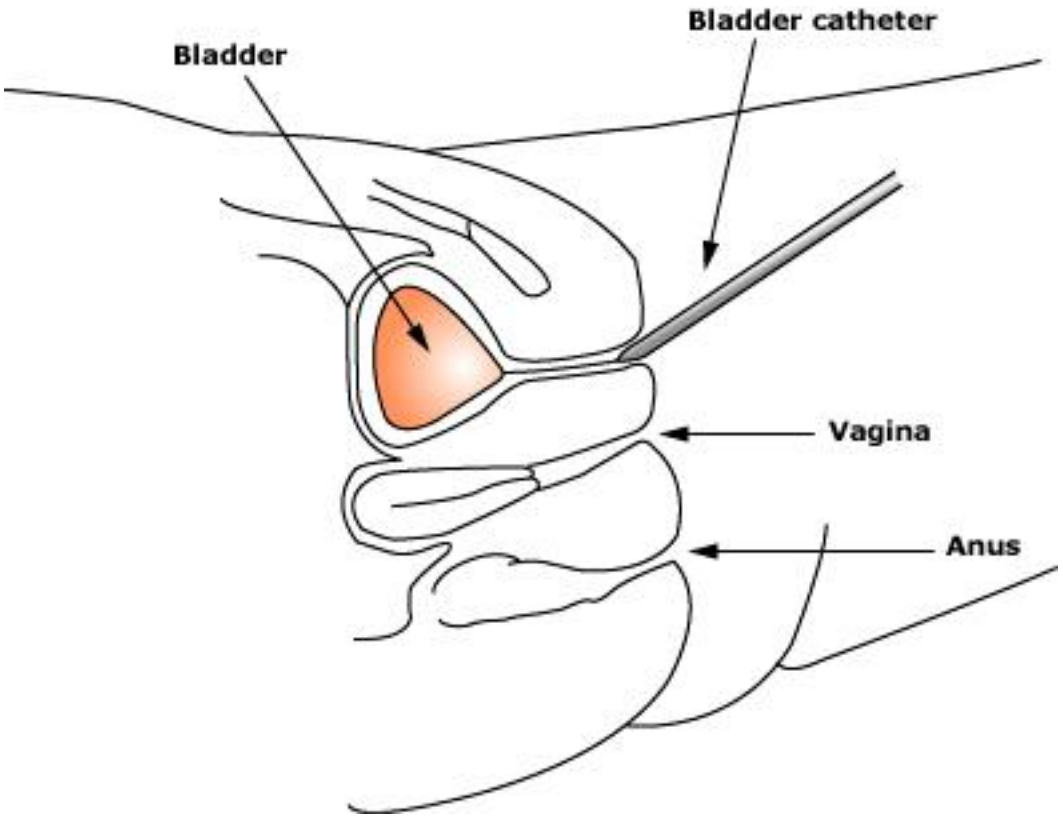

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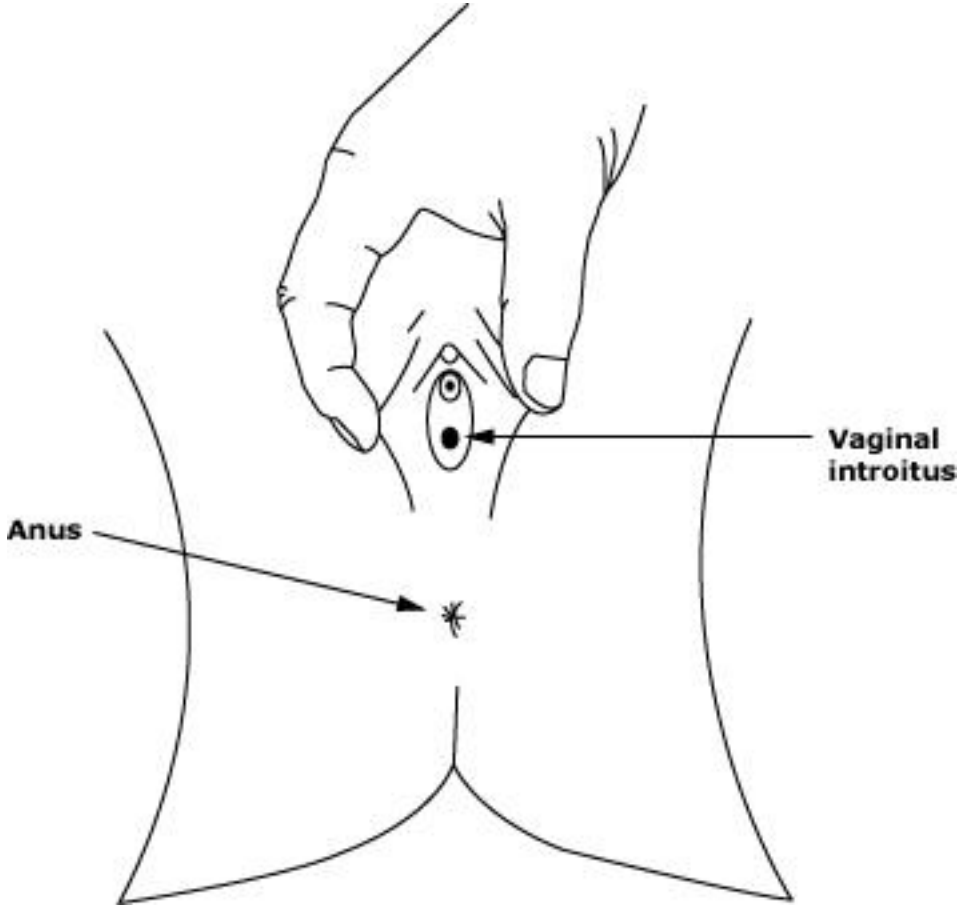

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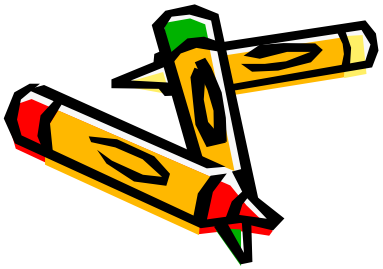
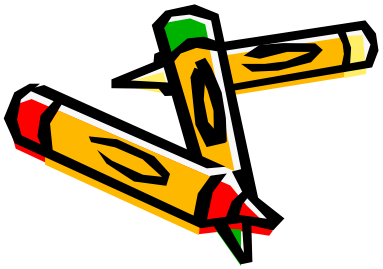
Presumped UTI

- ***CLEAN VOIDED BAG SAMPLES*** ***:U/A is positive & the patient is symptomatic & U/A>100,000 of a single organism***
- **Mid stream urine SAMPLES: U/C>50,000 of a single organism OR U/C>10,000 colony & the patient is symptomatic**
- **SUPRAPUBIC BLADDER ASPIRATION (SPA):** U/A> one colony
- **TRANSURETHRAL BLADDER CATHETERIZATION (TUBC):** U/A>100?,1000?,10,000?



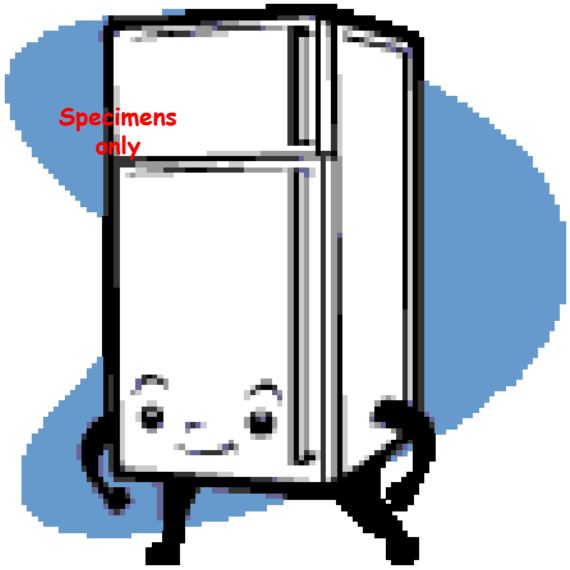
PROCESSING OF URINE SAMPLES

- The specimen should be examined within 60 TO 120 minutes of voiding
- If such immediate dispatch is not possible, the container should be transported in iced water and then stored in a refrigerator at 4°C. Cooling stops bacterial growth until the urine is plated on culture medium and incubated. However, urinary leukocytes may be altered by refrigeration, possibly affecting interpretation of the urinalysis.
- A small amount of sediment should be placed on a slide, while the supernatant should be tested for color (particularly for color suggesting the presence of heme pigments), protein, pH, concentration, and glucose.



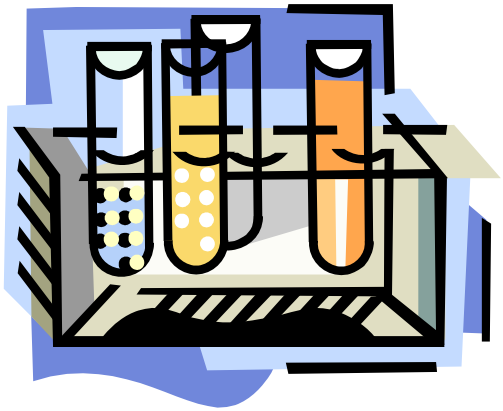
Obtaining Specimens: *Preservation and Storage*

- Chemical, physical, and microscopic changes occur if urine is left at room temperature for more than 1 hour



- Preservation
  - Refrigeration
    - Prevents growth for 24 hours
    - Return to room temperature before testing
  - Chemical preservatives

Physical Composition and Chemical Properties of Urine



- 95% water
- 5% waste products
- Other dissolved chemicals
  - Urea
  - Uric acid
  - Ammonia
  - Calcium
  - Creatinine
  - Sodium
  - Chloride
  - Potassium
  - Sulfates
  - Phosphates
  - Hydrogen ions
  - Urochrome
  - Urobilinogen
  - A few RBCs
  - A few WBCs

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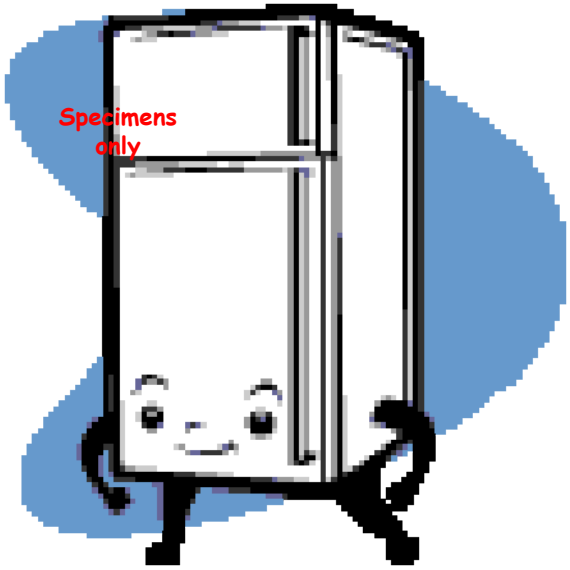

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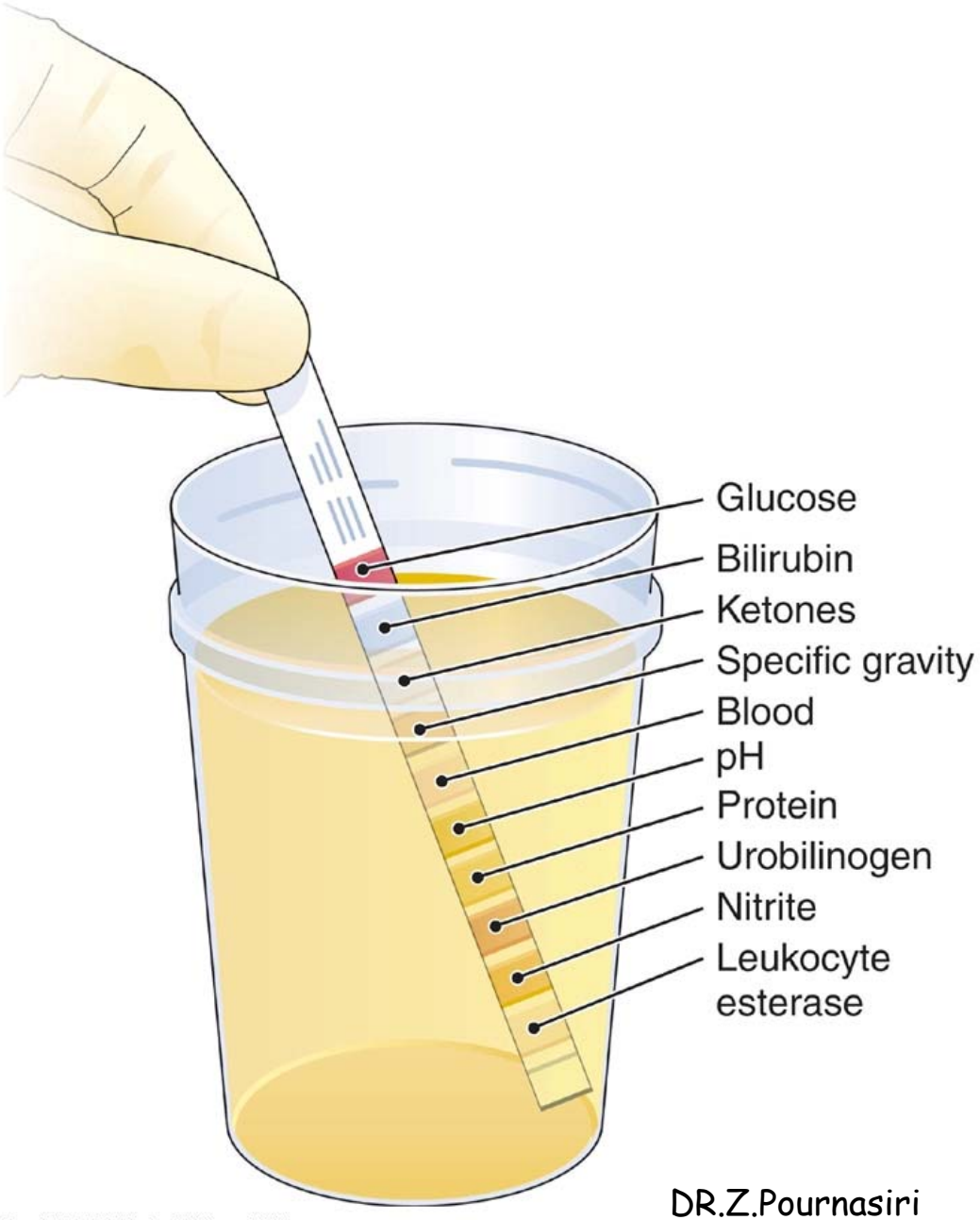

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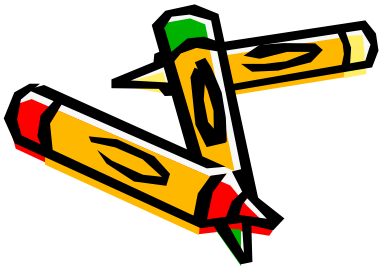
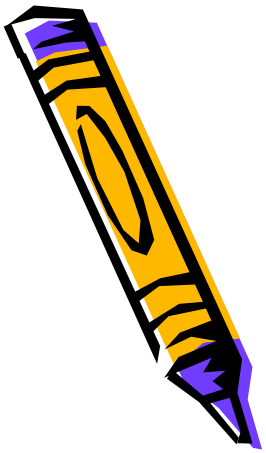
Color

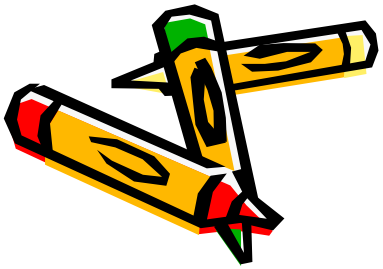
- The urine may also be:
- o white (eg, due to pyuria or phosphate crystals),
- o green (eg, due to the administration of methylene blue, amitriptyline, or propofol [General Anesthetic]),
- o black (eg, due to malignancy),
- o shades of red or brown



Turbidity or appearance

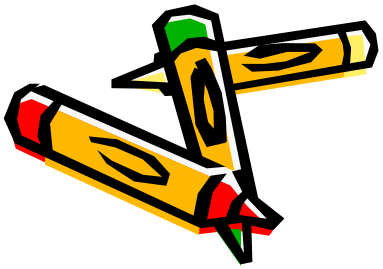


- Low value for diagnosis
- 10% of normal urines are turbid
- 50% of refrigerated urines are turbid
- Causes :contamination with vaginal mucus, precipitation of phosphate crystals in alkaline urine,RBC,WBC,bacteria,chylus



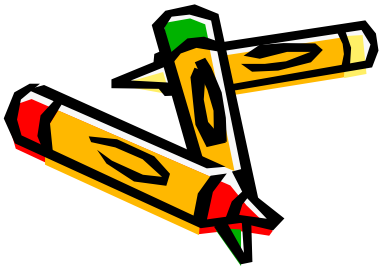
Causes of heme-negative red urine

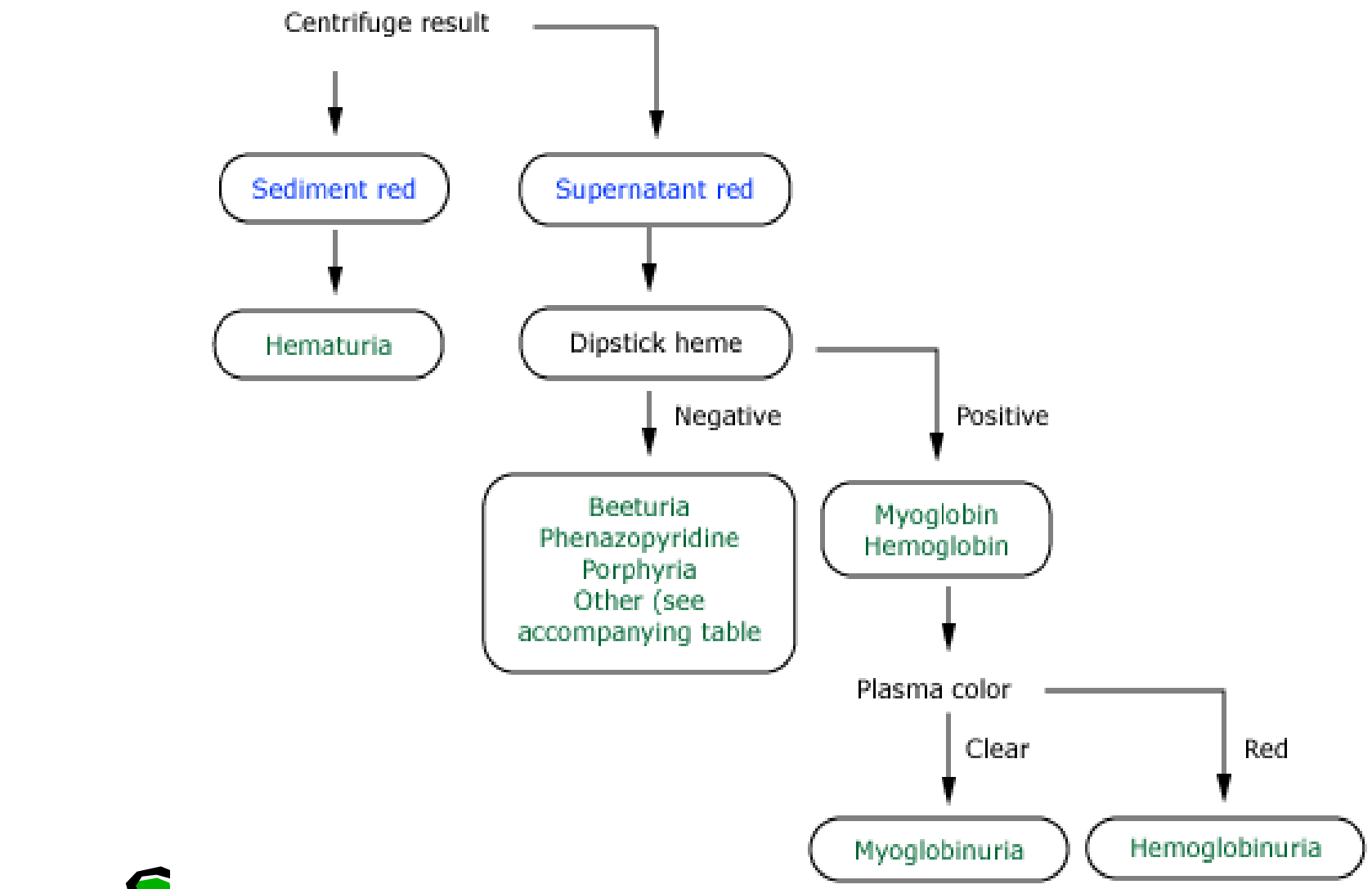
- **Medications:**Doxorubicin,Chloroquine,Deferoxamine,Ibuprofen,Ironsorbitol,Nitrofurantoin,Phenazopyridine,Phenolphthalein,Rifampin,salicylate,sulfasalazine,metronidazole
- **Food dyes:**Beets (in selected patients),Blackberries,Food coloring
- **Metabolities:**Bile pigments,Homogentisic acid,Melanin,Methemoglobin,Porphyrin,Tyrosinosis,Urates



Causes of heme-positive red urine

- myoglobinuria
- Hemoglobinuria
- ***False positive heme reactions*** may be seen if semen is present in the urine, if the urine is alkaline (pH >9), or contaminated with oxidizing agents used to clean the perineum





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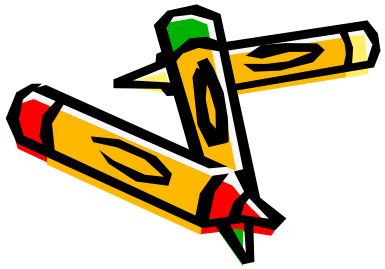
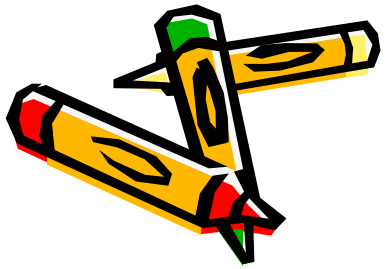
URINE CONCENTRATION

- 95% :WATER
- 5% :SOLUTE SUCH AS K,Na,SULFATE,UREA,URIC ACID,PHOSPHATE,CL,CA,OXALAT,..



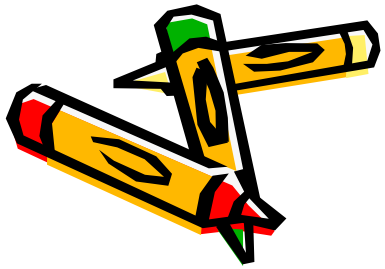
SPECIFIC GRAVITY

- :MASS PER UNIT VOLUME
- 1.003-1.035
- DILUTE URINE:SG<1.008
- CONCENTRATED URINE:SG>1.020



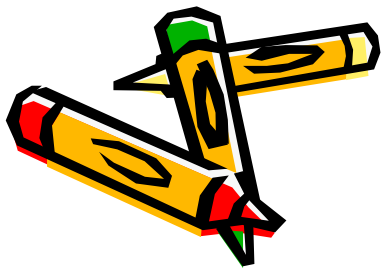
SG IS FALSELY HIGH

- HIGH TEMPRETURE
- PROTEINURIA
- GLUCOSURIA
- RADIOLOGIC CONTRAST AGENT
- MANNITOL
- DETERGANT
- ANTIBIOTIC
- DIURETIC



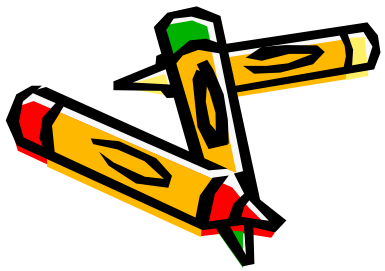
OSMOLALITY

- osmolality is proportional only to the number of particles in solution. (Specific gravity is proportional to the weight, as well as the number, of particles in the solution)
- OSMOLALITY=[SG-1.000] 40
- OSMOLALITY DON'T NEED TO CORRECTION IN PROTEINURIA OR GLUCOSURIA



URINE VOLUME

- NORMAL URINE VOLUME:1-4cc/kg/h
- Polyuria:>4cc/kg/h or >2000/1.73m2
- Oligouria: :<1cc/kg/h or <500/1.73m2
- Anuria: <0.5cc/kg/h or <100/1.73m2

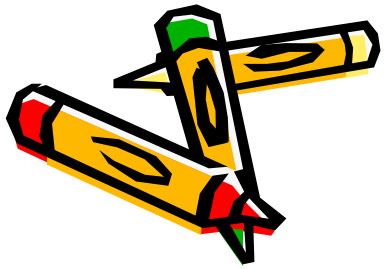


ketone

Is included:

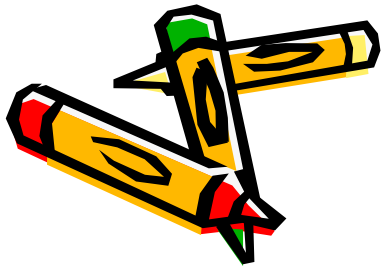
- Acetone
- Acetoacetic
- Beta-hydroxybutyric acid

Dipstick don't detected Beta-hydroxybutyric acid



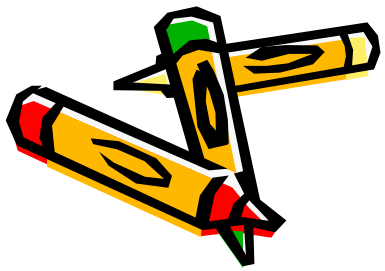
Cause of ketonuria

- DM
- GLYCOGEN STORAGE DX
- ORGANIC ACIDEMIA
- SALYCYLATE OVERDOSE
- STARVATION
- HIGH FAT DIET
- HYPERTHYROID
- FEVER
- PREGNANCY AND LACTATION
- VOMITING



FALSE -POSITIVE FOR KETONURIA

- PHENYLKETONE IN PKU
- METHYLDOPA
- CAPTOPRIL
- MESNA
- PENICILLAMINE
- L.DOPA

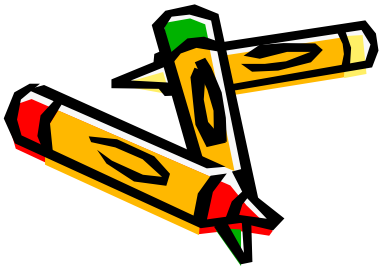


Protein

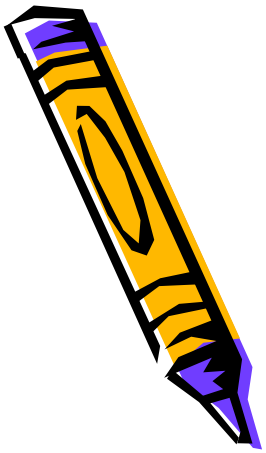
- Protein composition in normal urine:

  30% albumine ,30% globulin ,40% tamm-horsfall protein

  [tamm-horsfall proteins secret from TAL of henle & distal tubul]
- The urine dipstick primarily detects albumin but not other proteins, such as immunoglobulin light chains in multiple myeloma or LMW protein in proximal tubular injury such as fanconi sx

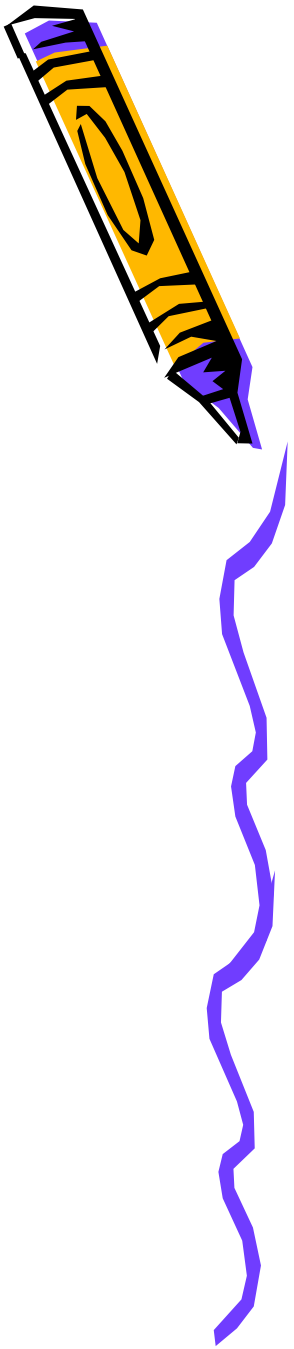


Dipstick reaction



- 0 = no turbidity (0 mg/dL)
- trace = slight turbidity (10 to 20 mg/dL)
- 1+ = turbidity through which print can be read (30 mg/dL)
- 2+ = white cloud without precipitate through which heavy black lines on a white background can be seen (100 mg/dL)
- 3+ = white cloud with fine precipitate through which heavy black lines cannot be seen (300 mg/dL)
- 4+ = flocculent precipitate (1000-2000 mg/dL)

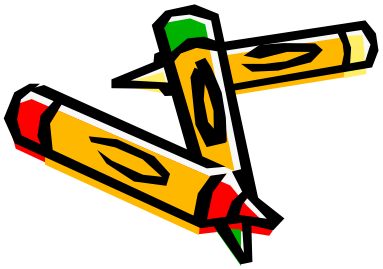
Dipstick reaction



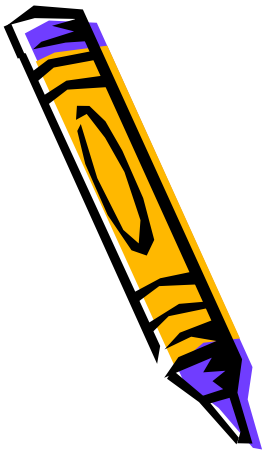
- Dipstick reaction is positive:

Protein>= 1+ in urine SG>1.015

Protein>= 2+ in urine SG<1.015



Dipstick reaction

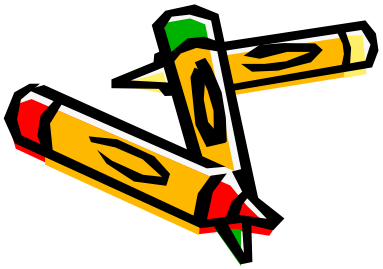


- False positive:

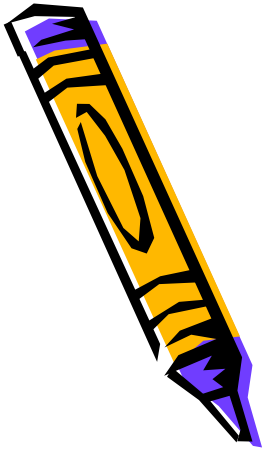
gross hematuria,contamination with antiseptic agents,urinary PH>7,phenazopyridine Rx,iodinated radiocontrast agents . [the urine should not be tested for protein with the dipstick for at least 24 hours after a contrast study.]

- False negative:

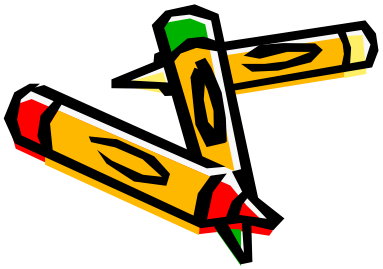
dilute urine<1.005;nonalbumine proteinuria



Protein in 24 hr urine collection



- Normal:<4mg/m2/hr
- Nonnephrotic range proteinuria:4-40 mg/m2/hr
- Nephrotic range proteinuria:>40 mg/m2/hr or >50mg/kg/24hr or >1gr/m2/24hr



Protein/creatinin

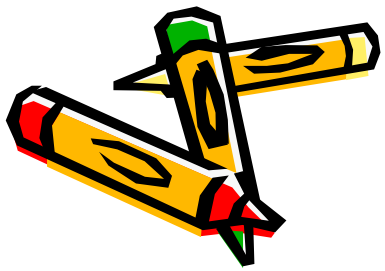
proteinuria is present:

Protein/creatinin in random of urine:

- Infant:>0.5
- Child:>0.2

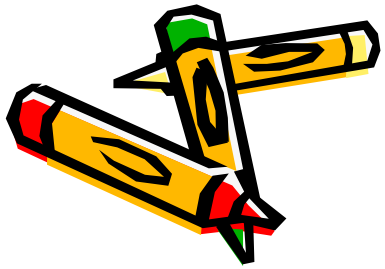
proteinuria is in nephrotic range:

- Protein/creatinin>2



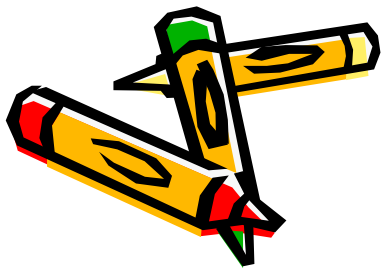
PH

- RANGE:4.5-8
- ACIDIC:4/5-5.5
- ALKALINE:6-8
- URINE MUST BE COLLECTED UNDEROIL AND CHECK BY PH-METER , NO TEST-TAPE



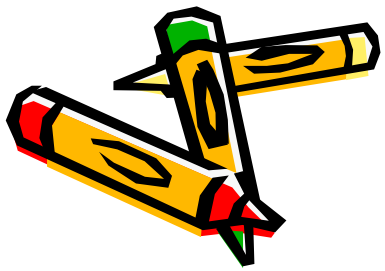
Cause of alkalin urine

- Vegetatary diet
- UTI with urease –producing bacteria
- Respiratory alkalosis
- Acute & chronic renal dx
- Sever vomiting
- Metabolic alkalosis
- Drug:acetozolamid,Hco3,polycitrate
- RTA



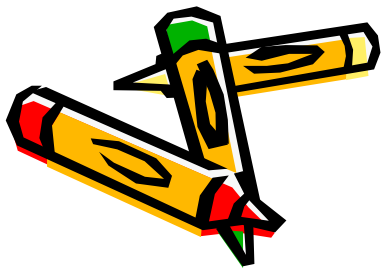
Cause of acidic urine

- High protein diet
- Fever
- Dehydration
- Diarrhea
- Uric acid & cystin renal stone
- Resp.& metabolic acidosis
- Ammonium chlorid



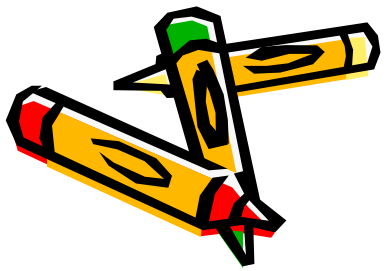
GLUCOSE

- Hyperglycemia
- Bacteria or fungus in urine
- Renal tubular injury such as fanconi syndrome
- Renal glucosuria(AR INHERITANCE,RARLY AD INHERITANCE)



False negative for glucose

- Aspirine
- Ascorbic acid
- Other suger except glucose such as galactose , lactose,... don't detect by tes-tape



NITRITE

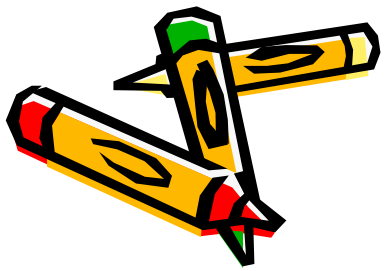
- IS POSITIVE IN UTI

FALSE NEGATIVE:

- URINARY FREQUENCY
- LOW URINE BACTERIAL COUNT
- URIARY TRACT OBSTRACTION
- UTI WITH ENTEROCOCCI
- ASCORBIC ACID
- GROSS HEMATURIA
- CONSUMPTION OF ANTIBIOTIC
- PROLANG CONTACT

LEUKOCYTE ESTERASE

- The presence of LE in the urine suggests the presence of neutrophils, whether due to infection or some other inflammatory process.
- Neutrophils can be labile in urine; thus, the presence of LE may detect the enzyme remnants of cells that are no longer visible on microscopic examination.



BILIRUBIN

- DIRECT BILIRUBIN IS water SOLUBLE AND DETECT IN URINE

- **UROBILINOGEN** IS NEGATIVE :BILLIARY TRACT OBSTR.,NEONATE
- UROBILINOGEN IS STRONGLY POSITIVE :HEMOLYTIC DX ,HEPATITIS

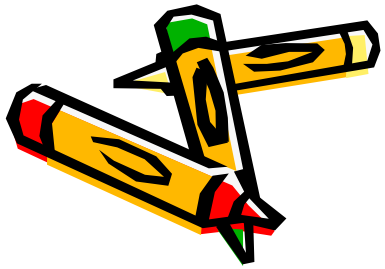


Table 1
Pathologic and nonpathologic causes of abnormal urine dipstick findings

Urine dipstick test	Nonpathologic causes	Pathologic causes
SG	Low SG: polydipsia High SG: inadequate volume intake	Low SG: DI, renal tubular dysfunction High SG: volume depletion
pH	Low pH: high protein diet High pH: low protein diet, recent meal	Low pH: acidosis High pH: renal tubular acidosis (inappropriate renal response), UTI
Blood	Menses, traumatic catheterization, exercise	Glomerular disorders, tubular disorders, UTI, stones, hypercalciuria, urinary tract trauma, tumor
Protein	Orthostatic proteinuria, fever, exercise	Glomerular disorders, tubular disorders, UTI
Glucose	Renal glycosuria	Diabetes mellitus, Fanconi syndrome
Ketones	Restricted carbohydrate intake	Diabetes mellitus
Bilirubin	None	Hepatitis, biliary obstruction
Urobilinogen	Low: systemic antibiotic therapy	Hepatitis, intravascular hemolysis
Nitrite	None	UTI
LE	Fever	UTI, glomerulonephritis, pelvic inflammation

False positive and false negative causes of abnormal results are not included.
Abbreviations: DI, diabetes insipidus; SG, specific gravity; UTI, urinary tract infection.

Table 2
Causes of false positive and false negative results in urine dipstick testing

Urine dipstick test	False positives	False negatives
SG	Contamination during collection/ storage	None
pH	High pH from urease producing organisms (eg, *Proteus mirabilis*), prolonged standing of urine	Low pH from mixing of reagents from adjacent test pads
Blood	Oxidizing contaminants (eg, hypochlorite), microbial peroxidase associated with UTI	High ascorbic acid, large nitrites, high SG
Protein	Fever, exercise, alkaline urine, concentrated urine, presence of cells/bacteria in urine	Dilute urine, low molecular weight proteins
Glucose	Strong oxidizing agents in urine container	Ascorbic acid, high SG, exposure to humid environment

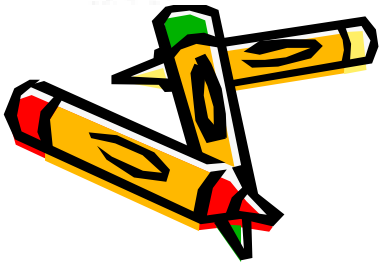


Table 2
Causes of false positive and false negative results in urine dipstick testing

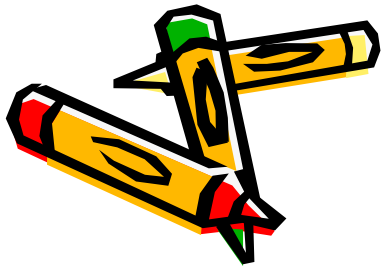
Urine dipstick test	False positives	False negatives
Ketones	Captopril, methyldopa	Prolonged standing of urine, moisture on test pad
Bilirubin	Rifampin, chlorpromazine	Ascorbic acid, prolonged standing in light
Urobilinogen	Alkaline urine, sulfonamides[a]	Broad-spectrum antibiotics, discolored urine, prolonged standing in light
Nitrite	Urine contamination, medications that turn urine color to red, gross hematuria	Inadequate dietary nitrate intake (vegetables), non–nitrate-reducing bacteria, insufficient incubation time for conversion of nitrate to nitrite, ascorbic acid, high urobilinogen
LE	Contamination with vaginal fluid, oxidizing agents, *Trichomonas*	Ascorbic acid, high protein, high glucose, high SG, cephalosporins, tetracycline, nitrofurantoin

Abbreviations: SG, specific gravity; UTI, urinary tract infection.

[a] For Multistix (Bayer Corporation, Elkhart, Indiana).

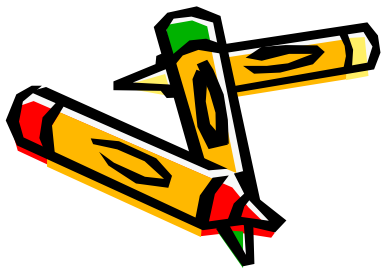
URINE SEDIMENT

- crystals, bacteria, cells, casts, white blood cells ,red blood cells
- The specimen is ideally examined within 30 to 60 minutes of voiding.
- The urine should be centrifuged at 3000 rpm for three to five minute

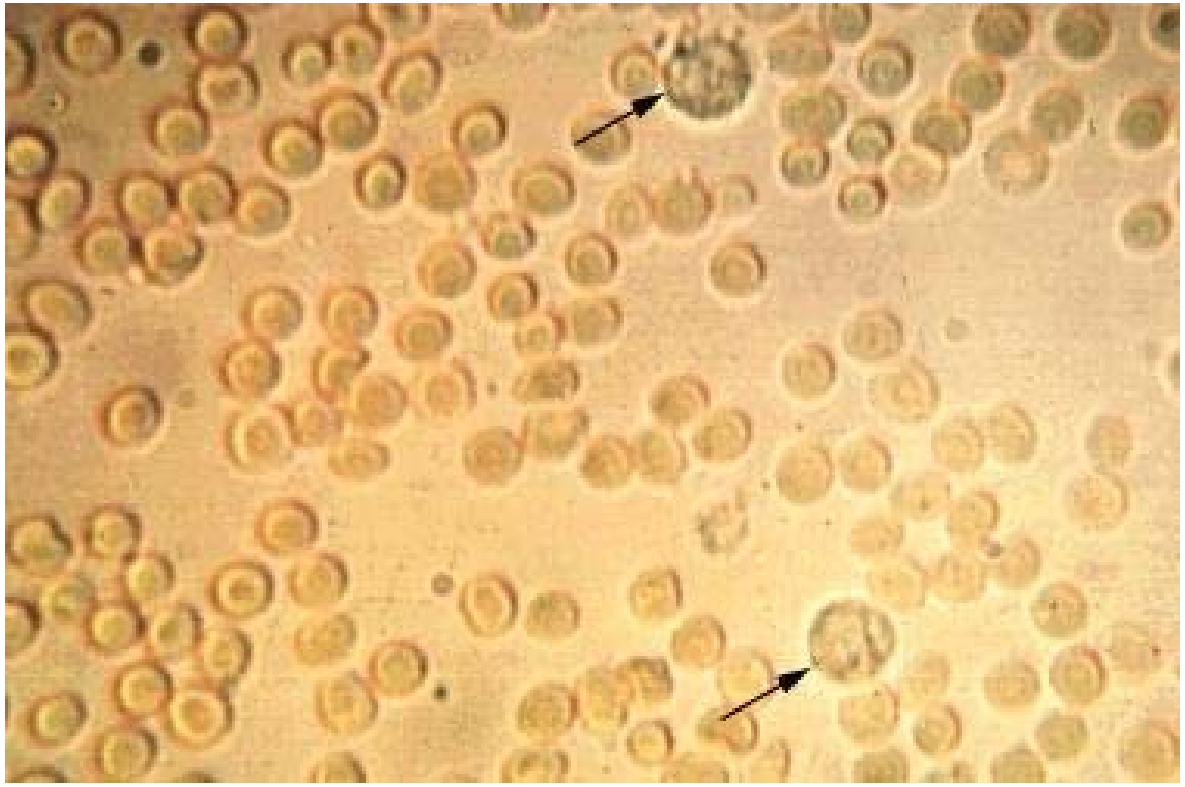


Hematuria

- Microscopic hematuria is commonly defined as the presence of more than 4 red blood cells per high powered field in a spun urine sediment .

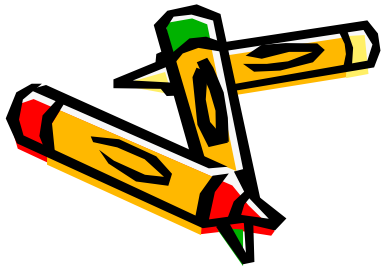


Urine sediment showing many red cells and an occasional larger white cell with a granular cytoplasm (arrows). The red cells have a uniform size and shape, suggesting that they are of nonglomerular origin.

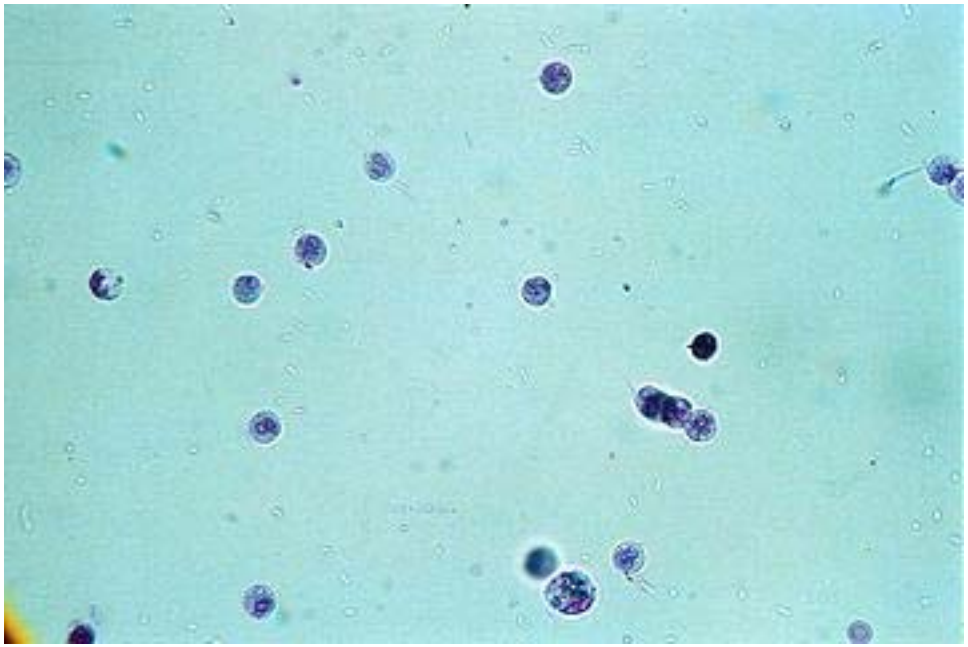


Pyuria

- Greater than five white blood cells per high-power field is generally considered abnormal
- White blood cells from the vagina can contaminate urine specimens and give a false positive reading.
- Prolonged standing of hypotonic urine results in lysis of white blood cells and a false negative reading.



White blood cells in the urine sediment with nuclei and granular cytoplasm.



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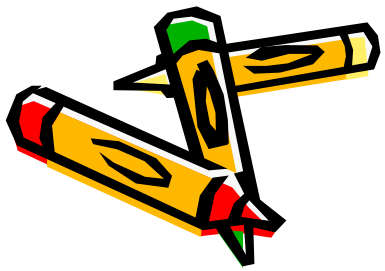
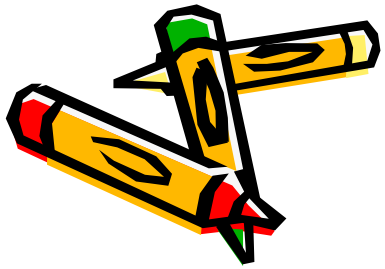
Sterile pyuria

- fever,
- glomerulonephritis,
- partial threated UTI,
- appendicitis,
- bladder,diverticulitis,
- viral gasteroenteritis,viral
- cystitis,
- dehydration,
- kawasaci,
- toxic shock sx,
- renal vein thrombosis,
- renall transplant rejection,



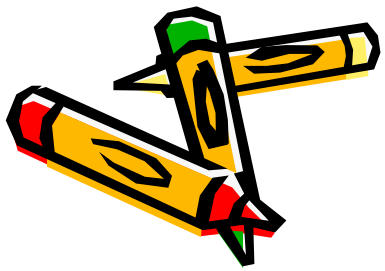
Sterile pyuria

- oral OPV vaccine,
- IM injection of iron,
- TB,
- gonoccocal or chlamydial urethritis,
- systemic fungal dx.,
- leptospirosis,
- acute or chronic glomerulonephritis,
- lupus nephritis,
- Alporte sx.,
- RTA
- Nail-patella sx.,



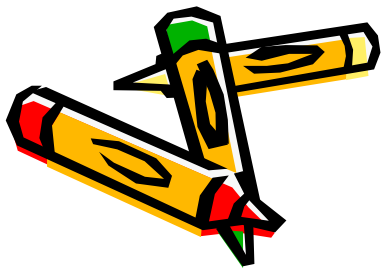
Sterile pyuria

Polycystic kidney,
tubulointerestial nephritis,
hyperoxaluria type 1,
GU tumor,
lymphoma with renal involvement,
renal papillary necrosis,
sarcoidosis with renal involvement ,
renal stone,
chemical irritation,
folllowing cystoscopy,
foreing body



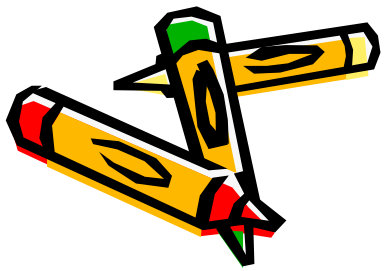
Bacteria

- The presence of bacteria in an asymptomatic patient is most likely due to contamination with normal flora from the external urethral meatus or vagina.
- Bacreria>10 in HPF is significant



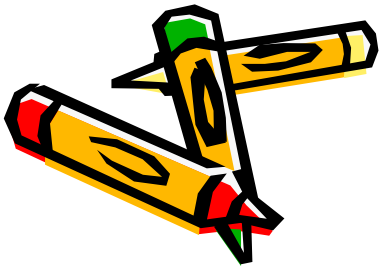
Crystals

- the observation of crystals in the urine is most frequently of little diagnostic importance
- Certain medications such as sulfonamides and ampicillin may crystallize in the urine.
- Prolonged standing of the urine may result in increased crystallization.

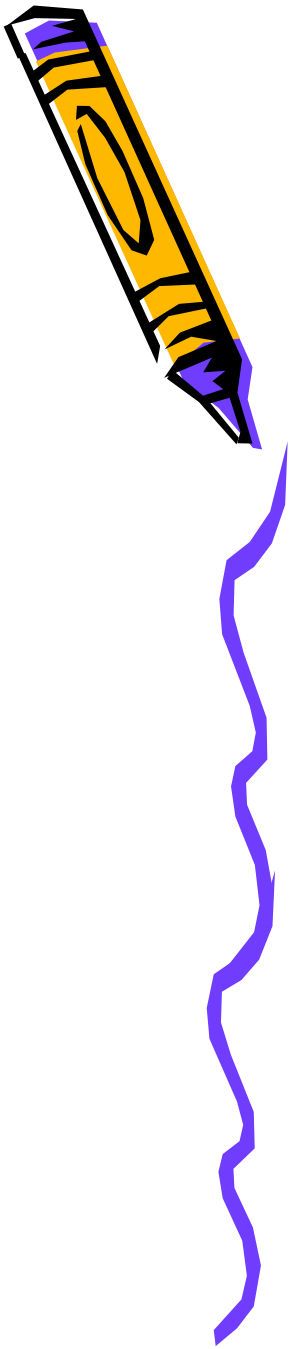


Cystine crystals are always abnormal:

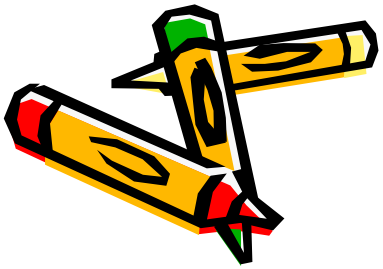
- cystinuria ,who often have kidney stones.
- Tyrosine and leucine crystals are also abnormal and suggest liver disease.
- Magnesium ammonium phosphate crystals (struvite)
- the combination of acute renal failure and calcium oxalate crystals (a setting consistent with ethylene glycol ingestion),
- the presence of a larger number of uric acid crystals occurring in association with acute renal failure (consistent with tumor lysis syndrome).



crystals are typically found in acidic urine :

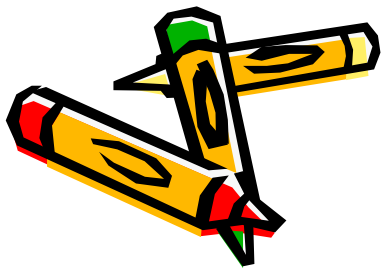


- Calcium oxalate,
- uric acid,
- amorphous urate crystals



crystals are typically found in alkaline urine :

- calcium Carbonate
- Triple phosphate
- Calcium phosphate,
- amorphous phosphate



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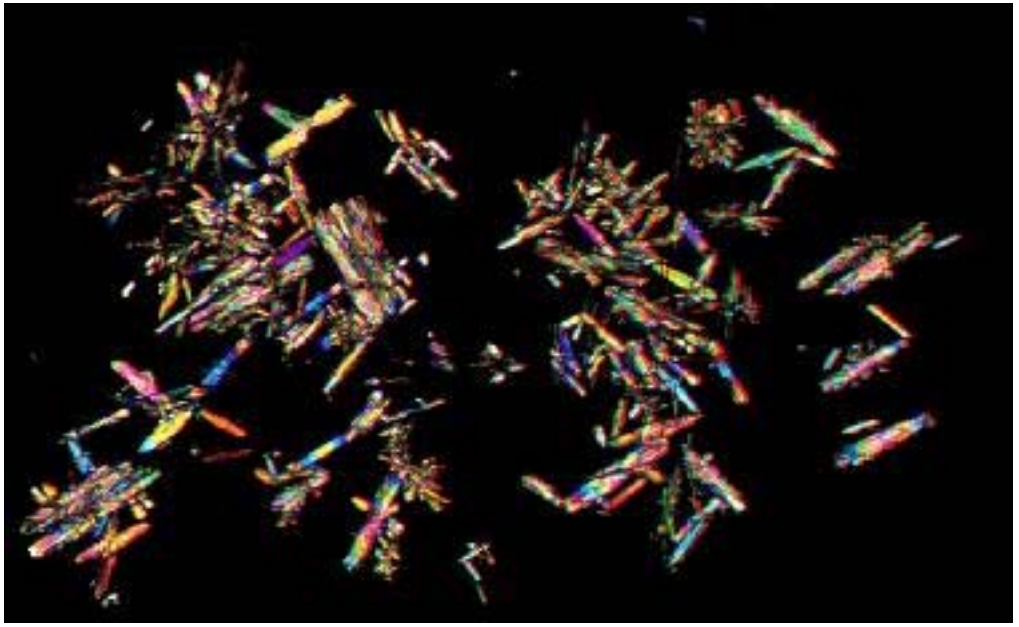
- Urine sediment viewed under polarized light showing coarse, needle-shaped calcium oxalate monohydrate crystals. These crystals have a similar appearance to hippurate crystals.



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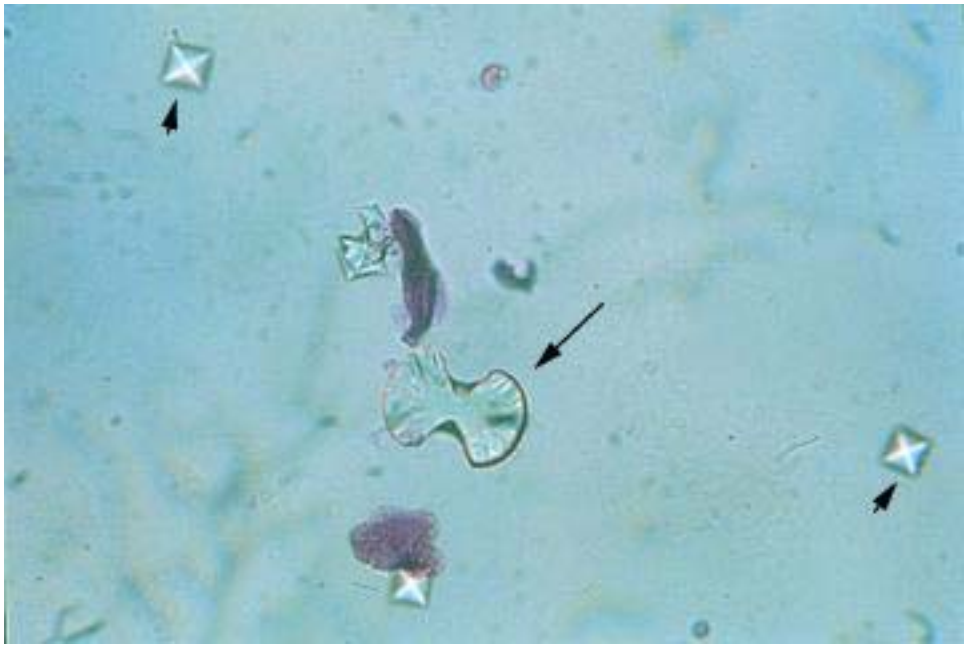
Urine sediment showing both dumbbell-shaped calcium oxalate monohydrate (long arrow) and envelope-shaped calcium oxalate dihydrate (short arrows) crystals. Although not shown, the monohydrate crystals may also have a needle-shaped

appearance.



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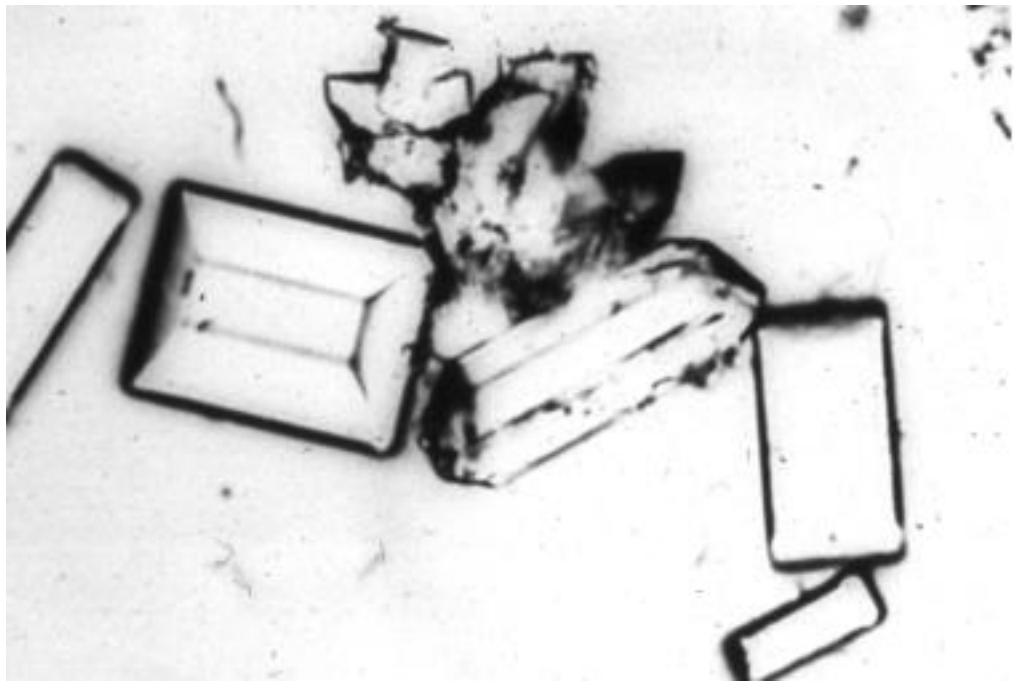
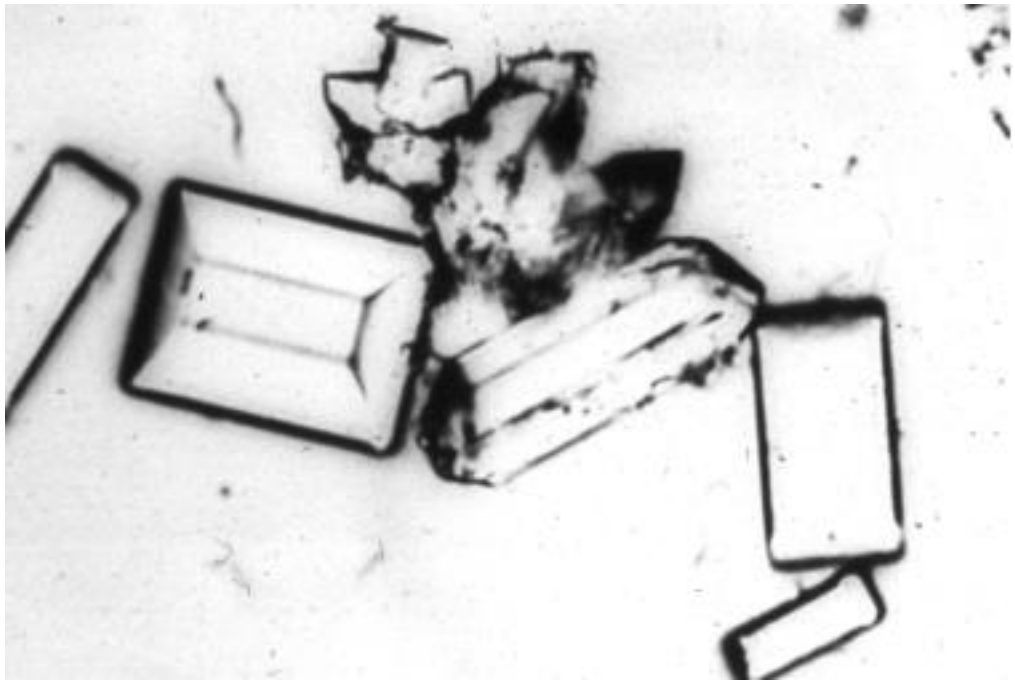
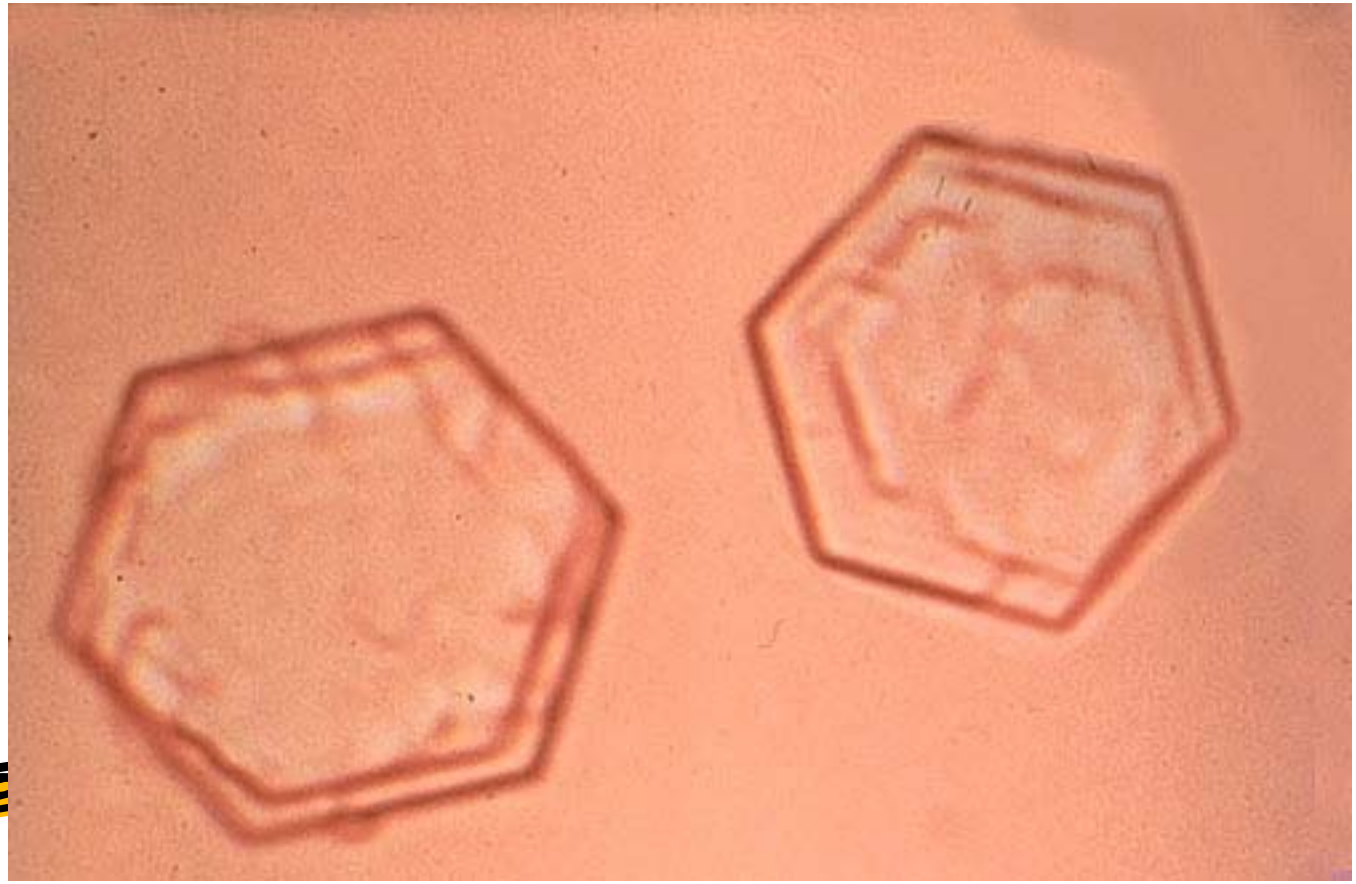
Urine sediment showing multiple "coffin lid" magnesium ammonium phosphate crystals which form only in an alkaline urine (pH usually above 7.0)



Urine sediment showing multiple "coffin lid" magnesium ammonium phosphate crystals which form only in an alkaline urine (pH usually above 7.0)



Urine sediment showing hexagonal cystine crystals that are essentially pathognomonic of cystinuria.



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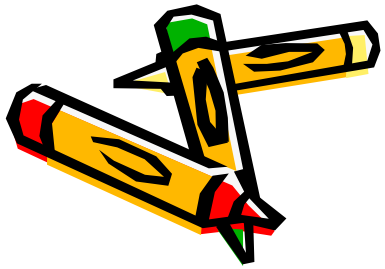
Uric acid crystal

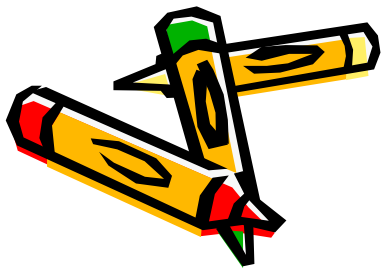
CASTS

- Casts are formed in the lumen of distal convoluted tubules and collecting ducts and consist of an organic matrix composed of Tamm-Horsfall mucoprotein with or without additional elements.
- Hyaline casts are the most common and can be seen in normal individuals. They consist primarily of mucoproteins and may be increased with concentrated urine, diuretics, renal disease, fever, and exercise.
- The presence of cellular casts is of greater significance. Because cellular casts can dissolve within 30 minutes in acidic urine and within 10 minutes in alkaline dilute urine, they can be missed if the microscopic examination is not performed soon after voiding.



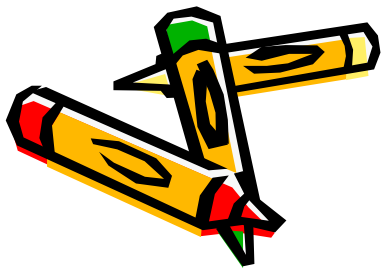
Hyaline casts

- **Component**:Mucoprotein
- **Common clinical situations** :Normal health, fever, exercise, diuretics, renal disease



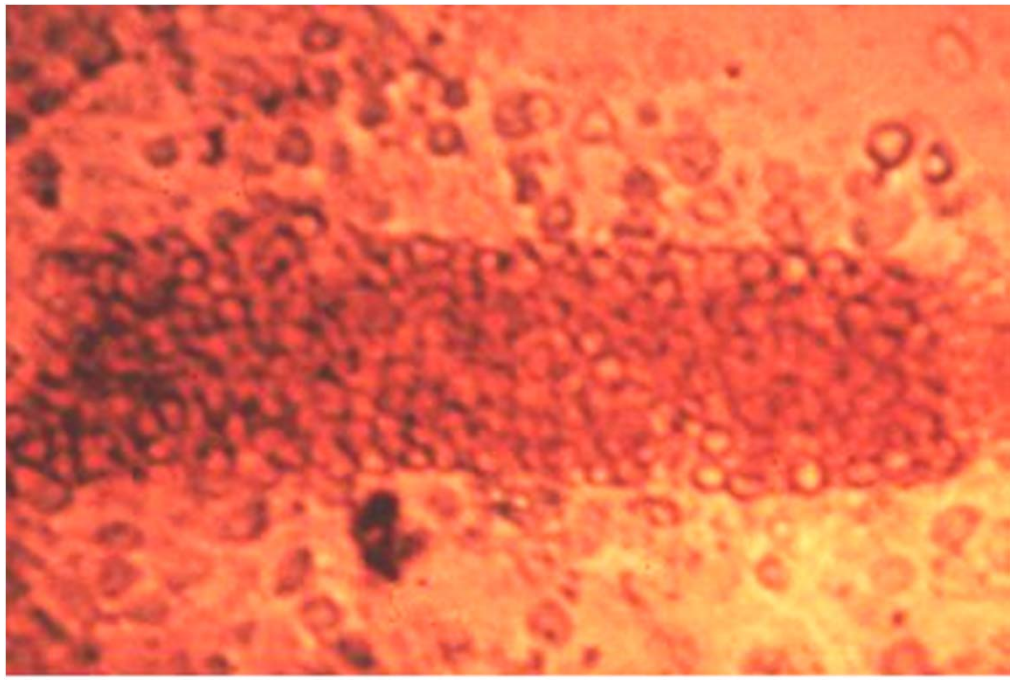
Red cell casts

- **Component:**Red blood cells
- **Common clinical situations :** Glomerulonephritis, tubulointerstitial nephritis, acute tubular injury/necrosis



Urine sediment showing free red cells and a red cell cast that is tightly packed with red cells. It is more common for red cell casts to have fewer red cells trapped within a hyaline or granular cast. Red cell casts are virtually diagnostic of

glomerulonephritis or vasculitis.



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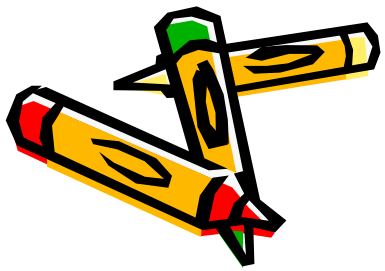
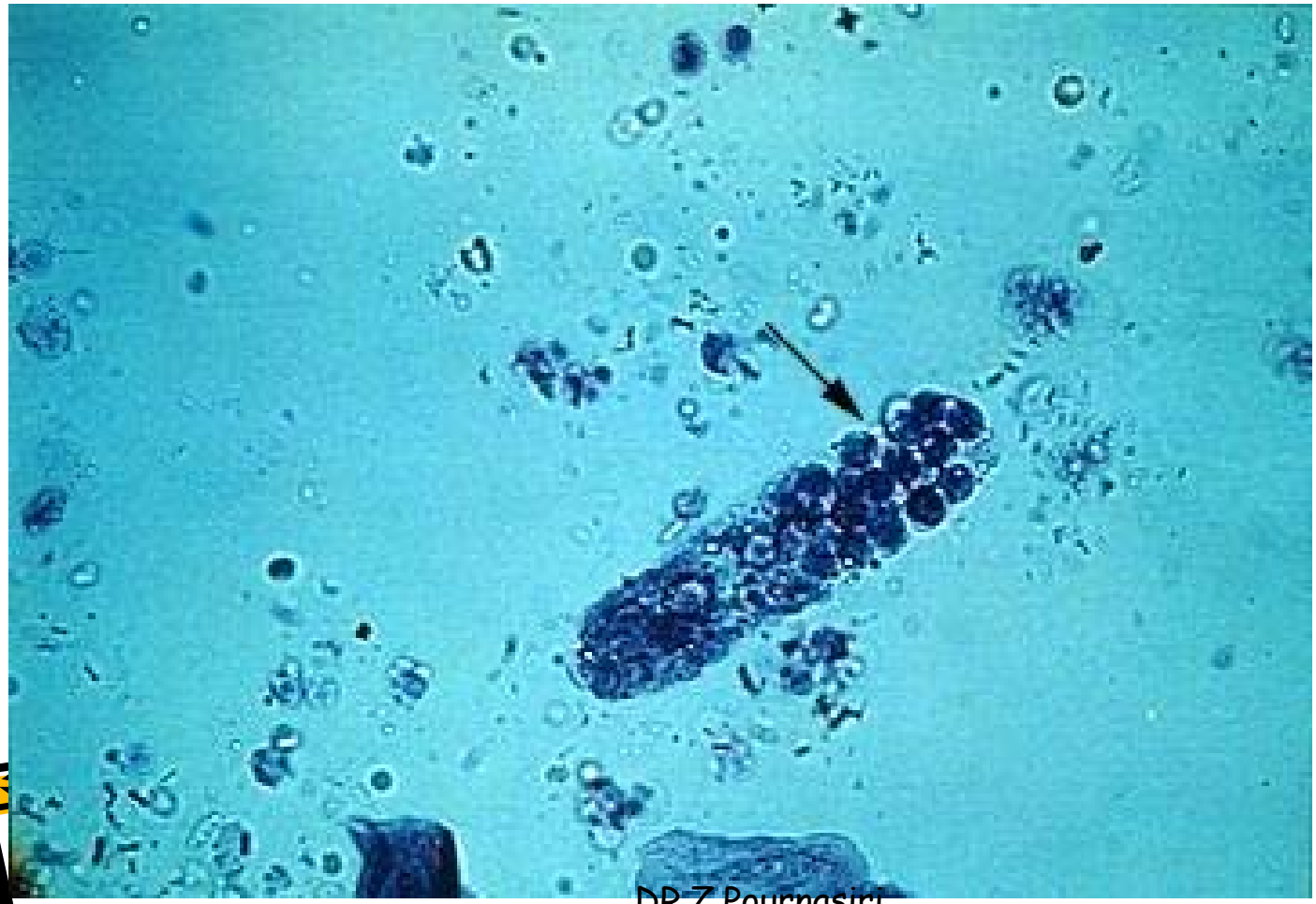
White cell casts

- **Component:** White blood cells
- **Common clinical situations :** Pyelonephritis, glomerulonephritis, tubulointerstitial nephritis



White cell cast in which blue stained white cells (arrow) are contained within a granular cast



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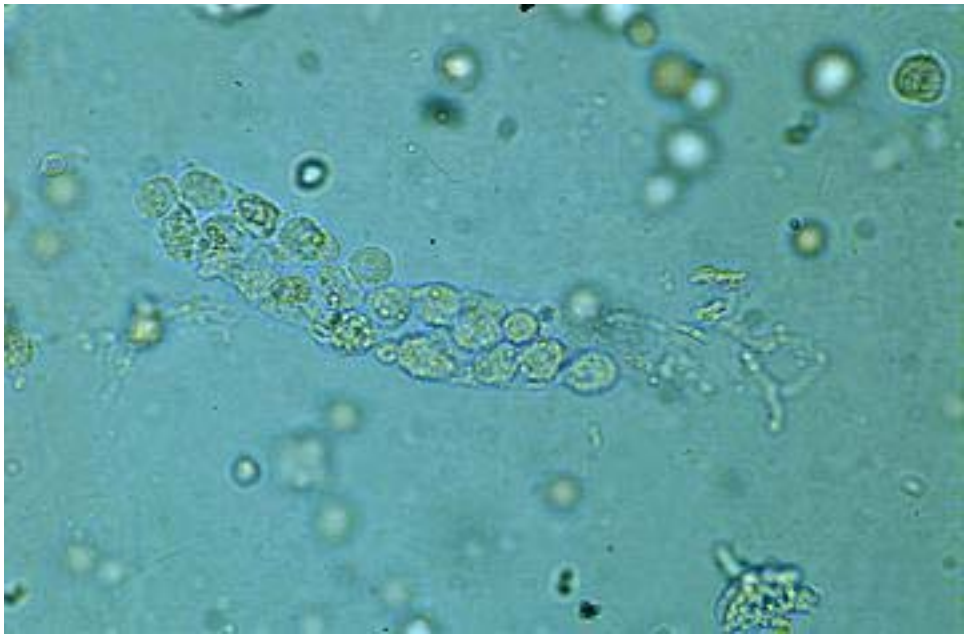
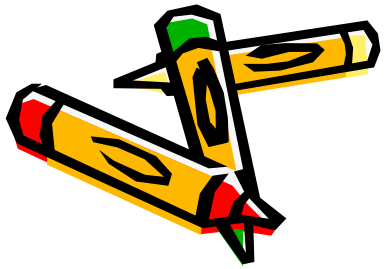
A white blood cell cast, three-quarters of which is filled with leukocytes.

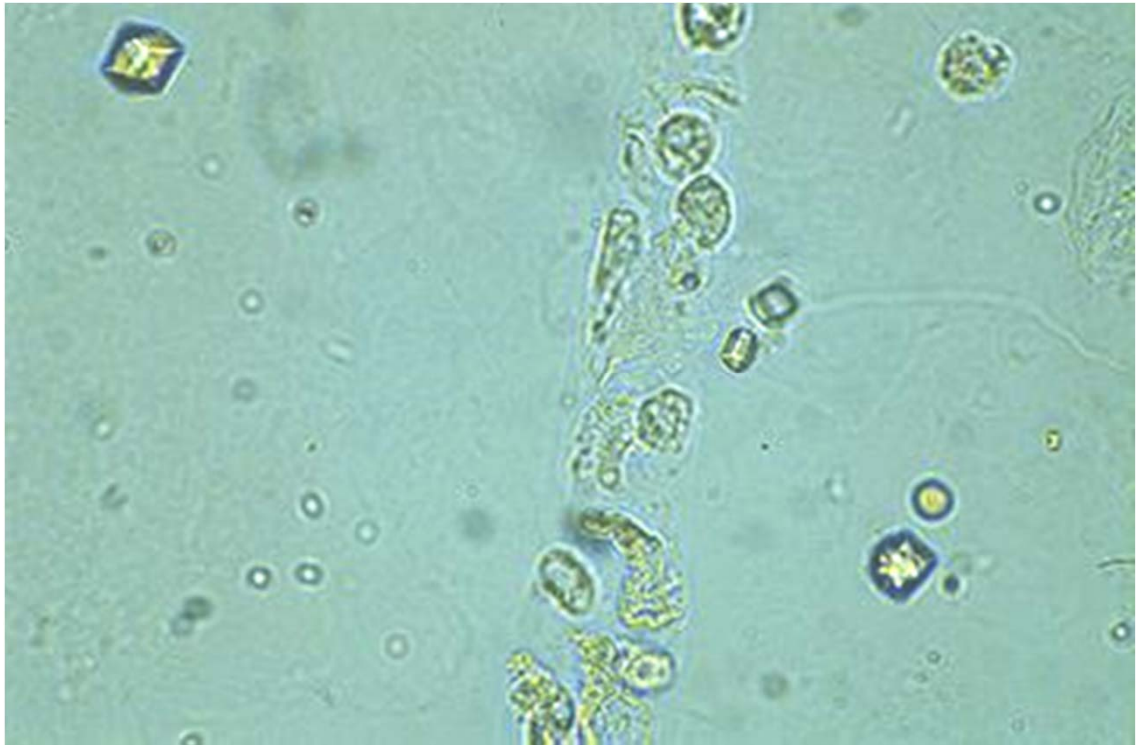


Epithelial cell casts

- **Component**:Renal tubular cells
- **Common clinical situations** : Acute tubular injury/necrosis, tubulointerstitial nephritis, glomerulonephritis

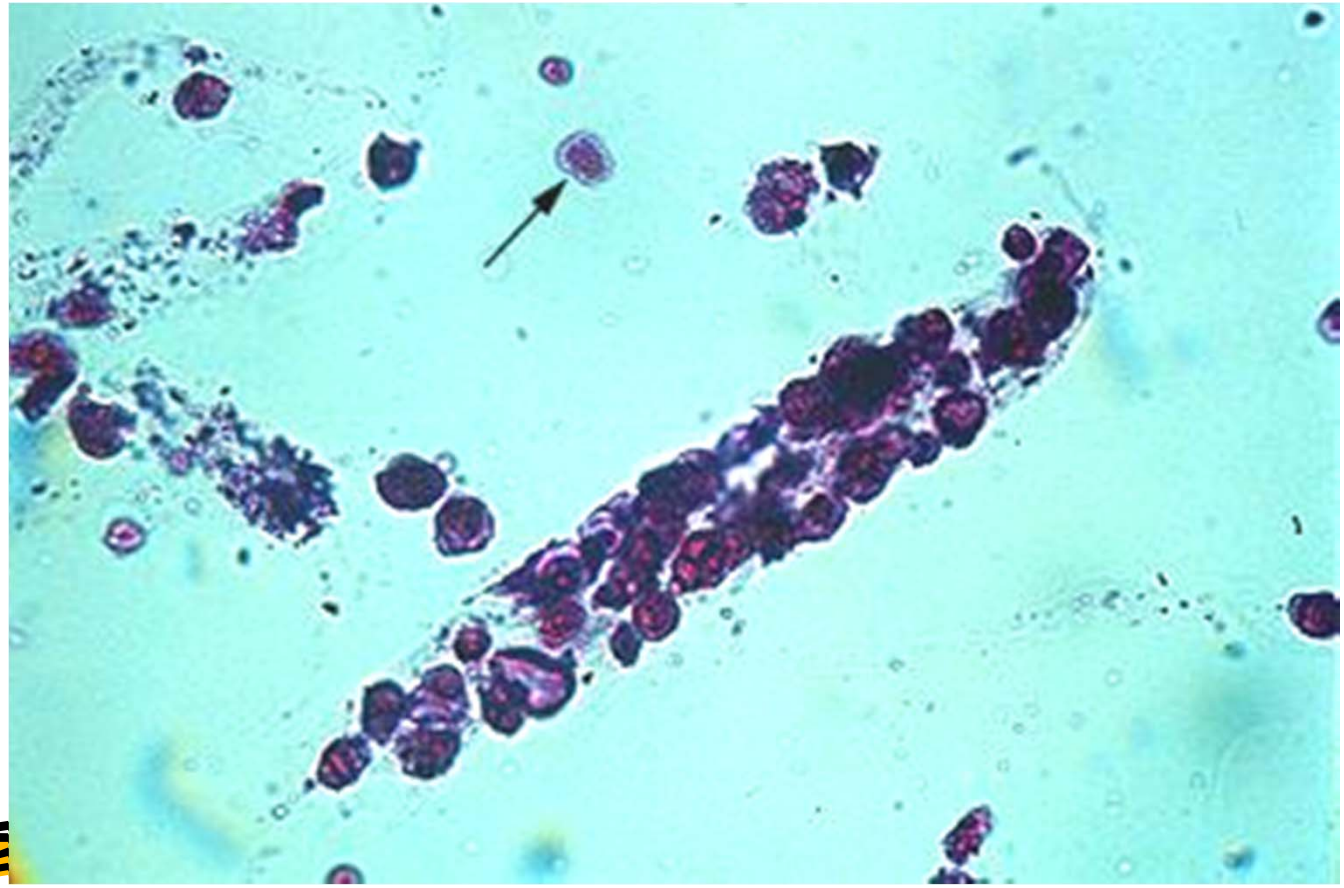


Epithelial cell cast containing cells that are larger than white cells.



Epithelial cell cast with free epithelial cells (arrow) in the urine sediment. Renal tubular epithelial cells are larger than

white cell and have a single, large central nucleus.



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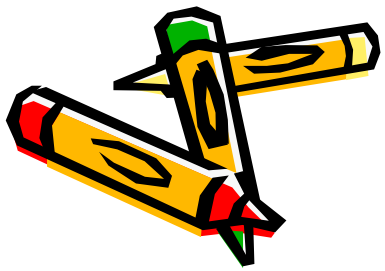
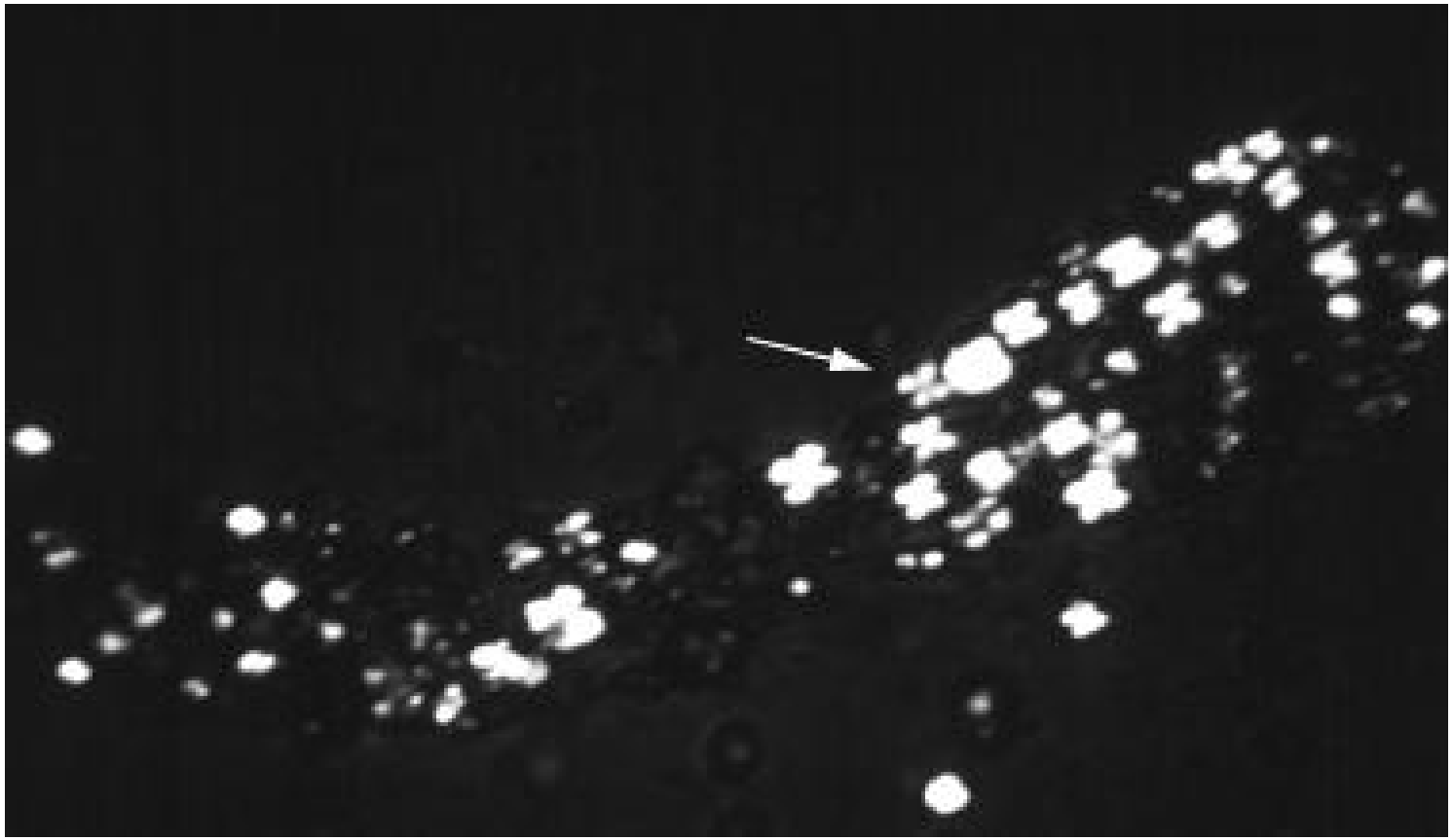
Fatty casts

- **Component**:Lipid-containing renal tubular cells
- **Common clinical situations** : Nephrotic syndrome
- These droplets are composed of cholesterol esters and cholesterol, which may also be observed free in the urine.



Urine sediment showing a fatty cast. The fat droplets (or globules) can be distinguished from red cells (which also have a round appearance) by their variable size (from much smaller to much larger than a red cell), dark outline, and "Maltese cross" appearance under polzarized light.



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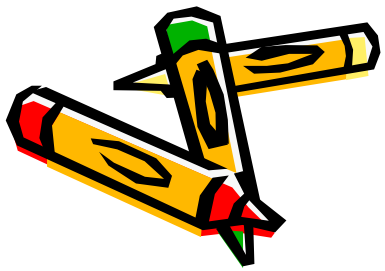
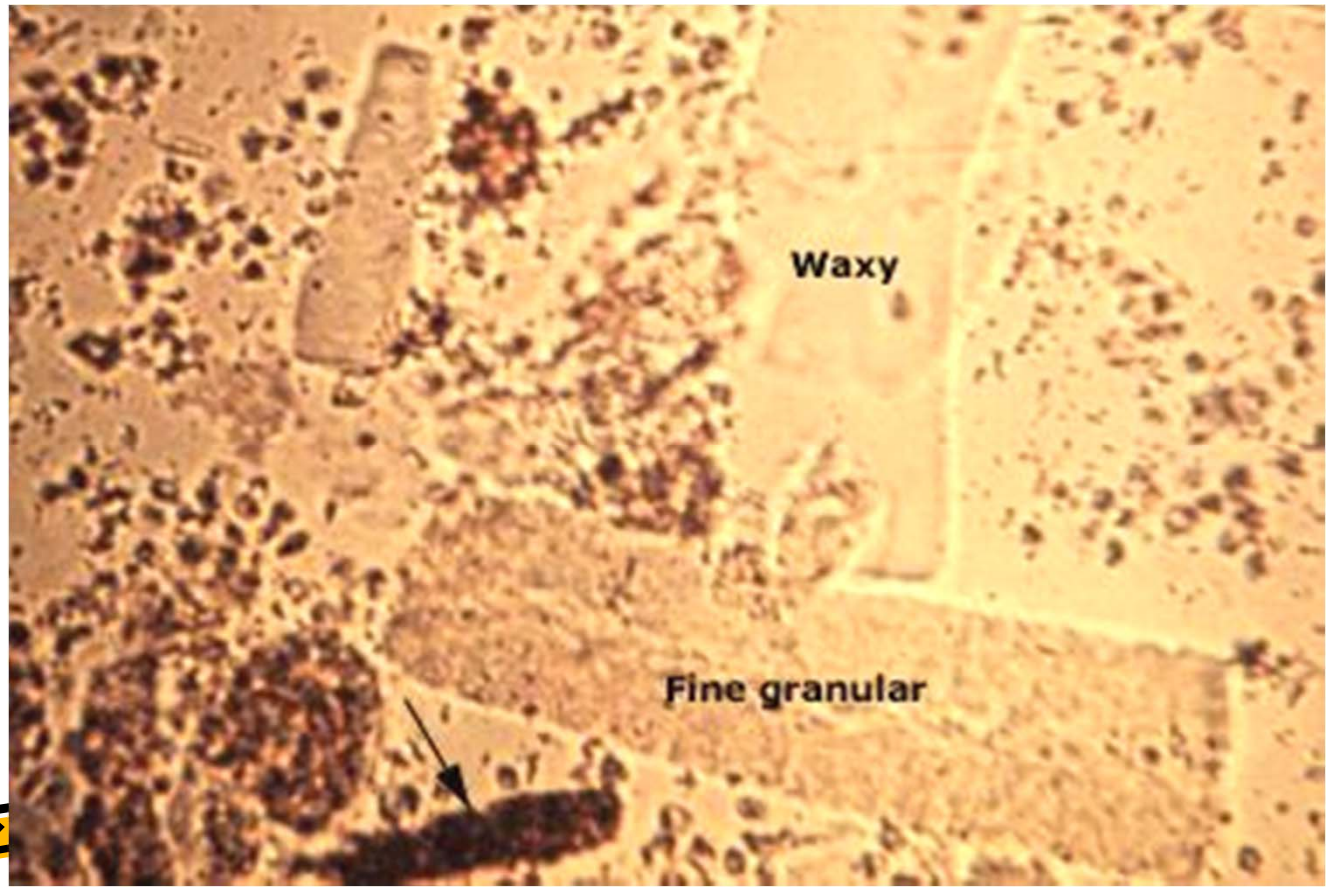
Granular casts

- **Component:** Degenerating cellular casts or aggregated proteins
- **Common clinical situations :** Glomerular disease, tubular disease, pyelonephritis, viral infections



Urine sediment showing waxy and fine and coarse (arrow) granular casts. The broader casts are thought to form when there is stasis (due to advanced renal failure) in the wider collecting tubules into which many nephrons drain



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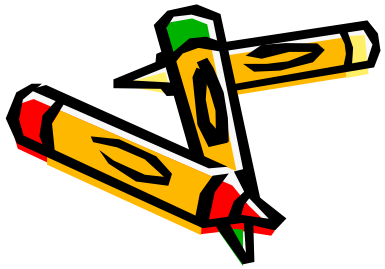
Waxy casts

- **Component:**Last stages of granular cast degeneration
- **Common clinical situations :** Advanced renal failure or other conditions with dilated tubules with diminished flow



Broad casts

- **Component:** As with waxy casts, broad casts, which are wider than other casts and tend to have a granular or waxy appearance, are thought to form in the large tubules of nephrons with little flow.
- **Common clinical situations** : advanced renal failure.