

URINALYSIS



A. Physical Examination

Includes:

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

B. Biochemical Examination

Includes:

1. Proteins.
2. Sugars.
3. Ketone bodies.
4. Bile salts.
5. Bile Pigments.
6. Blood.

C. Microscopic Tests

Include:

1. Cells.
2. Crystals.
3. Casts.
4. Microorganism
5. Parasites.
6. Contamination

Dipstick Urinalysis Interpretation



Leukocytes: Indicates infection or inflammation

Normal=negative

Fb/Nurse-Info

- **Pyuria:** Leukocytes in urine
- **Cystitis:** Bladder infection
- **Pyelonephritis:** Kidney infection

Table 1: Urine studies to order and interpret in four common clinical scenarios

Clinical Scenario:	Order:	Calculate:	Interpretation:
Acute Kidney Injury	Urine Sodium OR Urine Urea Urine Creatinine Serum Sodium OR Serum Urea Serum Creatinine	$\text{FENa: } \frac{\text{Na}_{\text{urine}} \times \text{Cr}_{\text{serum}}}{\text{Na}_{\text{serum}} \times \text{Cr}_{\text{urine}}} \quad \text{OR}$ $\text{FEUrea: } \frac{\text{Urea}_{\text{urine}} \times \text{Cr}_{\text{serum}}}{\text{Urea}_{\text{serum}} \times \text{Cr}_{\text{urine}}}$	<p>If FENa <1%, consider pre-renal and other causes</p> <p>If FEUrea <35%, consider pre-renal and other causes</p>
Hyponatremia	Urine Sodium Urine Osmolality Serum Osmolality	Assess RAAS and ADH action	<p>If Na_{urine} is low, RAAS is likely activated</p> <p>If $\text{Osm}_{\text{urine}}$ is high, ADH is activated</p>
Hypokalemia	Urine Potassium Urine Osmolality Serum Potassium Serum Osmolality	$\text{TTKG: } \frac{\text{K}_{\text{urine}} \times \text{Osm}_{\text{serum}}}{\text{K}_{\text{serum}} \times \text{Osm}_{\text{urine}}}$	If TTKG is high, consider renal potassium losses
Normal anion gap metabolic acidosis	Urine Sodium Urine Potassium Urine Chloride	$\text{UAG: } \text{Na}_{\text{urine}} + \text{K}_{\text{urine}} - \text{Cl}_{\text{urine}}$	<p>If UAG is positive, consider renal causes of acidosis</p> <p>If UAG is negative, consider GI causes of acidosis</p>

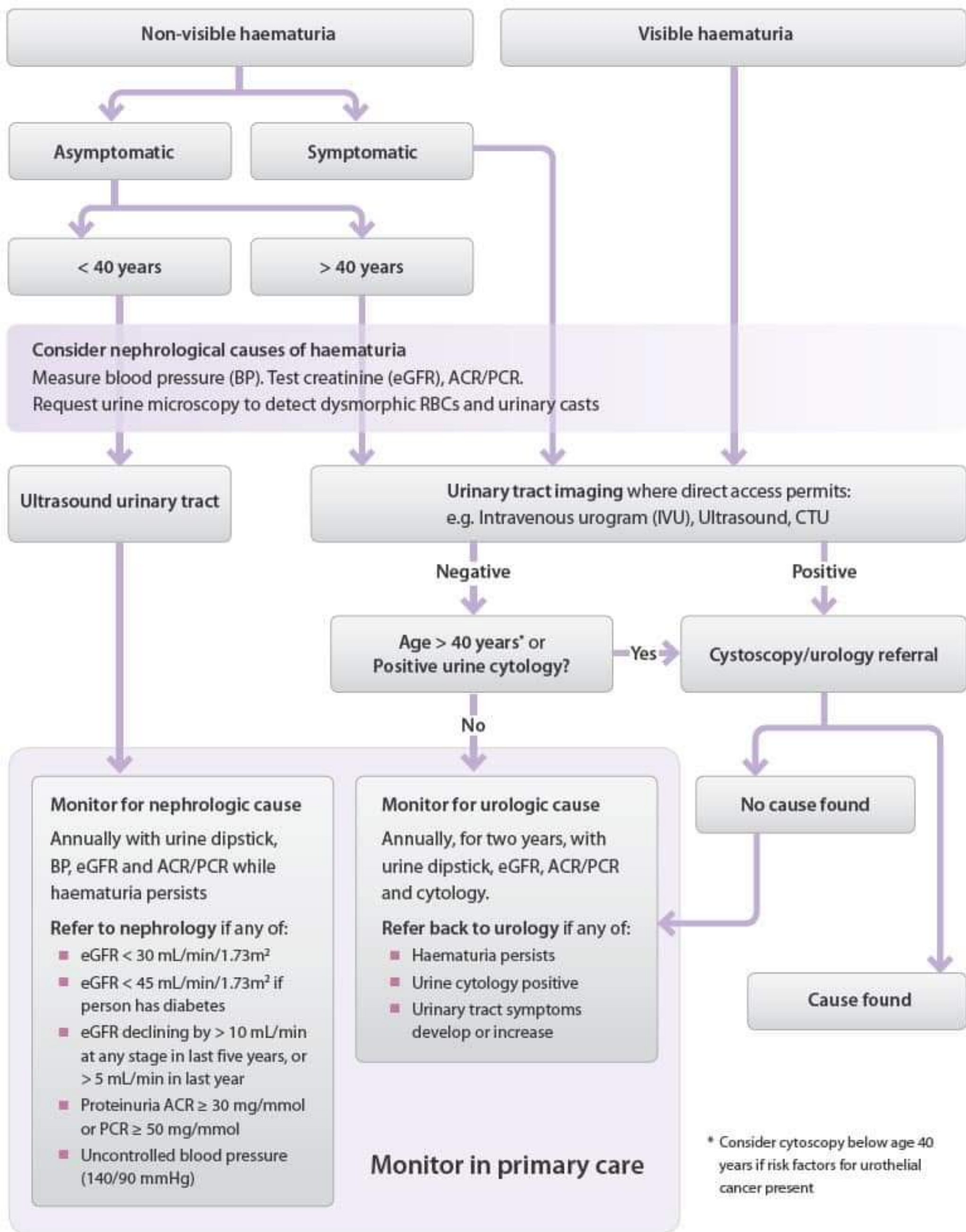


Table 1. Urinalysis Results

Test	Usual Range	Indicators of Infection	Accuracy
Bacteria	Absent	Any amount	Low sensitivity, ^a high specificity ^b
Leukocyte esterase	Absent	Positive = pyuria, presence of WBCs in urine	High sensitivity, low specificity
WBC	<5	Pyuria: WBC >10	High sensitivity, low specificity
Nitrite	Absent	Positive = presence of bacteria that reduce nitrate	Low sensitivity, high specificity
RBC	<5	Hematuria common in infection	Low sensitivity, high specificity
Epithelial cells	<5	<5 = good urine sample	High epithelial cells indicate contamination with skin flora
pH	4.5-8	pH ↑ if urea-splitting organism (e.g., <i>Proteus mirabilis</i>) is present	Low specificity (there are many other causes of alkaline urine)

^a Sensitivity = likelihood of positive test when disease is present.

^b Specificity = likelihood of negative test when disease is not present.

Source: Reference 1.

Types of urine sample

Sample type	Sampling	Purpose
Random specimen	No specific time most common, taken anytime of day	Routine screening, chemical & FEME
Morning sample	First urine in the morning, most concentrated	Pregnancy test, microscopic test
Clean catch midstream	Discard first few ml, collect the rest	Culture
24 hours	All the urine passed during the day and night and next day 1 st sample is collected.	used for quantitative and qualitative analysis of substances
Postprandial	2 hours after meal	Determine glucose in diabetic monitoring
Supra-pubic aspired	Needle aspiration	Obtaining sterile urine

White Cell Casts

- Usually indicates pyelonephritis (kidney infection)
- Other causes: Interstitial Nephritis (inflammation of the tubules and the spaces between the tubules and the glomeruli.)





Specific Gravity Densidad Densidade 60 sec/seg.								
	1.000	1.005	1.010	1.015	1.020	1.025	1.030	
pH 60 sec/seg.								
	5.0	6.0	6.5	7.0	8.0	9.0		
Leukocytes Leucocitos 60-120 sec/seg.								
	neg.	ca. 15	ca. 75	ca. 125	ca. 500	Leuko/ μ L		
Blood/Hemoglobin/ Sang(re)(ue)/Hemoglobina 60 sec/seg.								
	neg.	ca. 5-10	ca. 10	ca. 25	ca. 25	ca. 50	ca. 50	ca. 250 Ery/ μ L
Nitrite/Nitrito/Nitritos 60 sec/seg.								
	neg.	+	++					
Ketones/ C.Cetónicos 60 sec/seg.								
	neg.	5 (0.5)	15 (1.5)	50 (5)	150 (15)	mg/dL (mmol/L)		
Bilirubin/Bilirrubina/ 60 sec/seg.								
	neg.	+	++	+++				
Urobilinogen(o)/ Urobilinogênio 60 sec/seg.								
	normal	1 (17)	4 (70)	8 (140)	12 (200)	mg/dL (μ mol/L)		
Protein/Proteínas/ Proteínas 60 sec/seg.								
	neg.	15 (0.15)	30 (0.3)	100 (1)	300 (3)	1000 (10)	mg/dL (g/L)	
Glucose/Glucosa/ Glicose 60 sec/seg.								
	normal	100 (5.5)	300 (17)	1000 (55)	mg/dL (mmol/L)			



IVD



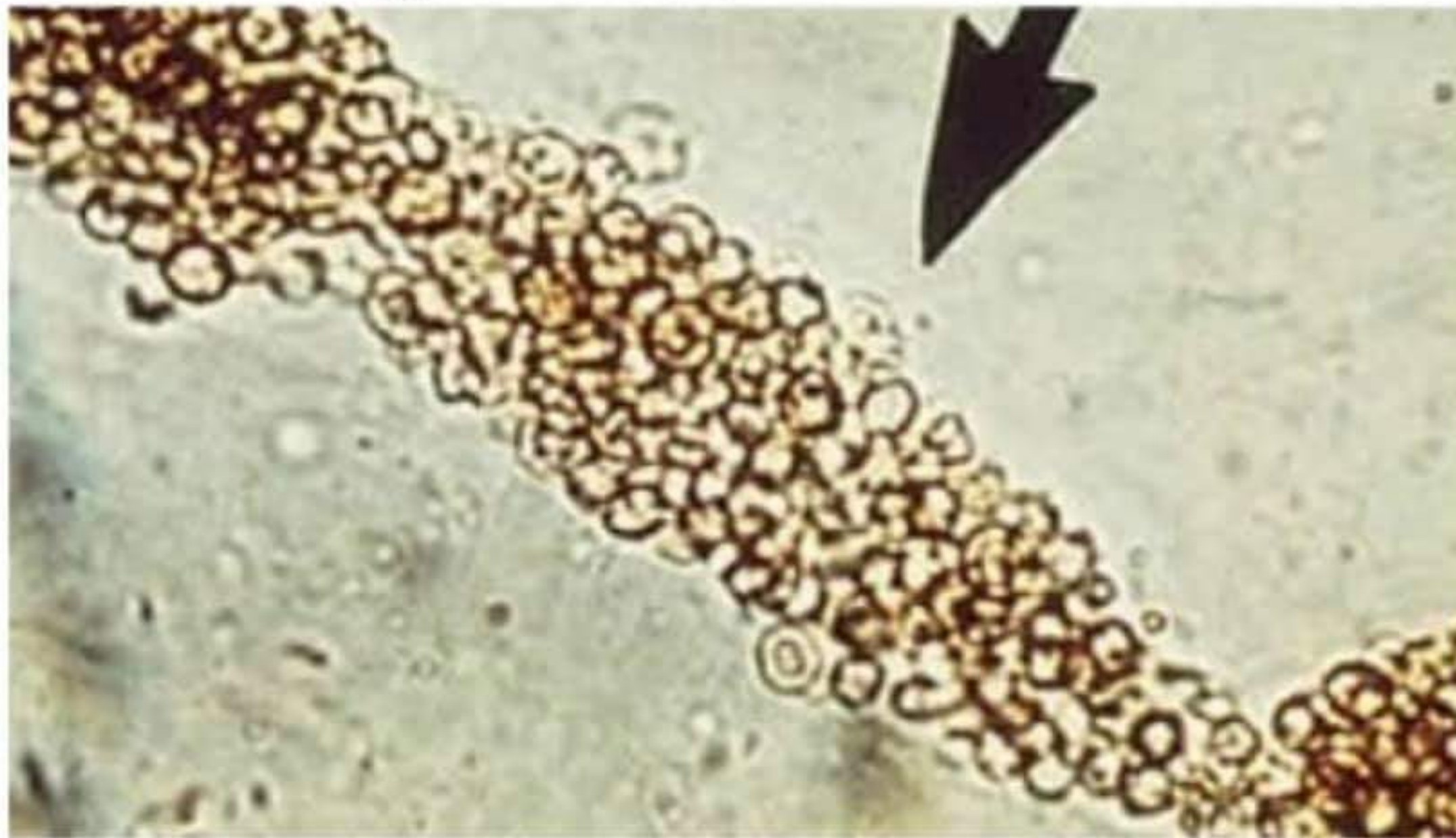
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LOT

Red Cell Casts

- Red blood cells may stick together and form red blood cell casts.
- Indicative of glomerulonephritis, with leakage of RBC's from glomeruli, or severe tubular damage.



Hyaline Casts

- Hyaline casts are composed primarily of a mucoprotein (Tamm-Horsfall protein) secreted by tubule cells.



Hyaline Casts appear Transparent

- **Causes:** Low flow rate, high salt concentration, and low pH, all of which favor protein denaturation and precipitation of the Tamm-Horsfall protein.

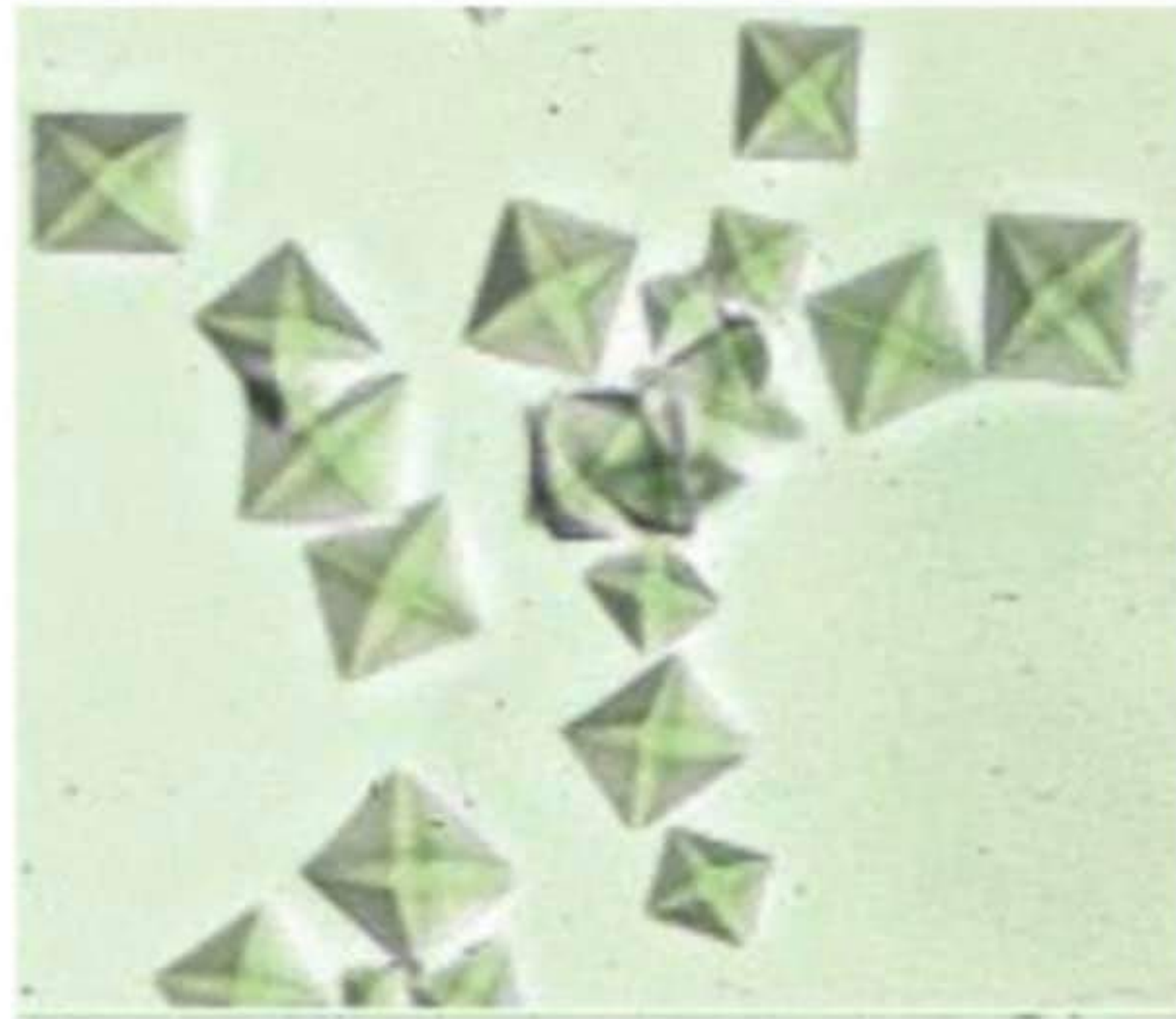
Microscopic Examination

Casts

- **Casts:** hardened cell fragments formed in the distal convoluted tubules and collecting ducts
- Usually pathological
- Can only be seen with microscopic examination

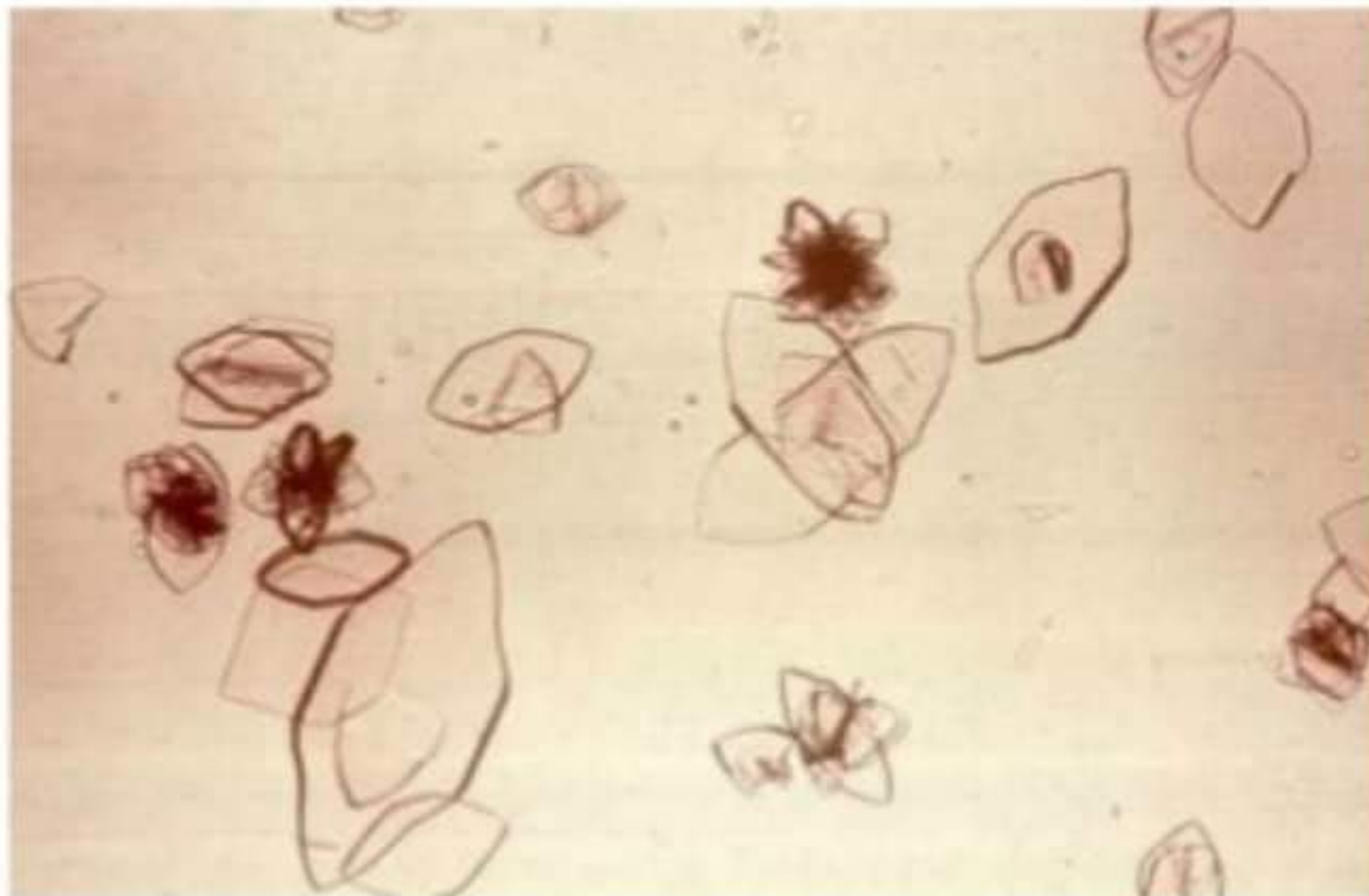
Calcium Oxalate Crystals

- They can occur in urine of any pH.
- Causes: Dietary asparagus and ethylene glycol (antifreeze) intoxication



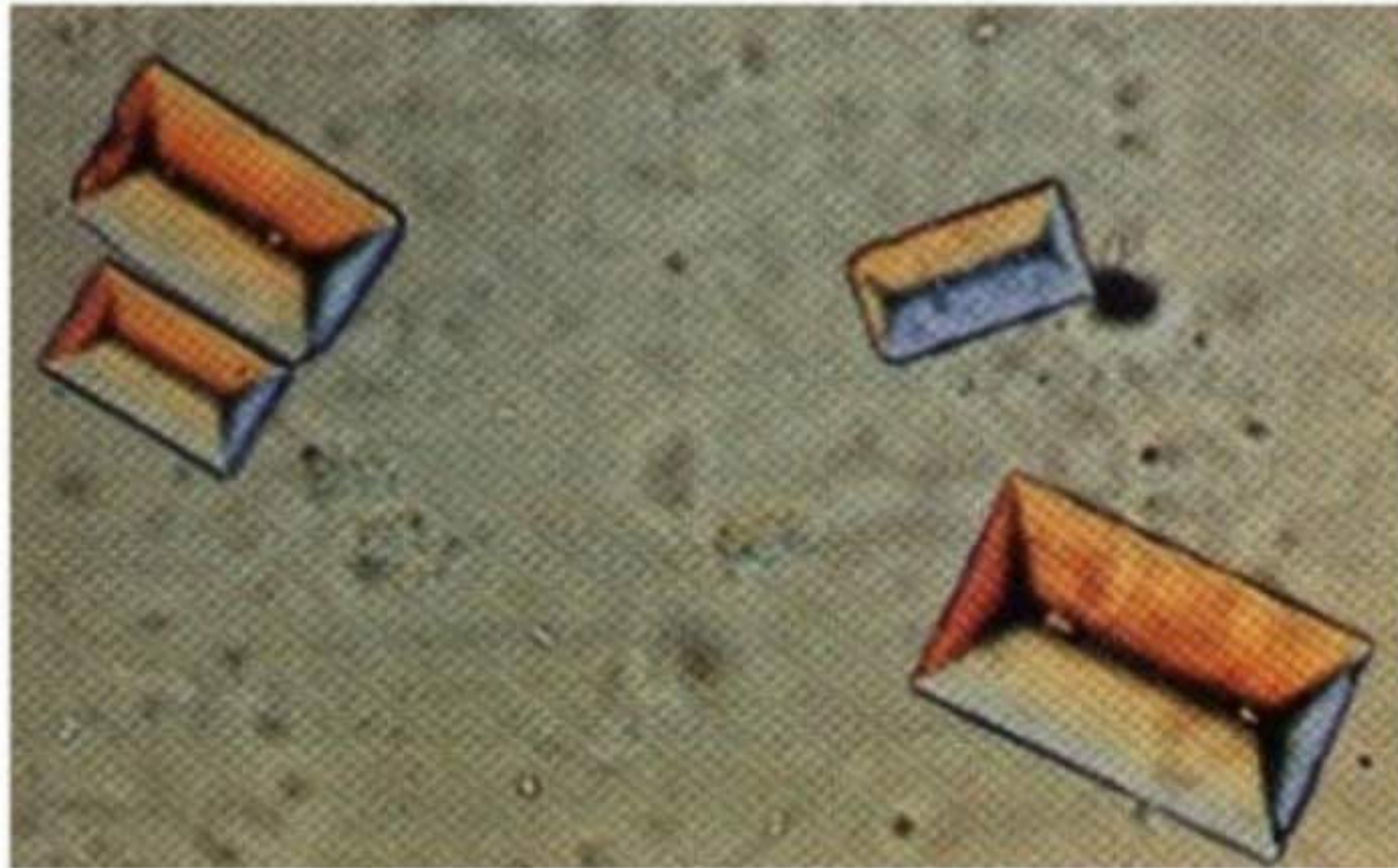
Uric Acid Crystals

- High uric acid in blood (by-product of purine digestion/high protein diet)
- Associated with gout (arthritis)



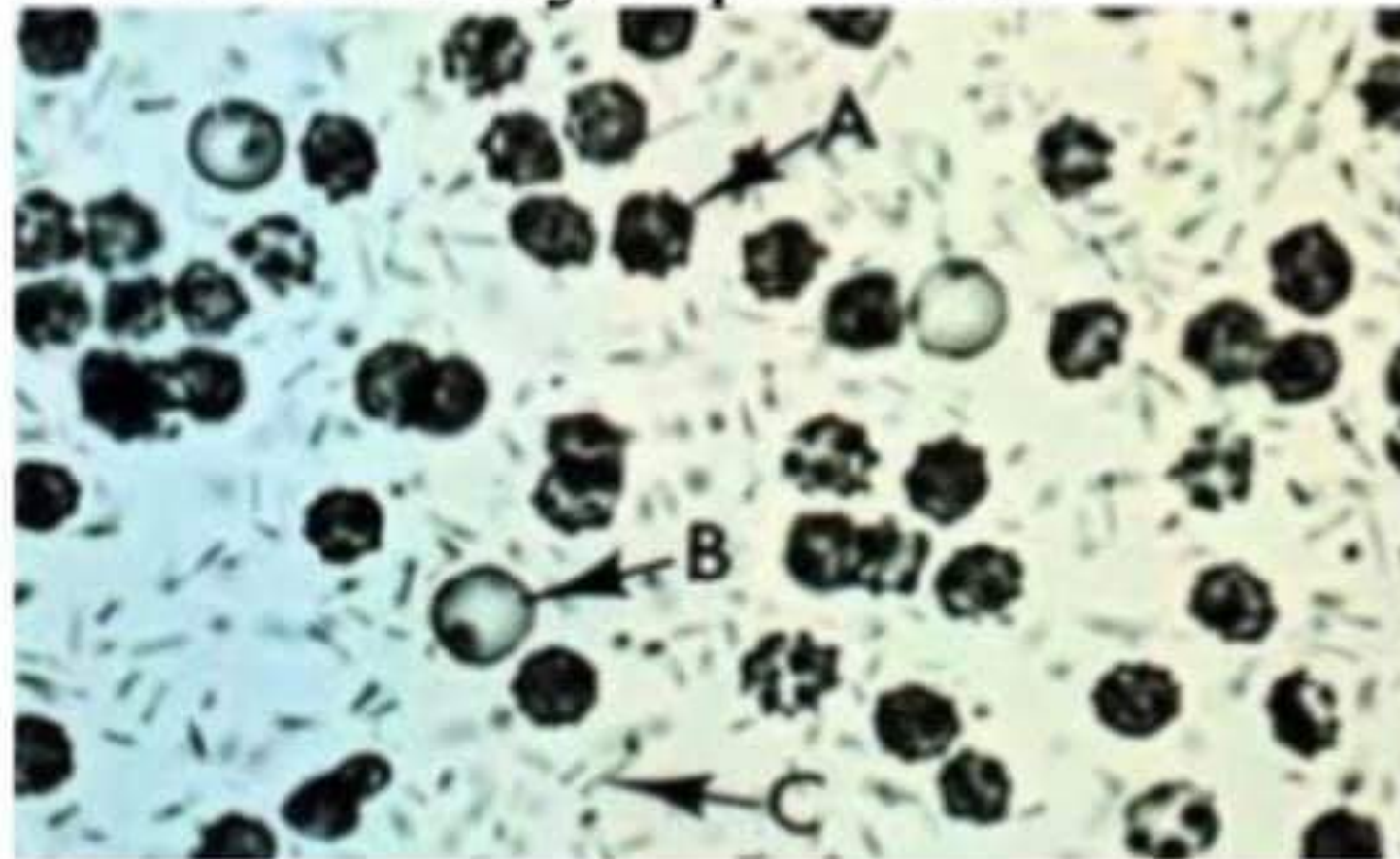
Struvite Crystals

- Formation is favored in alkaline urine.
- Urinary tract infection with urease producing bacteria (eg. *Proteus vulgaris*) can promote struvite crystals by raising urine pH and increasing free ammonia.



Microscopic Examination Bacteria

- Bacteria are common in urine specimens (from contamination)
- Therefore, microbial organisms found in all but the most scrupulously collected urines should be interpreted in view of clinical symptoms.



A = crenated RBC, B = RBC, C =

Microscopic Examination

Epithelial Cells

- Transitional epithelial cells originate from the renal pelvis, ureters, bladder and/or urethra.
- Large sheets of transitional epithelial cells can be seen in bladder cancer.



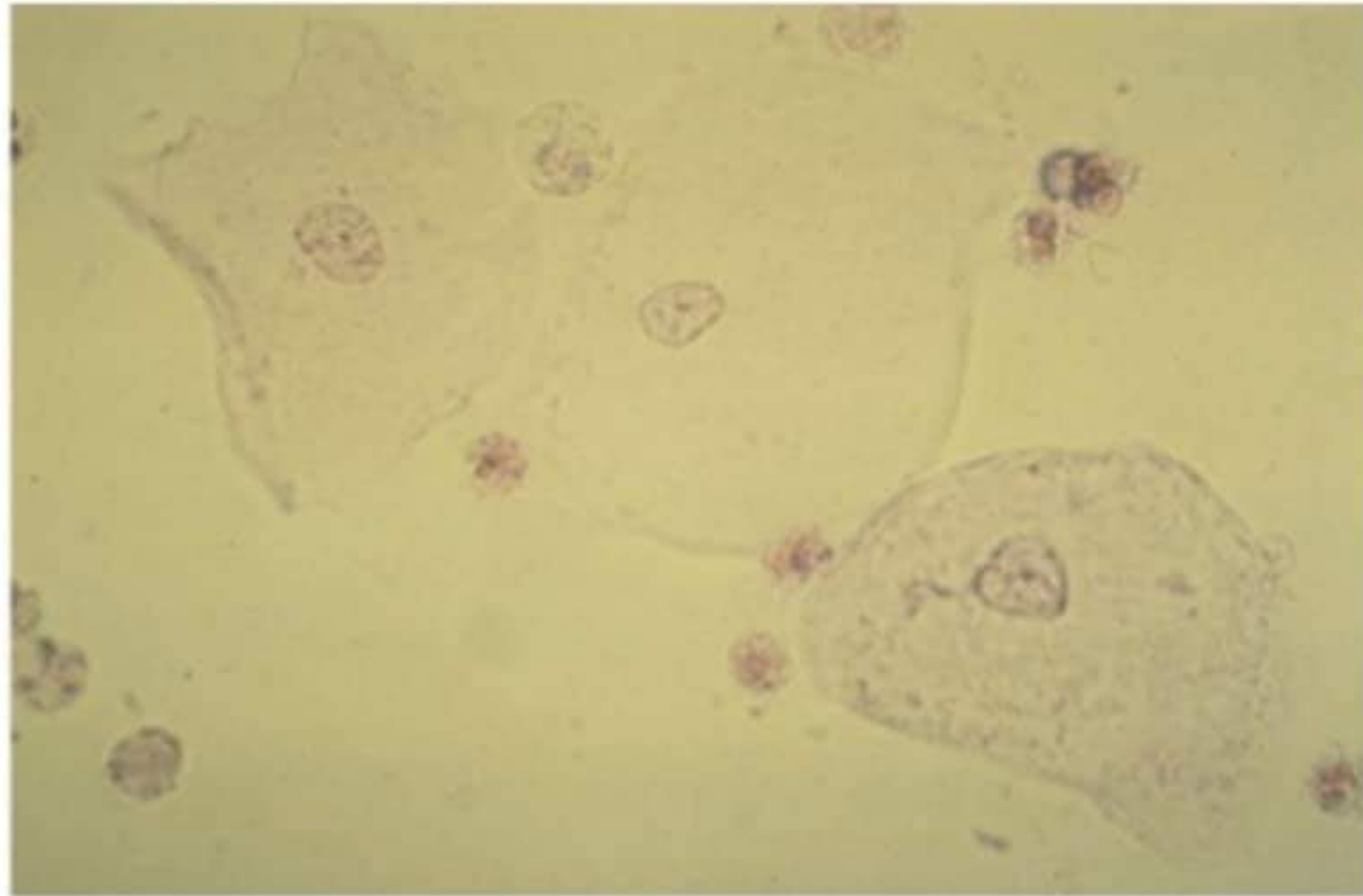
Squamous epithelial cell



Transitional epithelial cell

Microscopic Examination Epithelial Cells

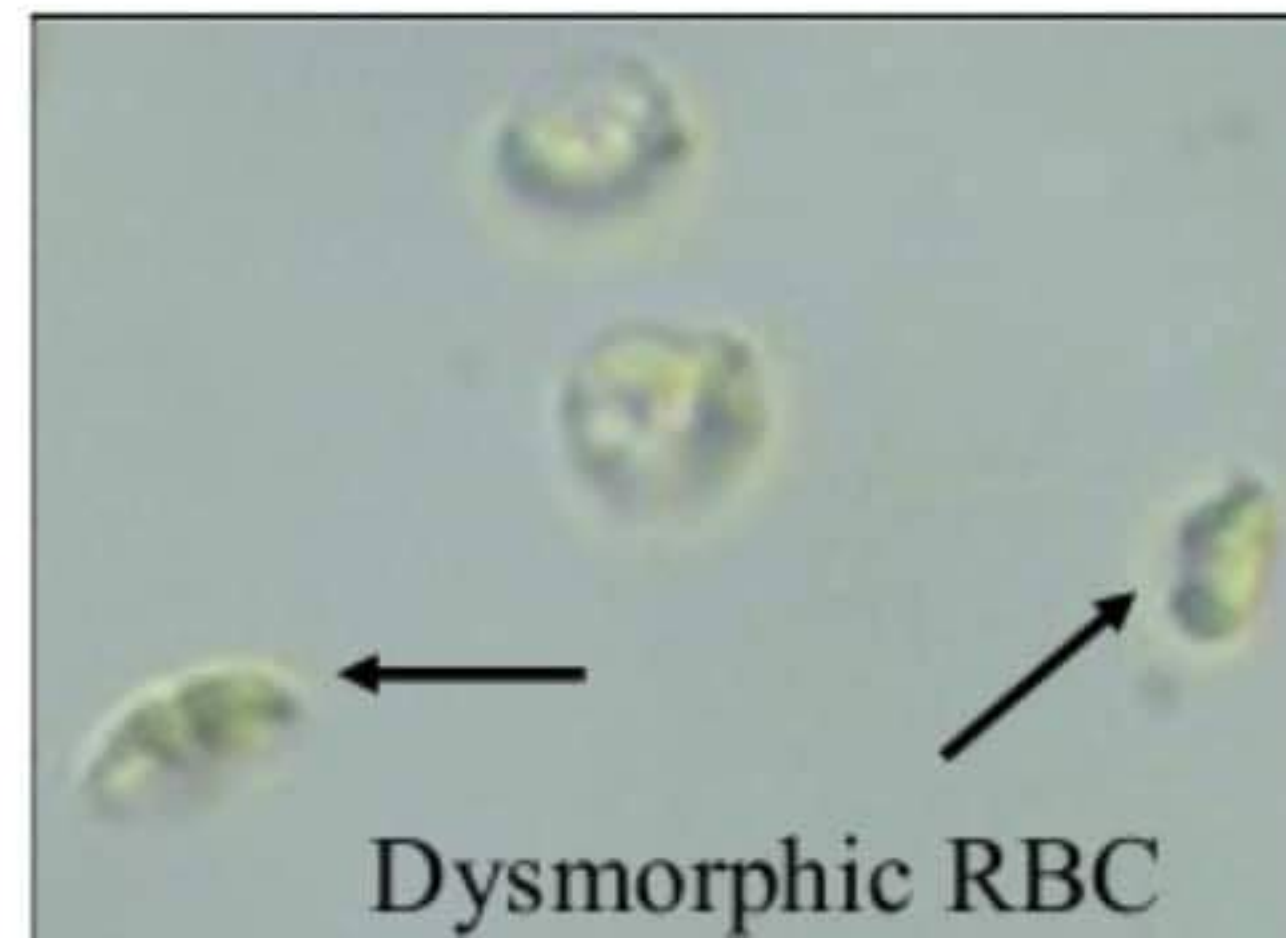
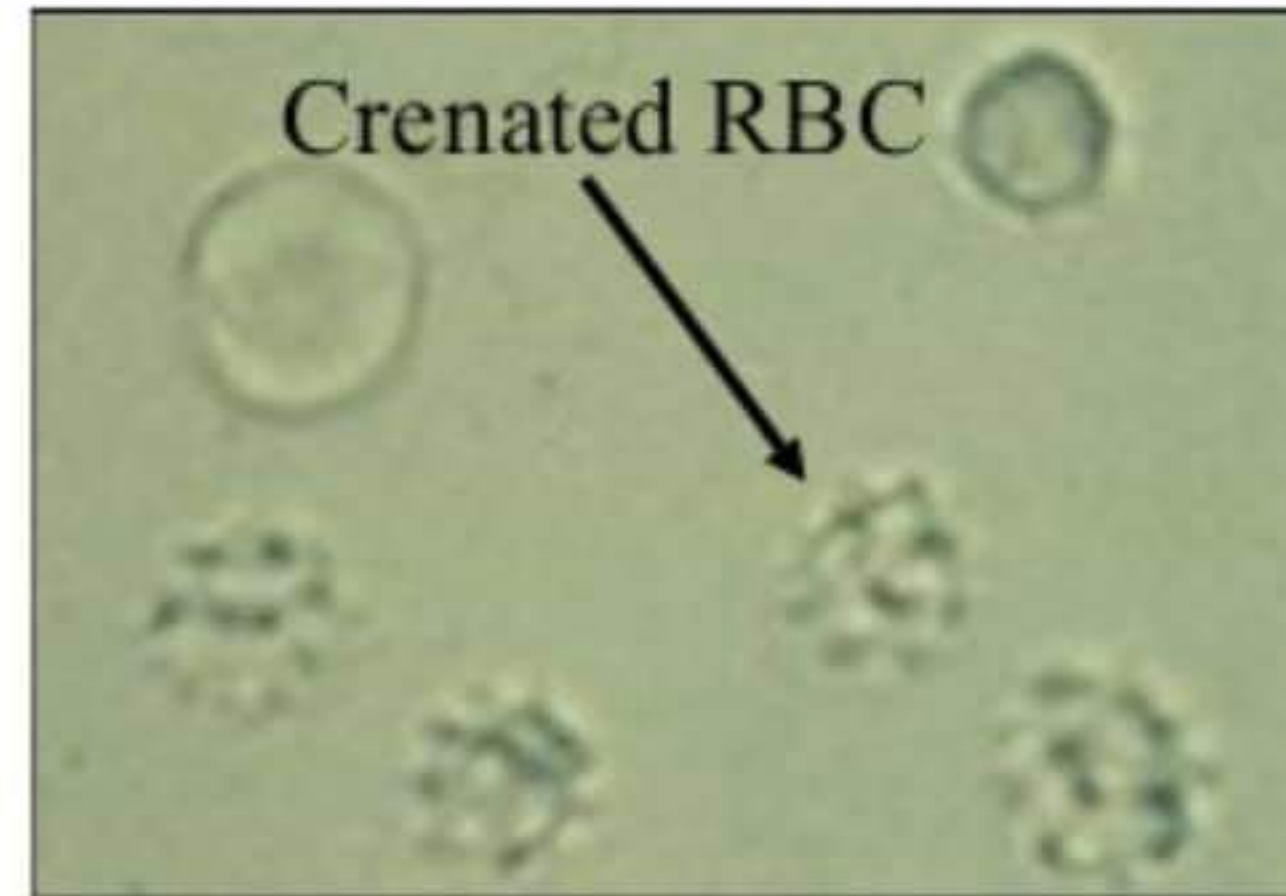
- Too many squamous cells: suggest contamination, poor specimen collection



Microscopic Examination

Hematuria: RBC in Urine

- RBC's may appear normally shaped, swollen by dilute urine or crenated by concentrated urine.
- The presence of dysmorphic (odd shaped) RBC's in urine suggests a glomerular disease such as a glomerulonephritis.



Microscopic Examination

Pyuria: WBC in Urine

- **Normal:**
 - Men: <2 WBCs per hi power field
 - Women: <5
- WBC generally indicate the presence of an inflammatory process somewhere along the course of the urinary tract

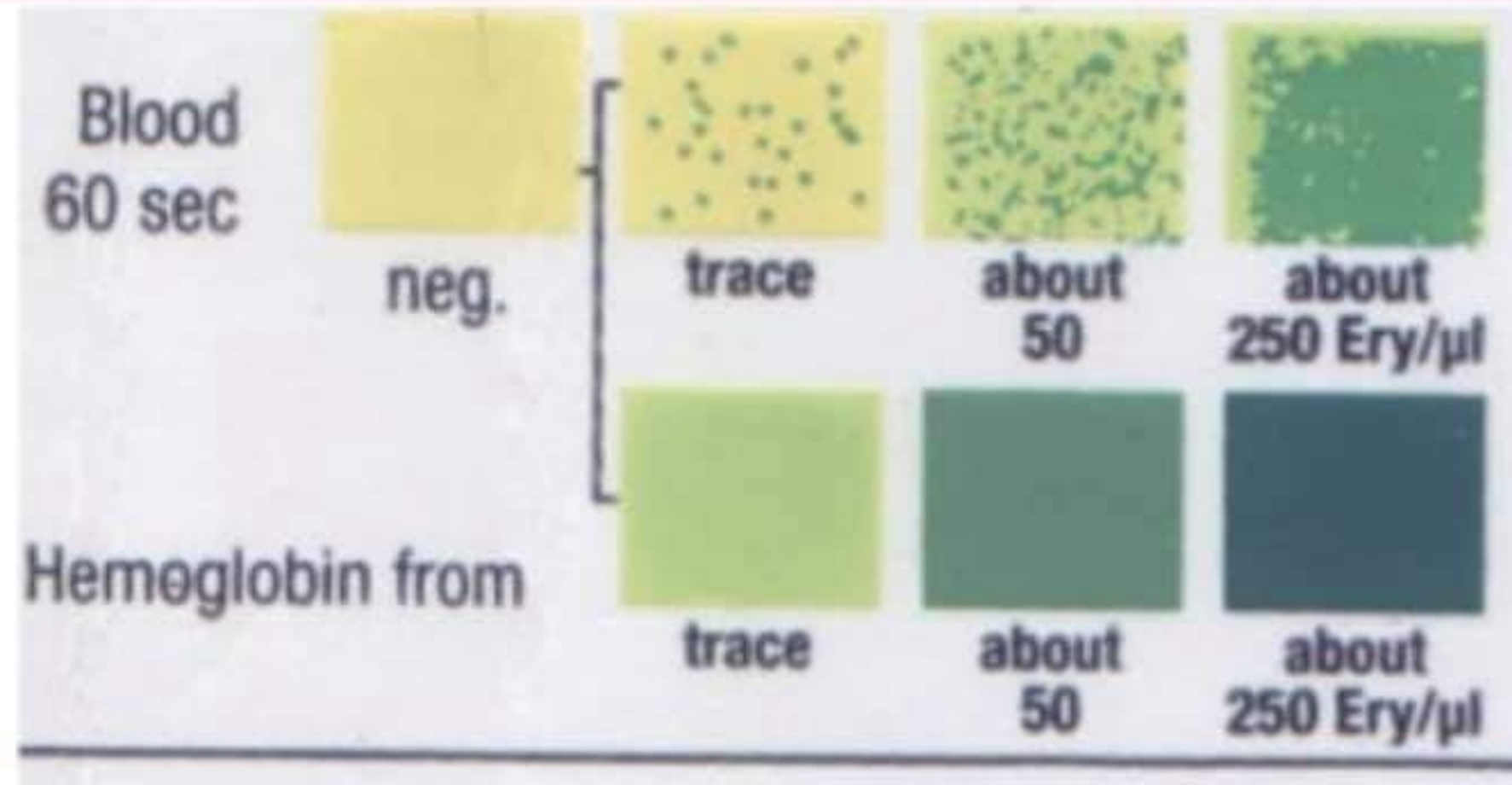


Chemical Analysis

- **Sulfates:** Normal constituent of urine
 - The urinary sulfate is mainly derived from sulfur-containing amino acids and is therefore determined by protein intake.
- **Phosphates:** Normal constituent of urine
 - Important for buffering H^+ in the collecting duct
- **Chlorides:** Normal constituent of urine.
 - Major extracellular anion.
 - Its main purpose is to maintain electrical neutrality, mostly as a counter-ion to sodium.
 - It often accompanies sodium losses and excesses.

Dipstick Urinalysis Interpretation

Blood: Almost always indicates pathology because RBC are too large to pass through glomerulus



Normal=negative

- **Hematuria:** Blood in urine
- Possible causes: Kidney stone, infection, tumor
- **Caution:** Very common finding in women because of menstruation.

Dipstick Urinalysis Interpretation



Bilirubin: indicates the presence of liver disease or biliary obstruction

Normal=negative

- **Bilirubinuria:** appearance of bilirubin in urine
 - Yellow foam when sample is shake

Dipstick Urinalysis Interpretation



Ketones: Intermediate products of fat metabolism

- Urine testing only detects acetoacetic acid, not the other ketones, acetone or beta-hydroxybuteric acid.
- **Normal=negative or trace amounts**
 - **Ketonuria:** ketones in urine
- (Ketonuria + glucose in urine may indicate diabetes mellitus)

Dipstick Urinalysis Interpretation



Glucose: In general the presence of glucose indicates that the filtered load of glucose exceeds the maximal tubular reabsorptive capacity for glucose.

Normal=negative

- **Glycosuria:** Glucose in urine

Dipstick Urinalysis Interpretation

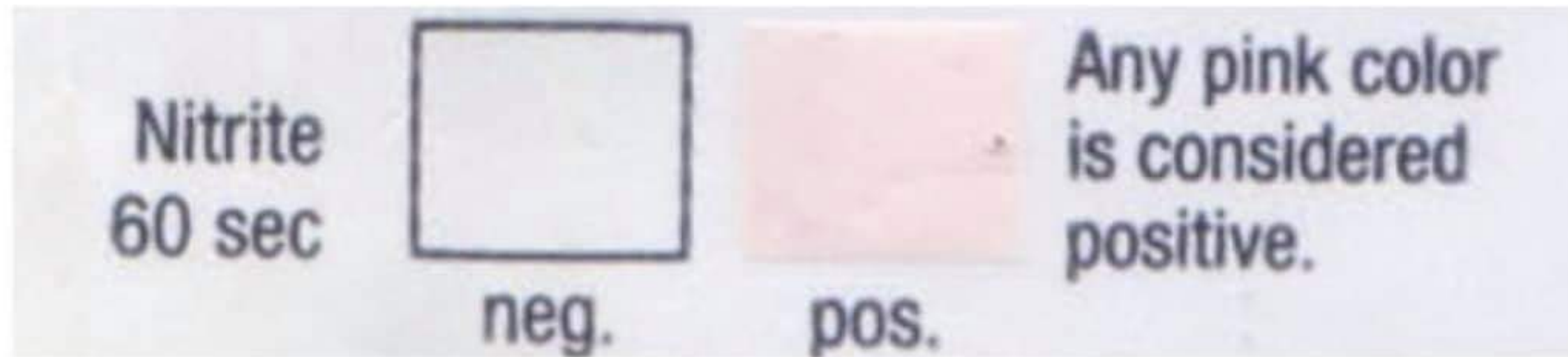


Protein: Usually proteins are too large to pass through glomerulus (Proteinuria usually represents an abnormality in the glomerular filtration barrier.)

Normal=negative

- Trace amounts normal in pregnancy or after eating a lot of protein
- **Albuminuria:** Albumin in urine

Dipstick Urinalysis Interpretation



Nitrite: Might indicate bacterial infection with gram-negative rods (like *E. coli*)

Normal=negative