Urinalysis

- **An important test for several organ systems. For some things, as important as blood tests or more important than blood tests!!!**
- Tests for
  - Urinary Tract Infection
  - Diabetes screening test
  - Renal (Kidney) Disease
  - Rule in or out UTI in dog's with incontinence
  - Endocrine Disease
    - Cushing's Disease
    - Diabetes Mellitus
    - Diabetes Insipidus

INTRODUCTION

- Urinalysis may be defined as the practice of examining urine as an aid in diagnosis and in following the course of treatment of a disease.

- Specimens for studies are easily obtained, tests are sensitive early detectors of disease, methodology is relatively convenient.

- In general, the concentration of most substances normally found in urine reflects the plasma level of the substances (Cavanaugh, 2003)

URINE FORMATION

- Urine is a unique body fluid formed by a process of glomerular filtration, selective tubular secretion and reabsorption of constituents by the kidneys (Agbedana and Anetor, 2006).

- 25% of cardiac output perfuses the kidney each minute.

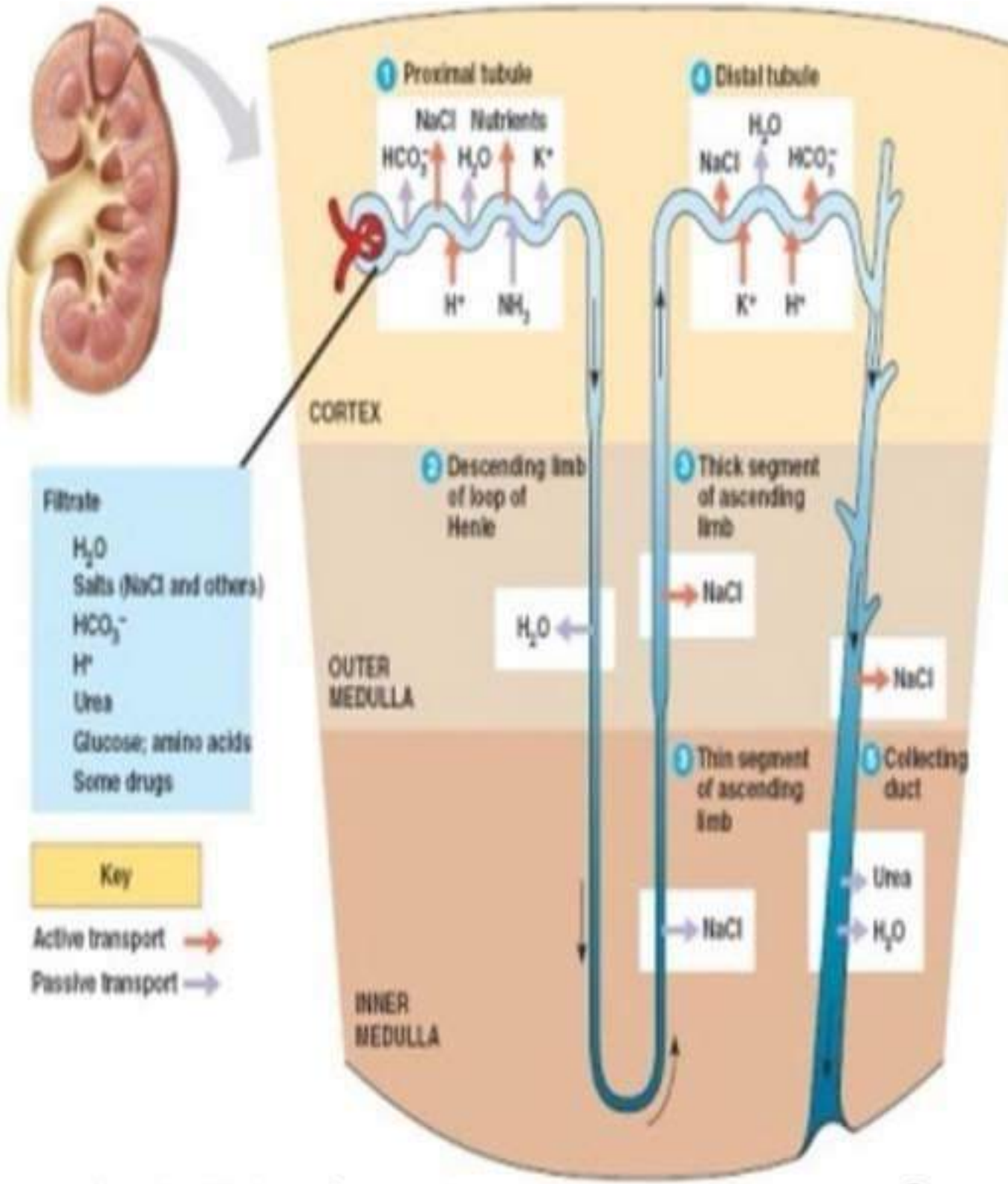


Fig. 2: Urine formation

The Urine Dipstick

- Commercially made test strips
- Color pads are exposed to urine and compared to a chart on the test strip bottle
- In our office, kept in the cabinet above the fecal workstation

URINE SPECIMEN COLLECTION

TYPES OF URINE SPECIMEN COLLECTION:

- SPOT
  - FIRST MORNING SPECIMEN
  - RANDOM SPECIMEN
  - SECOND VOIDED SPECIMEN
- TIMED
  - POST PRANDIAL
  - 2-HOURS VOLUME
  - 24-HOUR VOLUME
- CATHETERIZED

(Agbedana and Anetor, 2006; Sanford and McPherson, 2011)

Chemical Composition of Urine

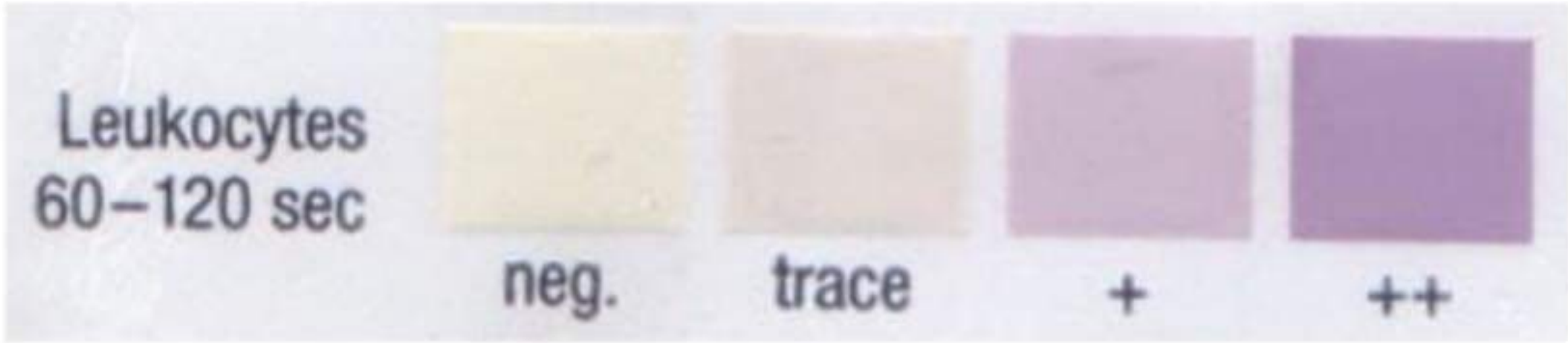
- Urine is 95% water and 5% solutes
- Nitrogenous wastes include urea, uric acid, and creatinine
- Other normal solutes include:
  - Sodium, potassium, phosphate, and sulfate ions
  - Calcium, magnesium, and bicarbonate ions
- Abnormally high concentrations of any urinary constituents may indicate pathology

Urinalysis

- "Dipstick" method: chemical reactions cause color changes on ten different pads on the test strip.

1. Leukocytes
2. Nitrite
3. Urobilinogen
4. Protein
5. pH
6. Blood
6. Blood
7. Ketones
8. Bilirubin
9. Glucose

Dipstick Urinalysis Interpretation

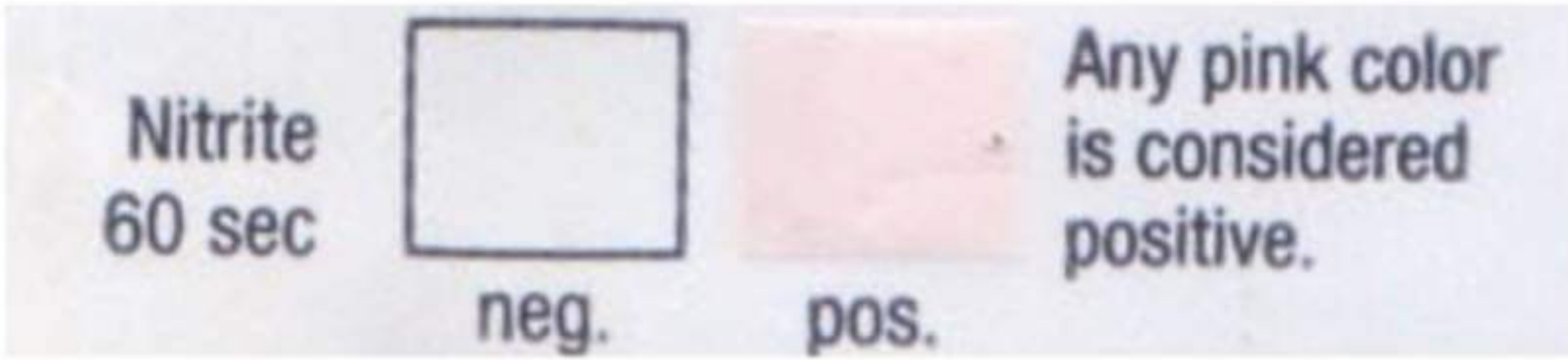


Leukocytes: Indicates infection or inflammation

Normal=negative

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

Dipstick Urinalysis Interpretation



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

Normal=negative

Dipstick Urinalysis Interpretation

pH: large range 4.5 to 8.0

- The urine pH should be recorded, although it is seldom of diagnostic value.
  - Diet can alter pH
    - Acidic: high protein diet, ketoacidosis
    - Alkaline: vegetarian diet, UTI
  - Phosphates will precipitate in an alkaline urine, and uric acid will precipitate in an acidic urine.

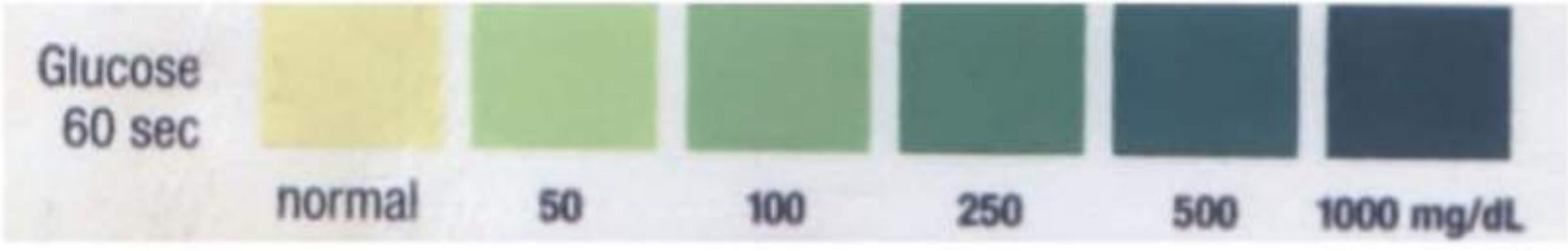
Dipstick Urinalysis Interpretation

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

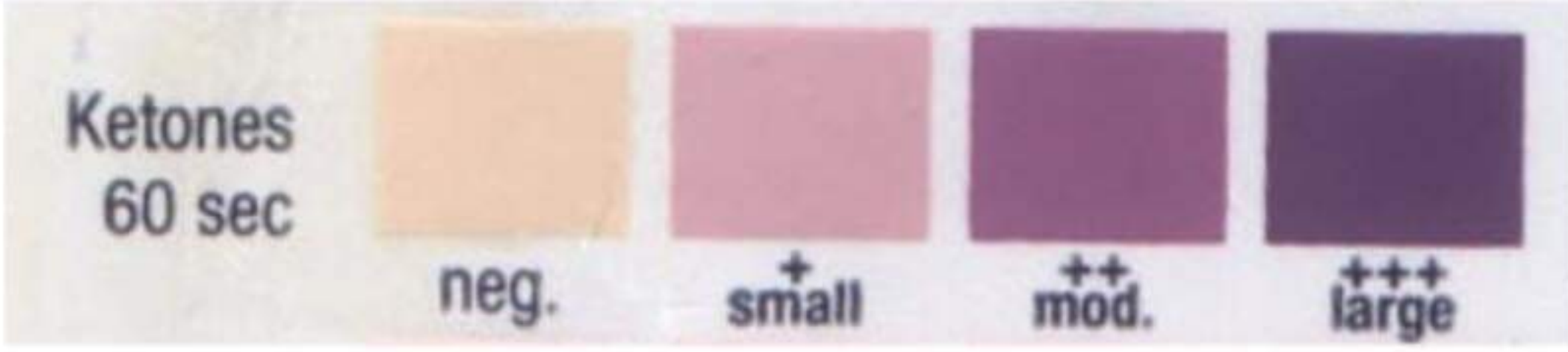


Glucose: In general the presence of glucose indicates that the filtered load of glucose exceeds the maximal tubular reabsorptive capacity for glucose.

Normal=negative

- Glycosuria: Glucose in urine

Dipstick Urinalysis Interpretation

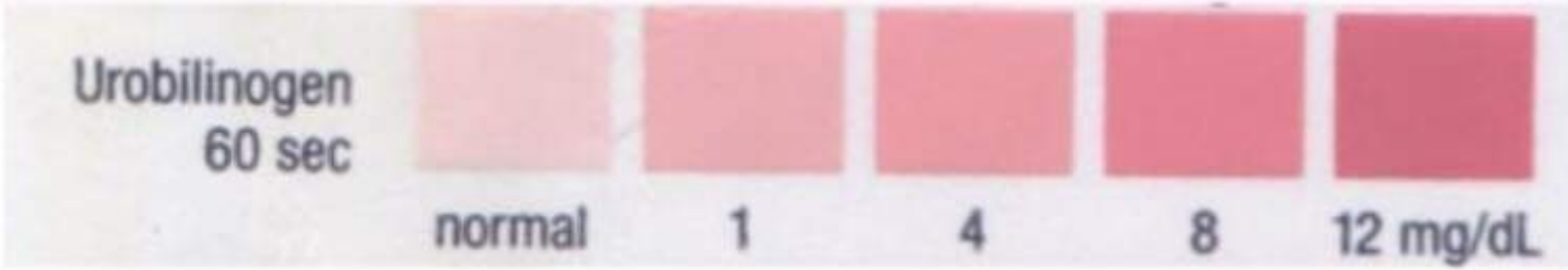


Ketones: Intermediate products of fat metabolism

- 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

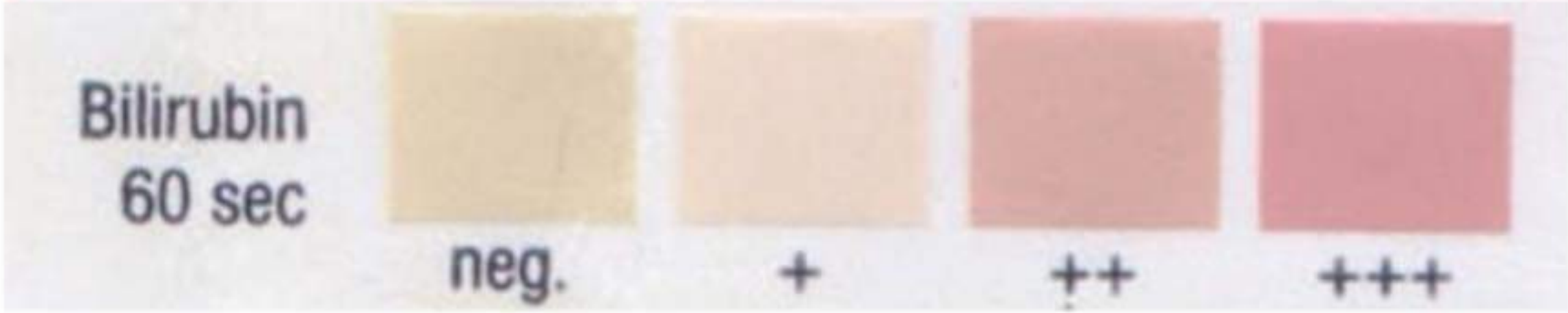


Urobilinogen: Produced in the intestine from bilirubin.

Normal=small amount

- Absence: renal disease or biliary obstruction
- Increased in any condition that causes an increase in production or retention of bilirubin
  - Hepatitis, cirrhosis or biliary disease

Dipstick Urinalysis Interpretation



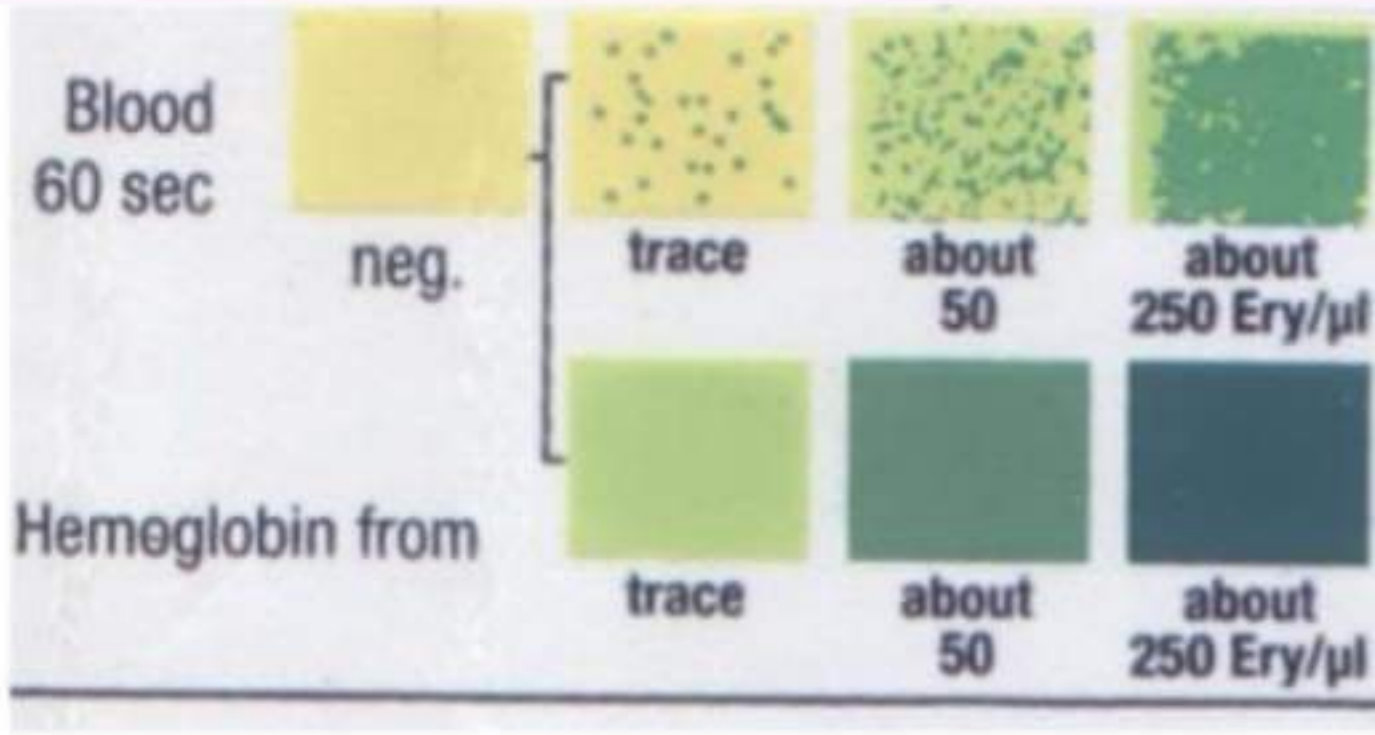
Bilirubin: indicates the presence of liver disease or biliary obstruction

Normal=negative

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

Dipstick Urinalysis Interpretation

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.

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.

Chemical Analysis

- Urea: The end product of protein breakdown

- Uric acid: A metabolite of purine breakdown

- Creatinine: Associated with muscle metabolism of creatine phosphate.

Microscopic Examination

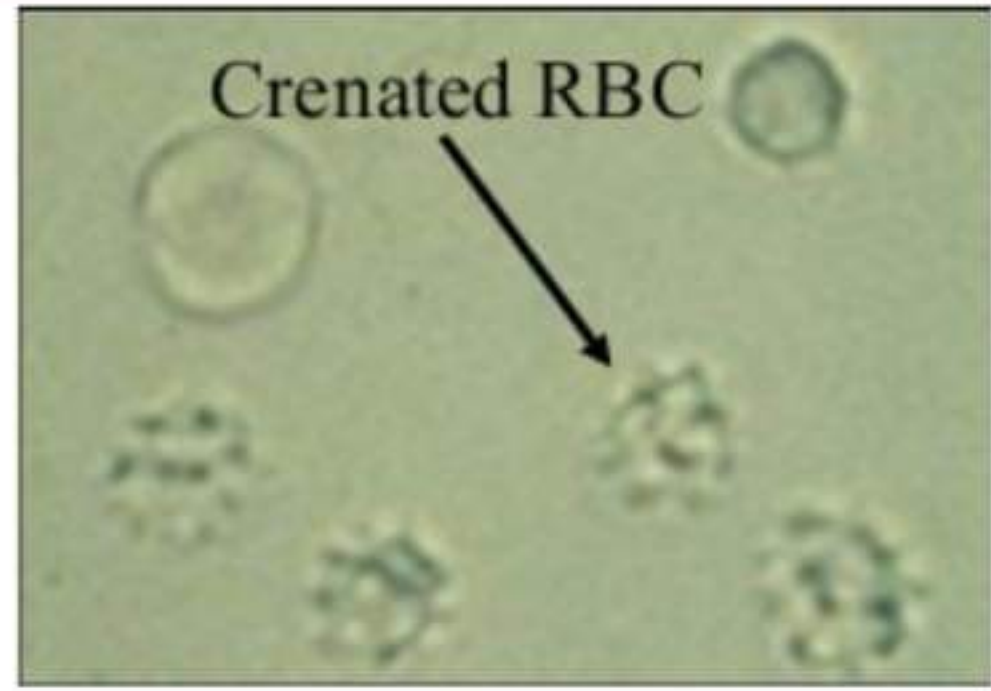
Pyuria: WBC in Urine

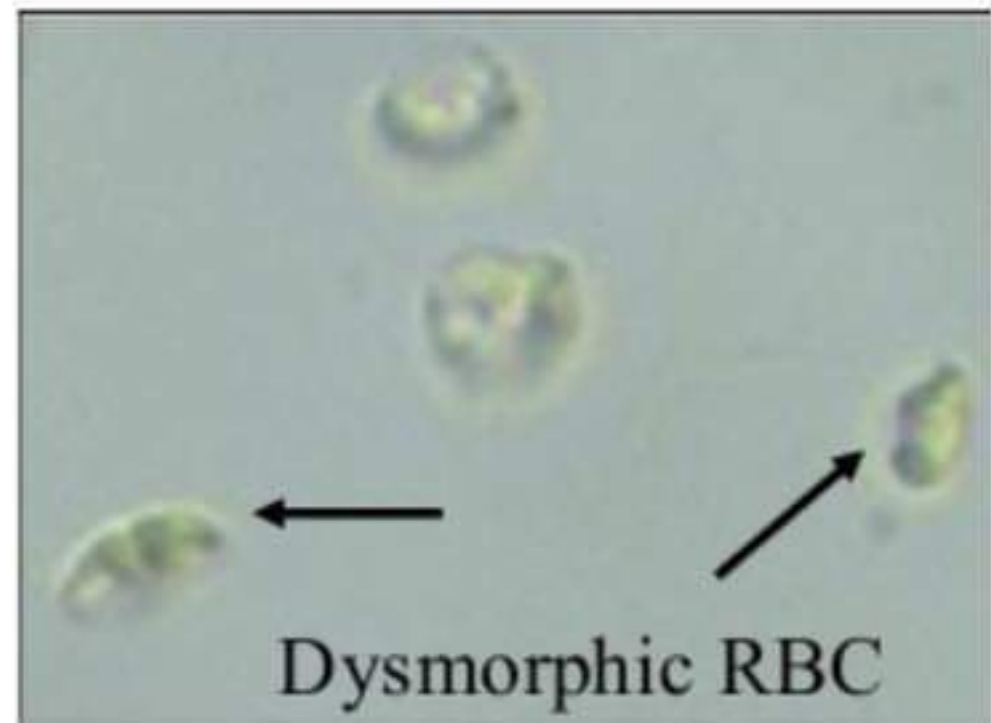
- Normal:
  - Men: <2 WBCs per hi power field
  - Women: <5
- WBC generally indicate the presence of an inflammatory process somewhere along the course of the urinary tract

Microscopic Examination

Hematuria: RBC in Urine

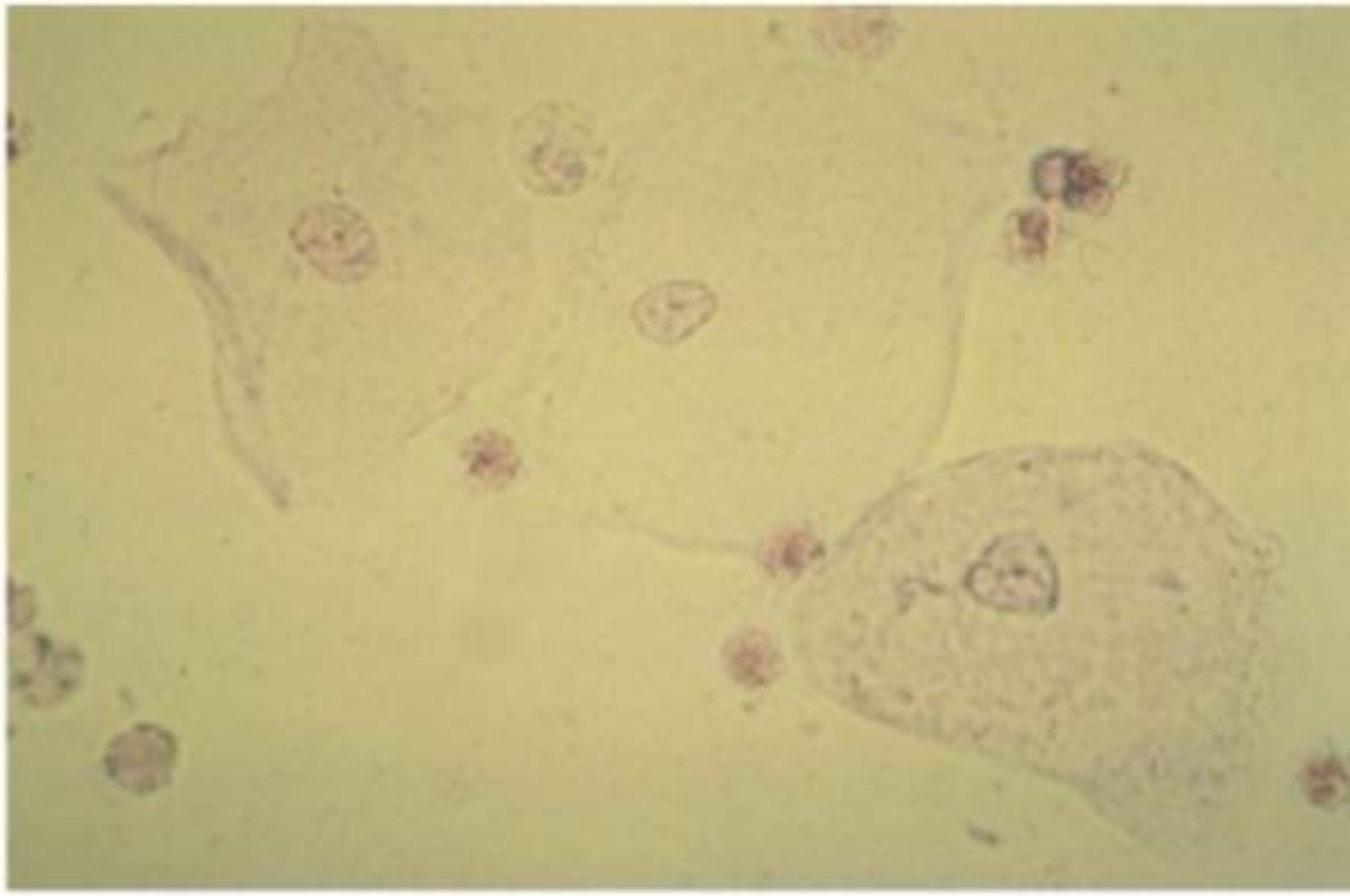
- RBC's may appear normally shaped, swollen by dilute urine or crenated by concentrated urine.
- The presence of dysmorphic (odd shaped) RBC's in urine suggests a glomerular disease such as a glomerulonephritis.





Microscopic Examination
Epithelial Cells

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



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.

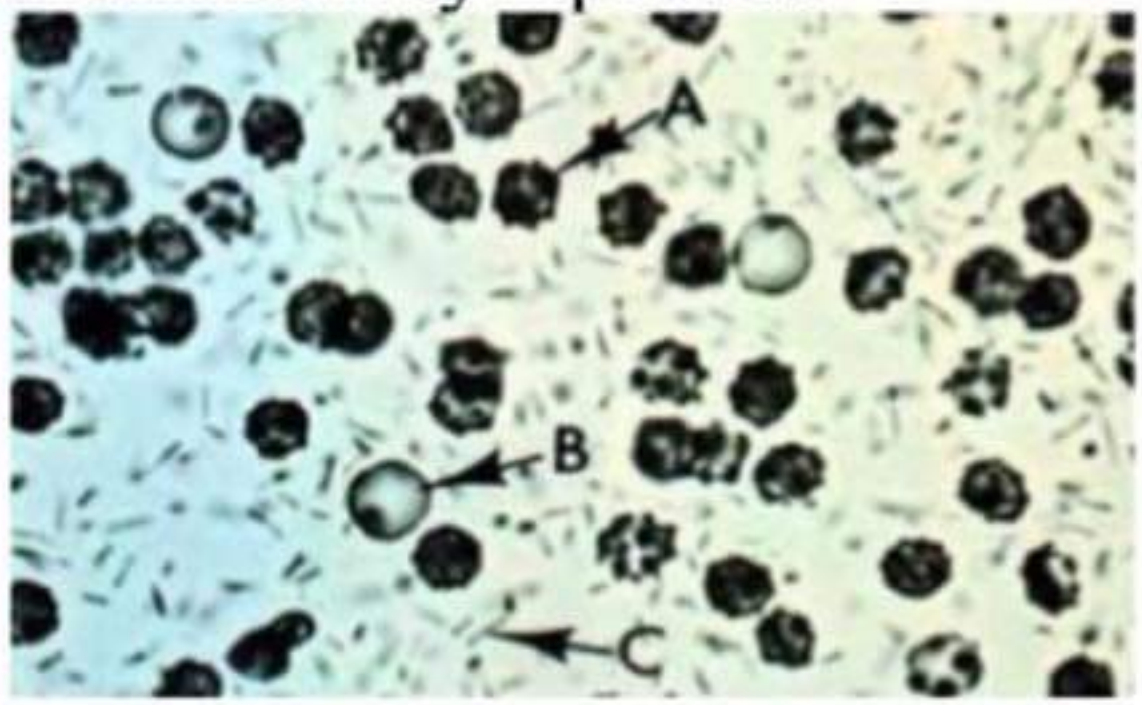
Squamous epithelial cell

Transitional epithelial cell

Microscopic Examination

Bacteria

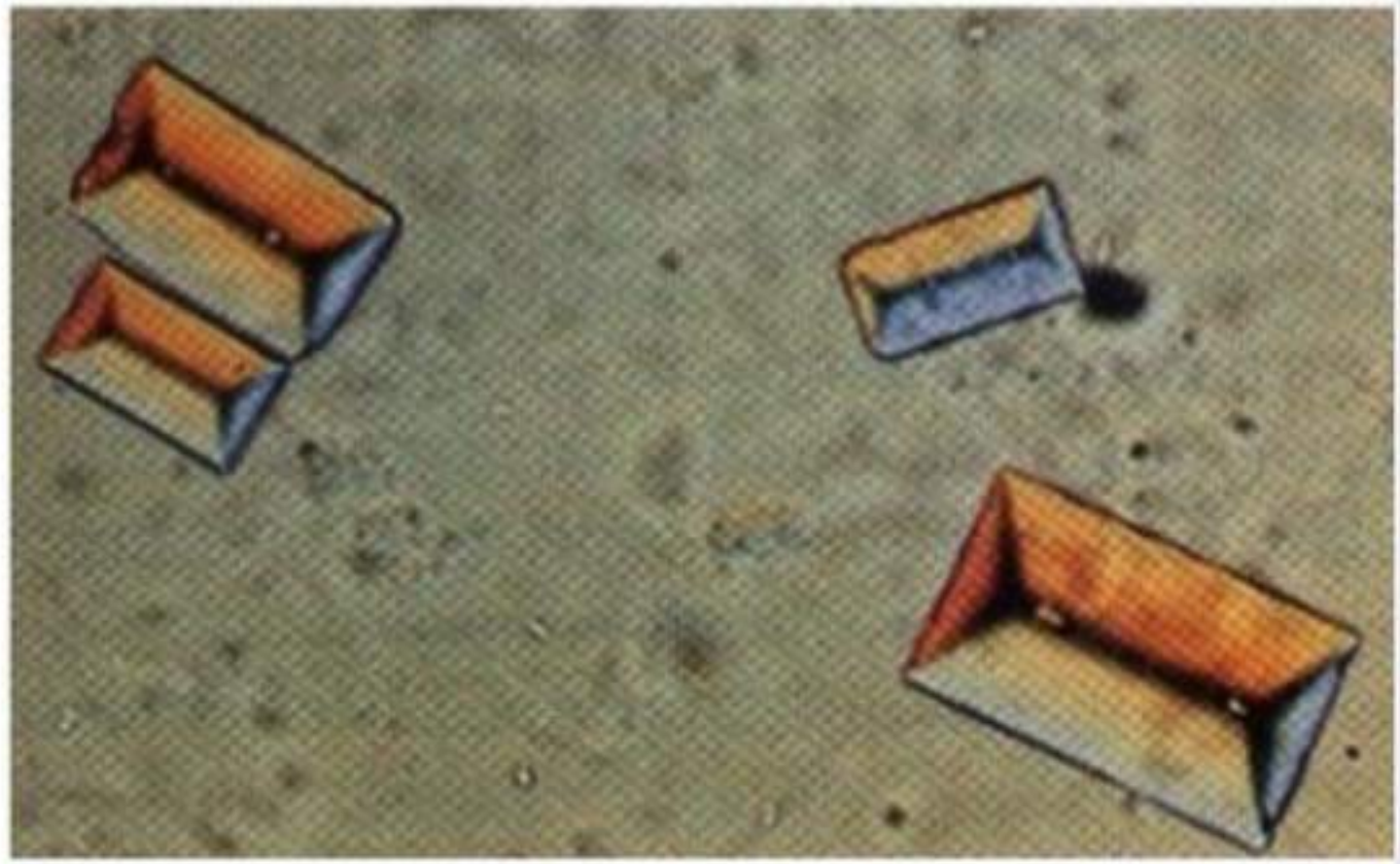
- Bacteria are common in urine specimens (from contamination)
- Therefore, microbial organisms found in all but the most scrupulously collected urines should be interpreted in view of clinical symptoms.



A = crenated RBC, B = RBC, **C =**

Struvite Crystals

- Formation is favored in alkaline urine.



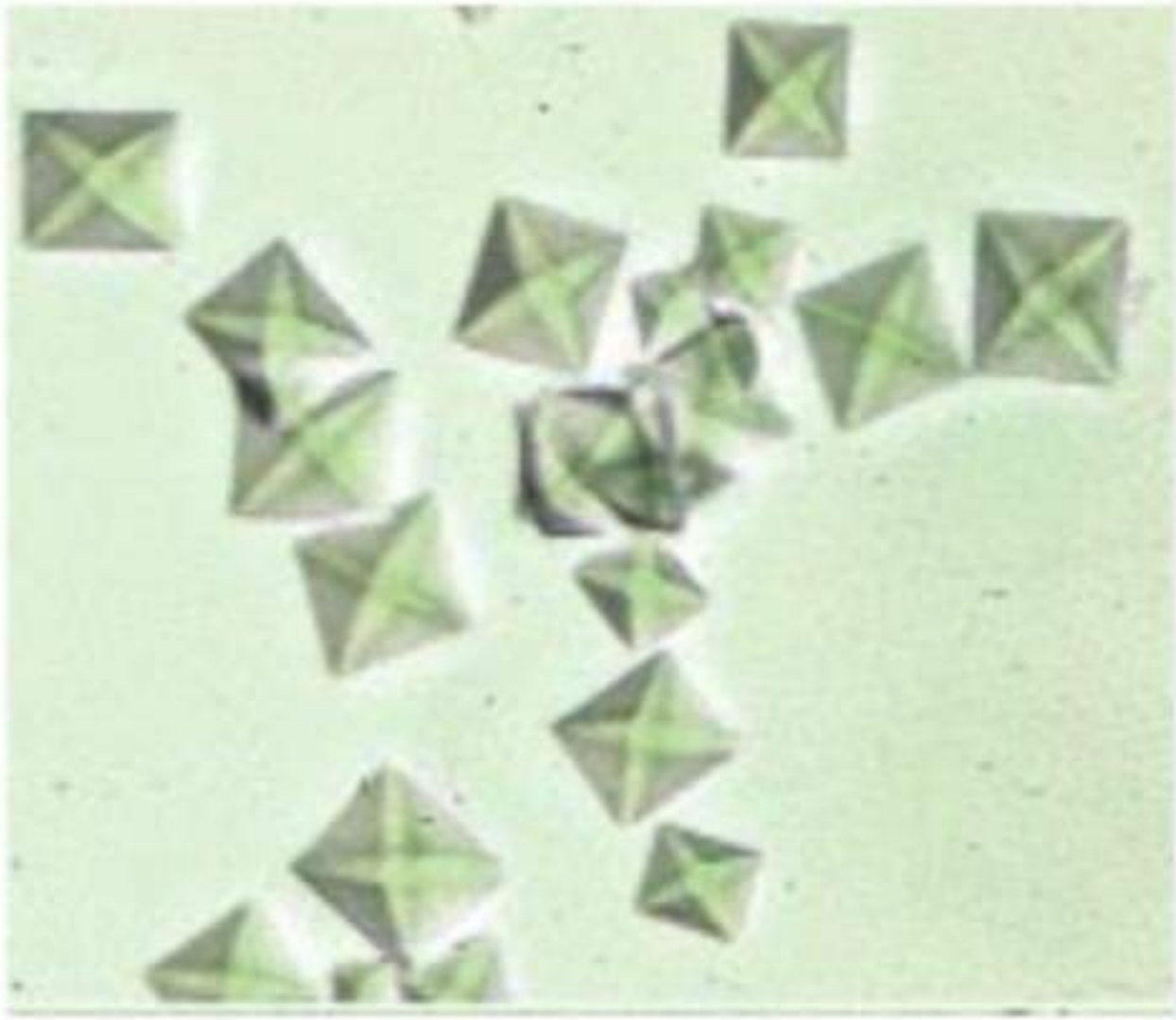
- Urinary tract infection with urease producing bacteria (eg. Proteus vulgaris) can promote struvite crystals by raising urine pH and increasing free ammonia.

Uric Acid Crystals

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

Calcium Oxalate Crystals

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



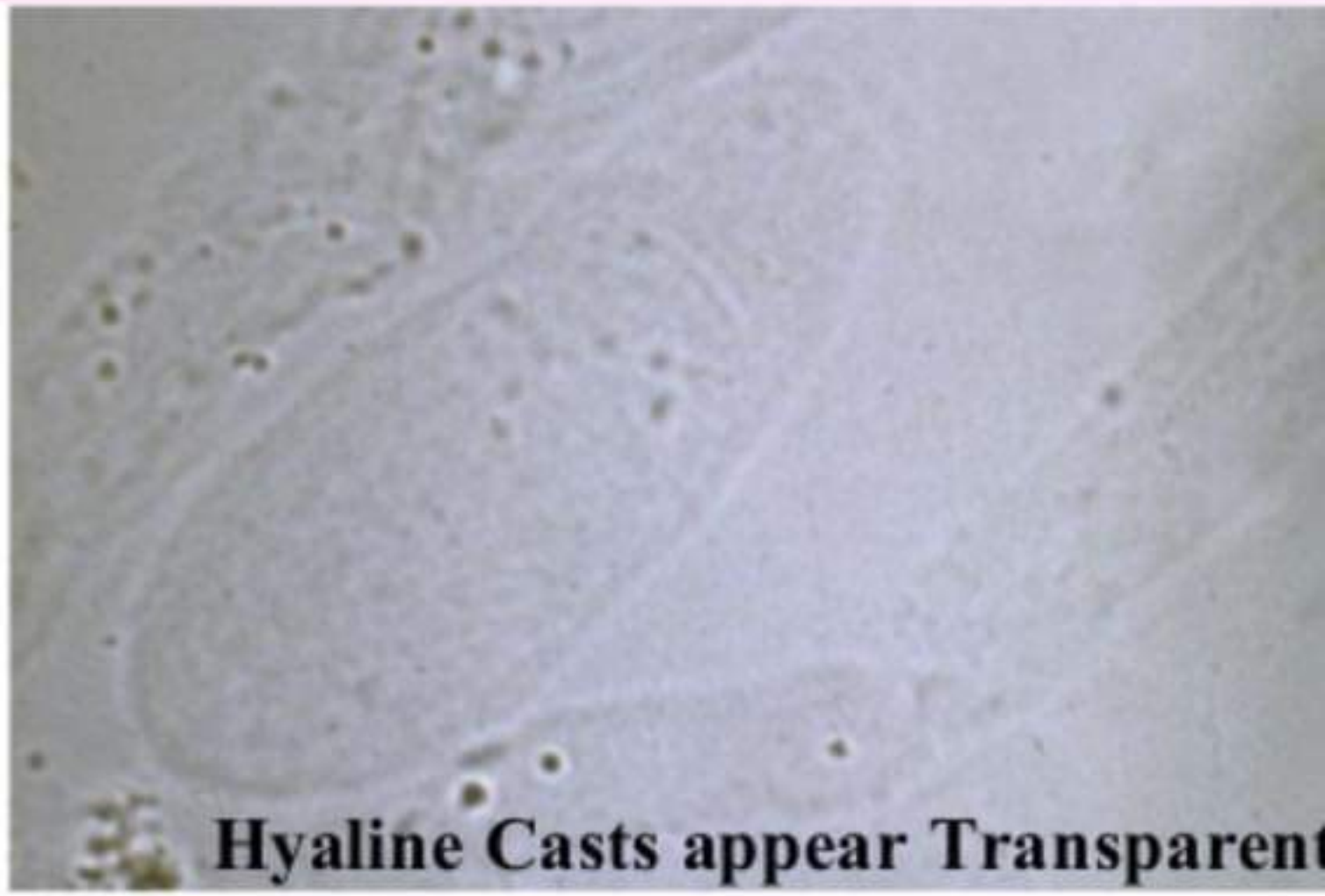
Microscopic Examination

Casts

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

Hyaline Casts

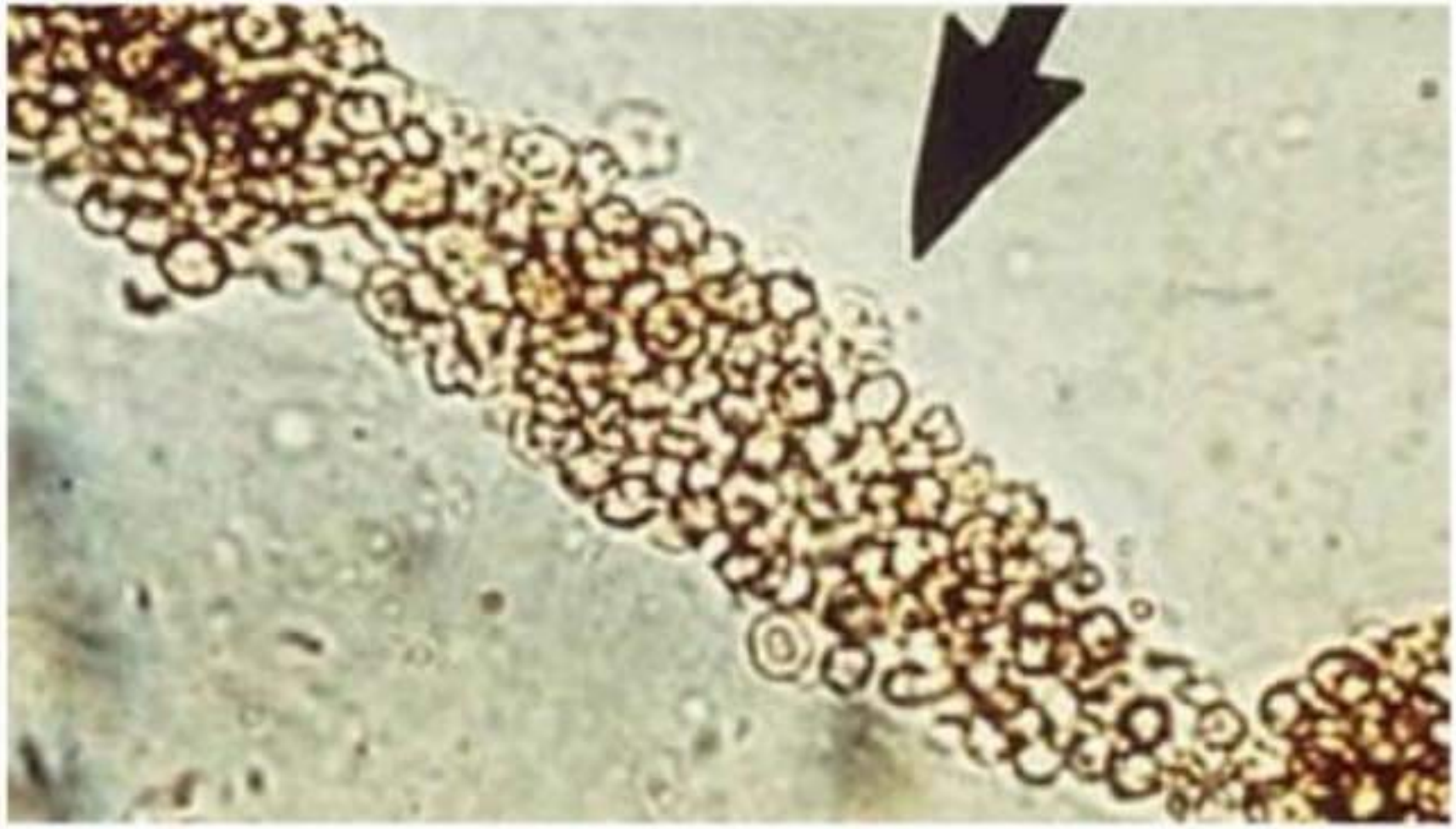
- Hyaline casts are composed primarily of a mucoprotein (Tamm-Horsfall protein) secreted by tubule cells.



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

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.



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.)