Microscopic Examination of Urine

Part 4: Formed Elements: Crystals

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Objectives:

• Review the objectives on page 1 and 2 of the lecture handout

• Objectives marked with '*' will not be tested over during student lab rotation

Crystals

• Not normally found in fresh urine

• If found in fresh urine, pathologic

• Crystals precipitate as urine cools to room temp or when urine is refrigerated

• All clinically significant crystals are found in acid urine

Crystal Formation Enhanced By

• Increased concentration of solute in urine

• Urine pH

• Urine stasis

• Temperature

Crystal Identification

• Microscopic appearance

• Urine pH

Crystal Correlation

• Correlate microscopic evaluation with
  – Physical exam
    • Color
    • Clarity
  – Chemical exam
    • pH
Crystals

- Normal acid pH crystals
- Normal alkaline pH crystals
- Pathologic crystals found in acid or neutral urine
- Drug induced crystals

Normal Acid pH Crystals

- Amorphous urates
- Uric acid
- Calcium oxalate

Amorphous Urates

- These crystals have no distinct form and appear as sand-like granules microscopically
- Macroscopically appear as a pink sediment after urine centrifugation
- Acid pH urine

Uric Acid Crystals

- Acid pH urine
- Appear in several forms
- Multicolored when polarized
- Diamond shape most common form

Uric Acid Crystals

Calcium Oxalate Crystals

- Acid pH urine
- Most frequently observed crystal in urine
- Most common form is octahedryl shape, often referred to as an ‘envelope’ shape
- Multicolored when polarized
Calcium Oxalate Crystals
- Oval form, can be confused with RBC (RBC do not polarize light)

Normal Alkaline pH Crystals
- Amorphous phosphates
- Triple phosphate
- Ammonium biurate
- Calcium carbonate

Amorphous Phosphates
- These crystals have no distinct form and appear as sand-like granules microscopically
- Macroscopically appear as a white sediment after urine centrifugation
- Alkaline pH urine

Triple Phosphate Crystals
- Most frequently observed crystal in alkaline urine
- Colorless, 4-6 sided prisms
- Referred to as ‘coffin lid crystals’

Triple Phosphate vs Calcium Oxalate

Ammonium Biurate Crystals
- Alkaline pH urine
- Yellow spheres with spicules on surface
- Referred to as ‘thorny apple crystals’
- Significant when found in fresh urine
- Presence indicates urine is old
Calcium Carbonate Crystals

- Alkaline pH urine; very small colorless granules, slightly larger than amorphous material
- Multicolored when polarized
- Easily confused with bacteria

Pathologic Crystals (acid, neutral pH)

- Cystine
- Tyrosine
- Leucine
- Cholesterol
- Bilirubin

Cystine Crystals

- Colorless hexagonal plates
- Do not polarize
- Can be confused with uric acid crystals

Cystine vs Uric Acid Crystals

- Cystine Crystal
  - Acid pH urine
  - Do not polarize light
- Uric Acid Crystal
  - Acid pH urine
  - Multicolored when polarized

Cholesterol Crystals

- Clear, large, flat, rectangular plates with notched corners
- Multicolored when polarized
- Can be confused with radiographic dye crystals
- Also should see proteinuria and lipiduria

Cholesterol Crystals

- Bright field Light vs Polarized Light
**Leucine Crystals**
- Yellow-brown spheres with concentric circles on surface
- Can resemble free fat globules

**Tyrosine Crystals**
- Colorless or yellow-brown fine delicate needles

**Bilirubin Crystals**
- Yellow-brown small clusters of needles or granules
- Must confirm with positive ictotest
- When present in urine, indicates large amount of bilirubin is present

**Bilirubin vs Tyrosine Crystals**
- Bilirubin: thicker needles, blunt ends
- Tyrosine: fine needles, pointy ends
- Ictotest positive
- Ictotest negative

**Drug Induced Crystals**
- Sulfonamides
- Radiographic dye (contrast media)

**Sulfa Crystals**
- Form varies dependent upon the type of sulfa drug administered
Radiographic Dye Crystals
- Also referred to as Contrast Media
- Colorless long pointed needles, or flat rectangular plates (resemble cholesterol crystals)
- Multicolored when polarized

Contrast Media vs Cholesterol
- Both crystals multicolored when polarized
- Contrast Media: specific gravity > 1.040
- Cholesterol: notched edges

True / False: Crystals are identified by shape and urine pH

True / False: Uric acid crystals are found in acid urine and are shaped like a ‘coffin lid’

True / False: Presence of ammonium biurate crystals indicate the urine is old

True / False: Presence of bilirubin crystals indicate severe liver disease