Microscopic Examination of Urine

Part 4: Formed Elements: Crystals

Ricki Otten MT(ASCP)SC
uotten@unmc.edu

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

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
- Alkaline pH urine
- Acid pH urine

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

<table>
<thead>
<tr>
<th>Cystine Crystal</th>
<th>Uric Acid Crystal</th>
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<tbody>
<tr>
<td>Acid pH urine</td>
<td>Acid pH urine</td>
</tr>
<tr>
<td>Do not polarize</td>
<td>Multicolored when polarized</td>
</tr>
</tbody>
</table>

Cholesterol Crystals

- Clear, large, flat, rectangular plates with notched corners
- Multicolored when polarized
- Can be confused with radiographic dye crystals

Cholesterol Crystals

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 ictotest positive
- Tyrosine: fine needles, pointy ends 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 often indicates the urine is old

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