Urinalysis and Body Fluids

Unit 2; Session 6

Urine Casts

- Overview of Urinary Cast Formation
- Hyaline Casts
- Cellular Casts
- Granular Casts
- Waxy Casts
- Pseudo Casts

Microscopic Sediment - Casts

- Definition: Cylinder-like structures with parallel sides, formed from gelled muco/glyco protein (Tamm–Horsfall protein).
- Cast formation
  1. normal nephron
  2. epithelial cell cast formation
  3. WBC cast formation
  4. RBC cast formation
Urinary Cast: Formation

- Formed in lumen of the kidney distal convoluted tubules and Loop of Henle.
- Molded in the shape of the tubules.
- Tamm-Horsfall mucoprotein comprises the matrix.
- May contain cells that are present in the tubules at the time of cast formation.

Factors of cast formation:
- Urinary stasis
- Acid pH
- High solute concentration
- Abnormal ionic or protein constituents
- May be indicated by the presence of urinary protein.
- However, casts can be present in the absence of protein.
- Microscopic examination is important.

Urinary Cast: Identification of Casts

- Casts:
  - Have parallel sides with rounded or blunted ends.
  - Vary in size and shape according to the tubules in which they were formed.
  - Convoluted, straight, or curved.
  - Are cylindrical in shape with no dark edges.
Urinary Cast: Significance of Casts

- Cast are always renal in origin
- Casts often indicate pathologies:
  - glomerular damage
  - tubular damage
  - renal inflammation
  - renal infection
- Cast Size
  - indicates the diameter of the tubule in which it was formed
  - Broad casts & Narrow
    - formed in pathologically dilated or atrophied tubules or in collecting tubules
    - indicate renal trauma / failure

Urinary Cast: Classification

- Based on appearance and contents:
  - hyaline
  - red cell
  - white cell
  - epithelial cell
  - granular (coarse and fine)
  - Waxy
  - Fatty
  - mixed
Urinary Cast: Sequence of Degeneration

Sequence of urinary cast degeneration

Urinary Casts: Detection

- Low power and low light to find:
  - high power to identify
    - must use low level of light or will look right through them
- Cylindrical body with parallel sides and rounded ends.
- May be confused with cylindroids, mucous threads, and rolled up squamous epithelial cells, also artifacts such as fibers.
  - **cylindroids** - have the same clinical significance

Urinary Cast: Enumeration

- Counted on low-power (100x)
- If using the slide & coverslip sediment preparation method, casts are more frequently seen along the edges of coverslip
- Reported according to type and range seen
  - Follow Urine Standardization Guide (rare, occasional, 0-2, 3-5, etc.)
    - Example:
      - Hyaline casts 6-10/LPF
      - Granular casts 2-5/LPF
Urinary Casts: Hyaline Casts

Hyaline cast and red blood cells.

- Can be seen in even the mildest kind of renal disease.
- A few hyaline casts may be found in the normal urine.
- Frequently present
  - following physical exercise
  - physiologic dehydration
Urinary Casts: Hyaline Casts

Hyaline casts. Viewed with an 80A filter

Urinary Casts: Hyaline Casts

- Hyaline casts using phase contrast microscopy

Microscopic Sediment - Casts

- Cellular Casts
  - Very significant
  - Is there a matrix?
  - Can you identify the structures within?
  - Support?
    - Patient history / diagnosis
    - Physical & chemical results
    - Other microscopic structure
Urinary Casts: Red Blood Cell Casts

Red cell cast and RBCs

- Always pathologic
- Hematuria is present
- Conditions include:
  - acute glomerulonephritis
  - lupus nephritis
  - Goodpasture syndrome
  - subacute bacterial endocarditis
  - renal trauma
  - renal infarction
  - severe pyelonephritis
  - right-sided congestive heart failure
  - renal vein thrombosis
  - periarteritis nodosa

Urinary Casts: Red Blood Cell Casts

Convoluted red blood cell cast
Urinary Casts: Red Blood Cell Casts

Urinary Casts: White Blood Cell Casts
White cell cast and WBCs

Urinary Casts: White Blood Cell Casts

- Can be present during renal infection and inflammation.
- acute pyelonephritis
- interstitial nephritis
- lupus nephritis
- glomerular disease
Urinary Casts: White Blood Cell Casts

SM-stained WBC cast

Urinary Casts: Epithelial Cell Casts

- What kind of epithelial cells are found in epithelial cell casts?
Urinary Casts: Epithelial Cell Casts

- May be present after exposure to:
  - nephrotoxic agents
  - viruses (e.g., cytomegalovirus, hepatitis virus)
- Due to damage that accompanies glomerular injury
- Also present in the rejection of a kidney allograft

Urinary Casts: Epithelial Cell Casts

- Formed in DCT = small, round cells
- Fibrils forming cast pull cells from damaged tubules
- Majority of cells are on the cast matrix
- Differentiate from WBCs: stain to show single nucleus

Urinary Casts: Mixed Cell Casts

Mixed cell cast, WBCs, and RBCs.
Urinary Casts: Mixed Cell Casts

SM-stained mixed cellular cast.

Urinary Casts: Mixed Cell Casts

SM-stained hyaline cast, granular cast, mixed cellular cast, and partially degenerated renal tubule epithelial cells

Urinary Casts: Granular Casts

Broad coarsely granular

Finely granular casts
Urinary Casts: Granular Casts

- Usually indicate renal disease.
- But may be briefly present after strenuous exercise.
- These casts have remained in the tubule for enough time to allow for the degeneration of cellular components.
- May be confused with casts containing bacteria or crystals.
Microscopic Sediment – Casts

- Granular casts

**Urinary Casts: Waxy Casts**

- Waxy cast, WBCs, and bacteria

Found in urine from patients with:
- severe chronic renal failure
- malignant hypertension
- renal amyloidosis
- and diabetic nephropathy
- acute renal disease
- tubular inflammation and degeneration
- and during renal allograft rejection.
Urinary Casts: Waxy Casts

- Waxy cast and amorphous urates.

Urinary Casts: Granular to Waxy transformation

Fine granular cast becoming a waxy cast.

Urinary Casts: Waxy Casts

Convoluted waxy cast.
Urinary Casts: Fatty Casts

- Present during fatty degeneration of the RTE cells
  - *degenerative tubular disease
  - nephrotic syndrome
  - diabetic glomerulosclerosis
  - lipoid nephrosclerosis
  - Glomerulonephritis
  - Kimmelstiel-Wilson syndrome
  - Systemic Lupus Erythematosus
  - toxic renal poisoning

Microscopic Sediment - Casts

- Fatty casts
**Urinary Casts: Other Casts**

- **Mixed cast.**

**Urinary Casts: Other Casts**

- **Bacterial Casts**
  - May be pure bacteria or mixed with WBCs
  - Resemble granular casts
  - Look for free WBCs and bacteria
  - Confirm with Gram stain
  - Seen in pyelonephritis

**Urinary Casts: Pseudo Casts**

*Cylindroids.*
Urinary Casts: Confusing Artefacts - Mucous Threads

Urinary Casts: Confusing Artefacts - Fibers

Urinary Casts: Confusing Artefacts - Hair
Urinary Casts: Confusing Sediment - Yeast

SM-stained yeast with pseudohyphae and WBCs

Urinary Casts: Confusing Comparison

A. Fine granular cast  B. Fiber.

Summary

- Casts, comprised of a Tamm-Horsfall mucoprotein matrix are formed in lumen of distal tubules.
- Casts are classified by their contents.
- Several artifacts may be misidentified as casts.
- Reagent strip tests for protein may or may not be positive when casts are present.
- Casts may be present in physiologically normal conditions.
- Casts usually accompany renal disorders.
References

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