

# Urothelial Carcinoma of the Renal Pelvis

Pathology: origin • morphology • clinical correlation

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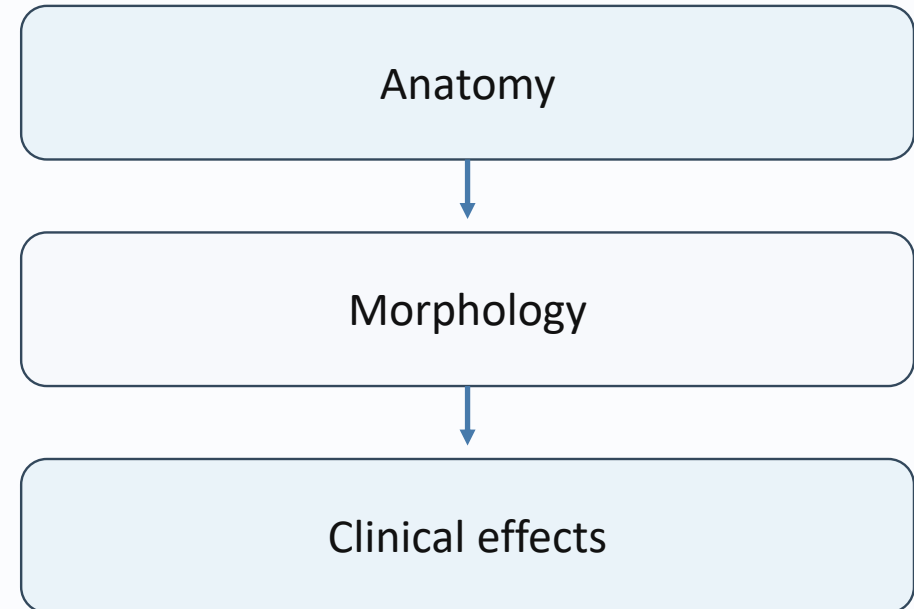
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# Learning objectives

- Localize the tumor to collecting-system urothelium rather than renal parenchyma.
- Recognize papillary, flat in situ, and invasive urothelial patterns.
- Explain hematuria, obstruction, multifocality, and prognostic implications.

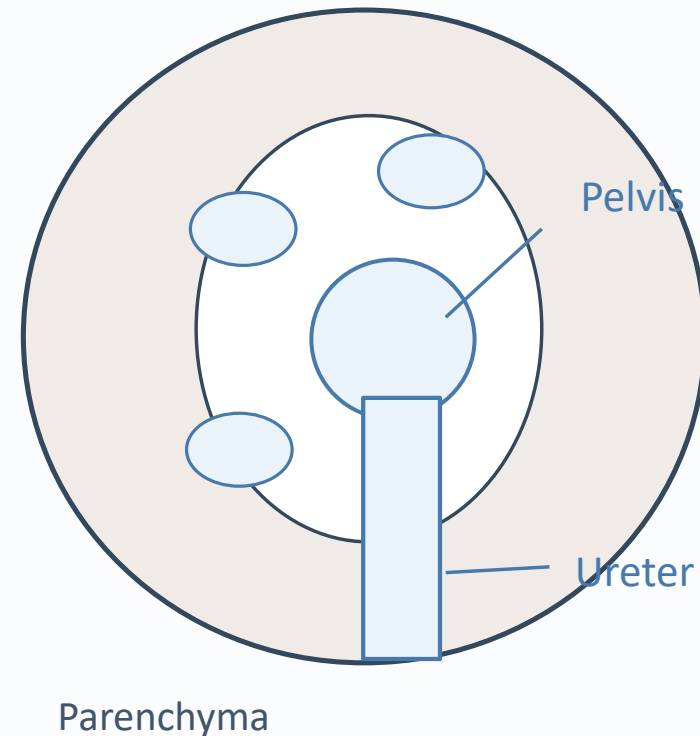
*Schematic*



# Renal pelvis: An epithelial rather than parenchymal origin

- The renal pelvis receives urine draining from the calyces.
- Its urothelial lining is continuous with ureter and bladder.
- A renal-pelvis urothelial tumor begins at this luminal epithelial surface.

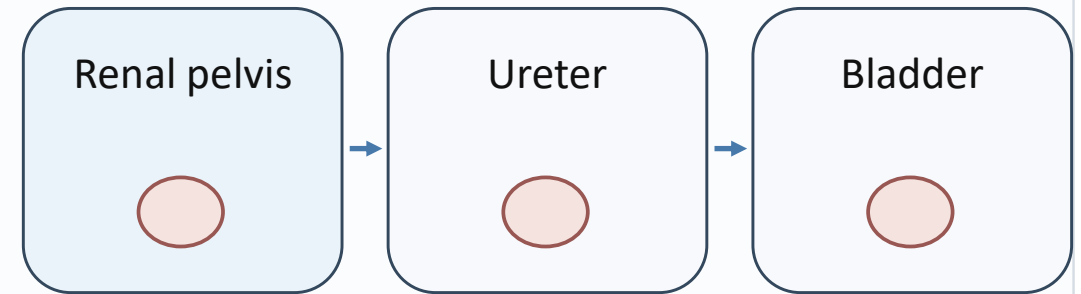
*Schematic*



# A continuous urothelial compartment

- Renal pelvis, ureters, bladder, and most of the urethra share urothelium.
- A lesion at one site can have histologic counterparts at another.
- This explains why renal-pelvis tumors are interpreted with lower-tract pathology.

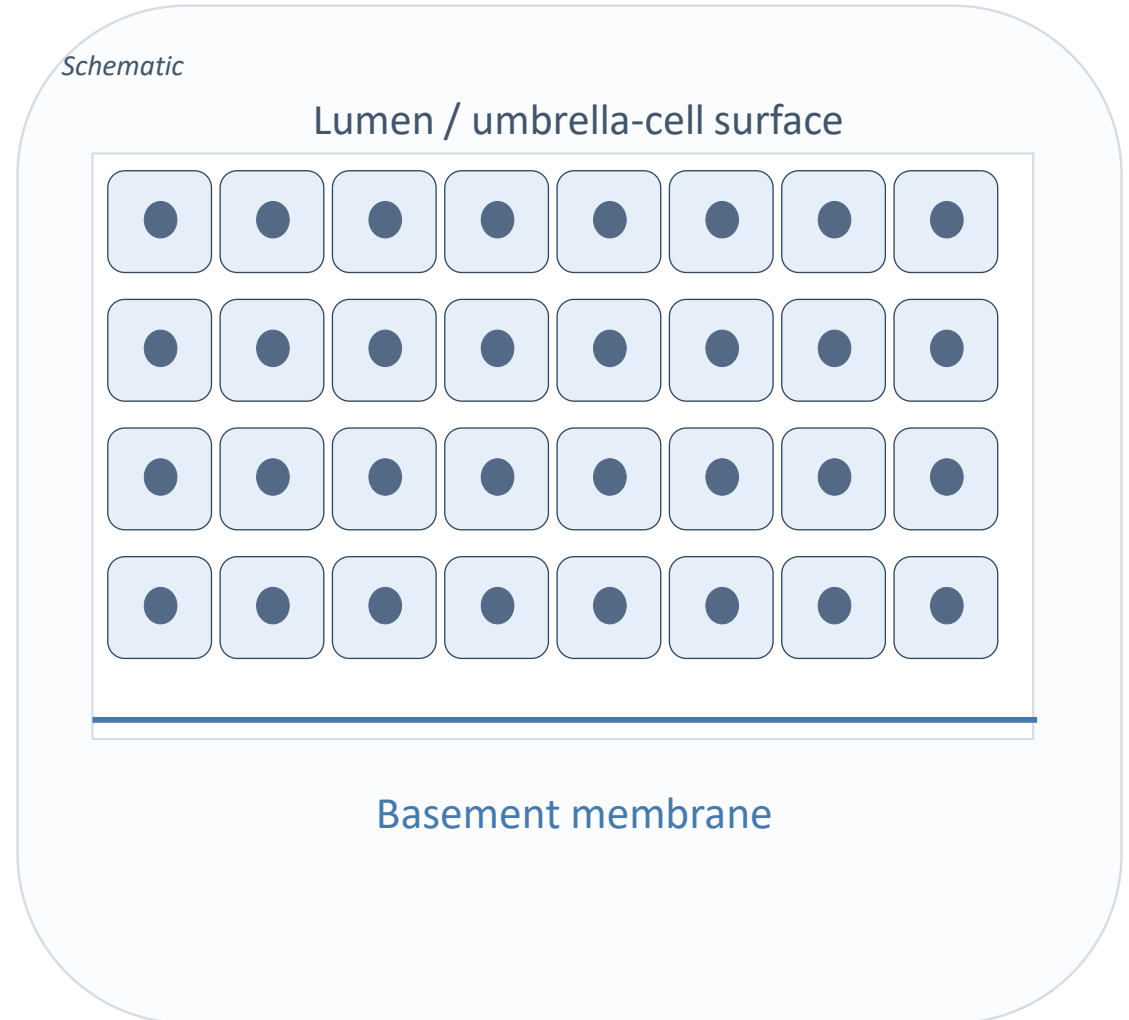
*Schematic*



Multiple epithelial sites; Not three renal masses

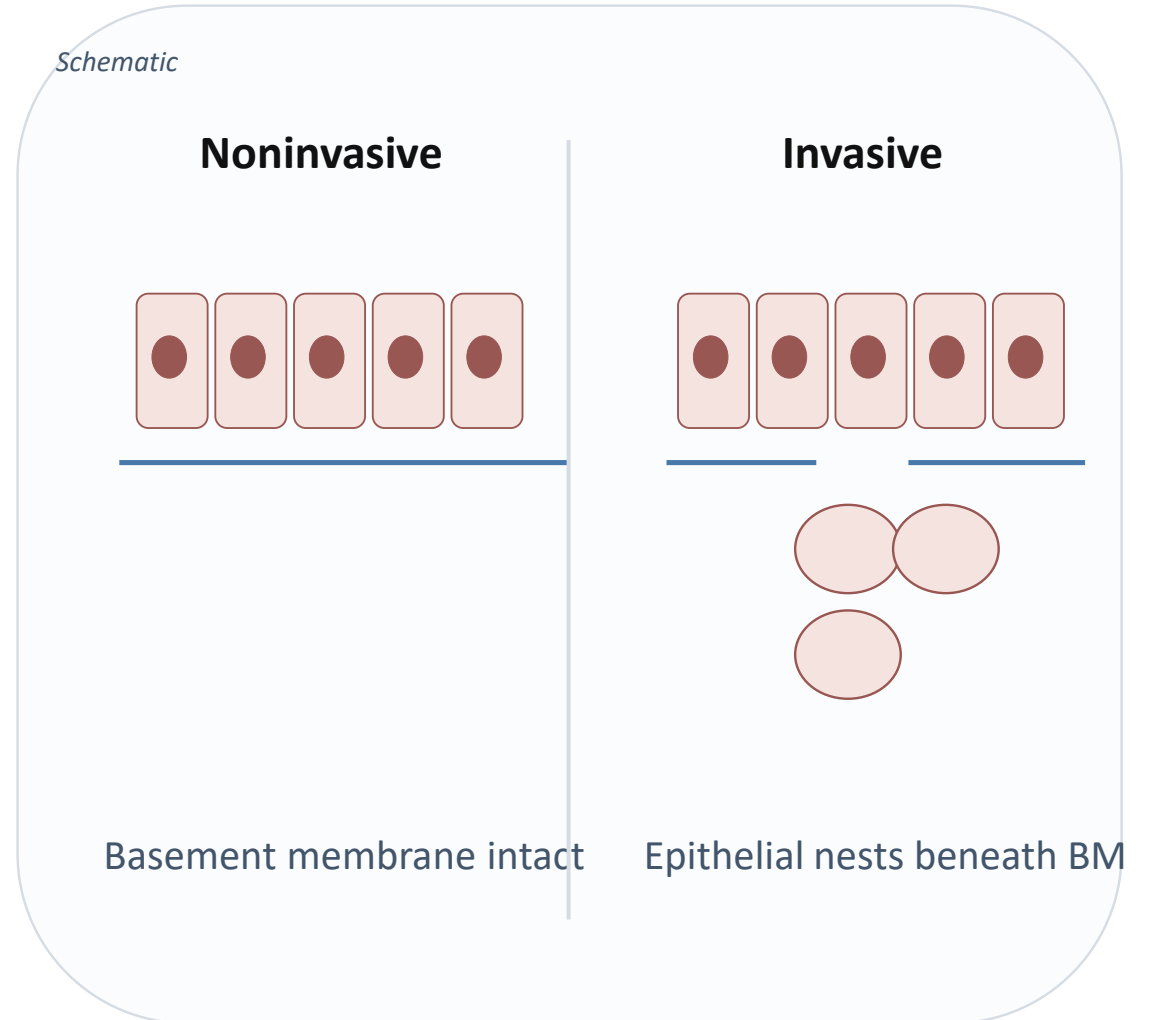
# Normal urothelium: Layered and specialized

- Urothelium is normally several cell layers thick.
- Large superficial umbrella cells form a differentiated surface layer.
- The epithelium rests on a basement membrane above the lamina propria.



# The basement membrane defines noninvasion

- Cytologic malignancy can be confined to the epithelial compartment.
- Crossing the basement membrane creates stromal invasion.
- Architectural grade and depth of invasion answer different questions.



## Renal-pelvis tumors constitute a distinct renal group

- Approximately 5%–10% of primary renal tumors to pelvic urothelium.
- This estimate concerns origin within the kidney, not all urothelial carcinomas.
- Renal cell carcinoma instead arises from renal epithelial parenchyma.

*Schematic*

**5%–10%**

Of primary renal tumors arise from pelvic urothelium (Robbins)

# Renal cell carcinoma versus pelvic urothelial carcinoma

- Renal cell carcinoma arises in the renal parenchyma.
- Pelvic urothelial carcinoma arises at the collecting-system lining.
- A mass in the kidney must be located before its morphology is interpreted.

*Schematic*

Renal parenchyma →  
RCC

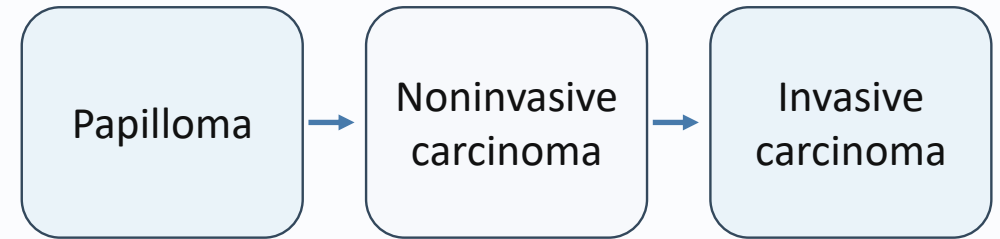


Collecting-system  
lining → UC

# The clinical spectrum is broader than invasive cancer

- Papillomas occupy the benign end of the urothelial lesion spectrum.
- Noninvasive papillary carcinomas show malignant cytology without stromal invasion.
- Invasive urothelial carcinoma extends beyond the epithelial compartment.

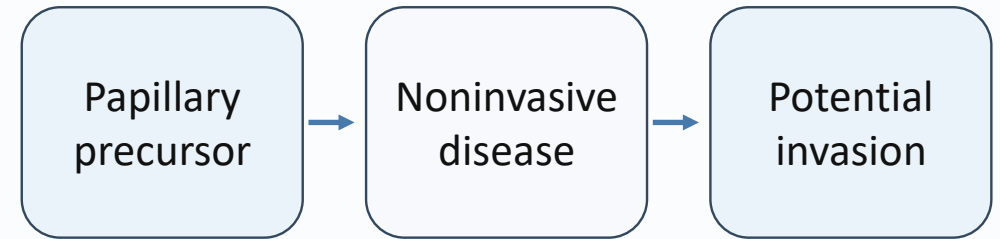
*Schematic*



## Two broad noninvasive pathways precede invasion

- One precursor category is a papillary urothelial neoplasm.
- The other is flat urothelial carcinoma in situ (CIS).
- Both are described in bladder pathology and may occur throughout urothelium.

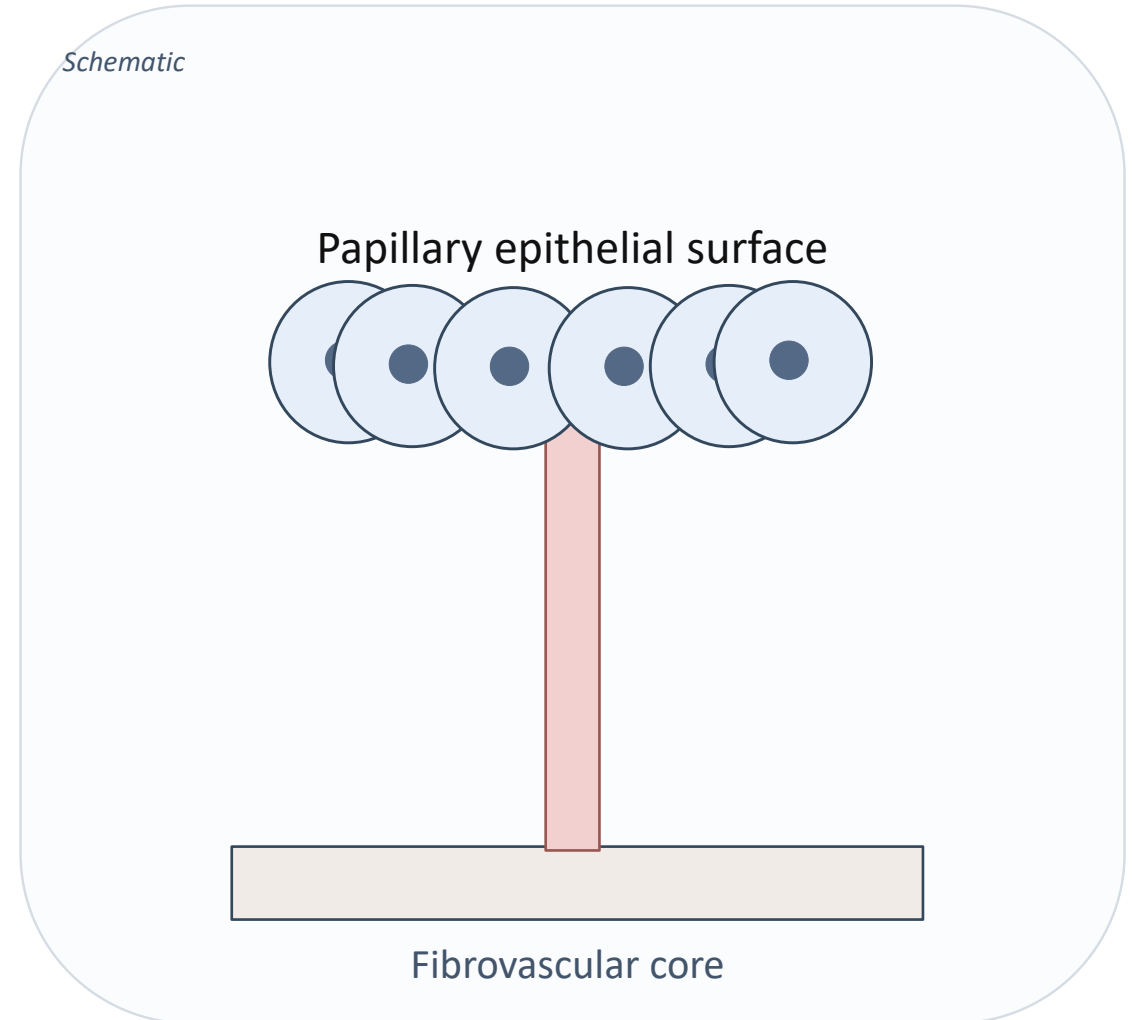
*Schematic*



# Papillary growth projects into the lumen

- Exophytic papillary lesions form fronds with fibrovascular cores.
- The epithelial lining may be bland, mildly atypical, or markedly atypical.
- Papillary configuration alone does not establish grade or invasion.

*Schematic*

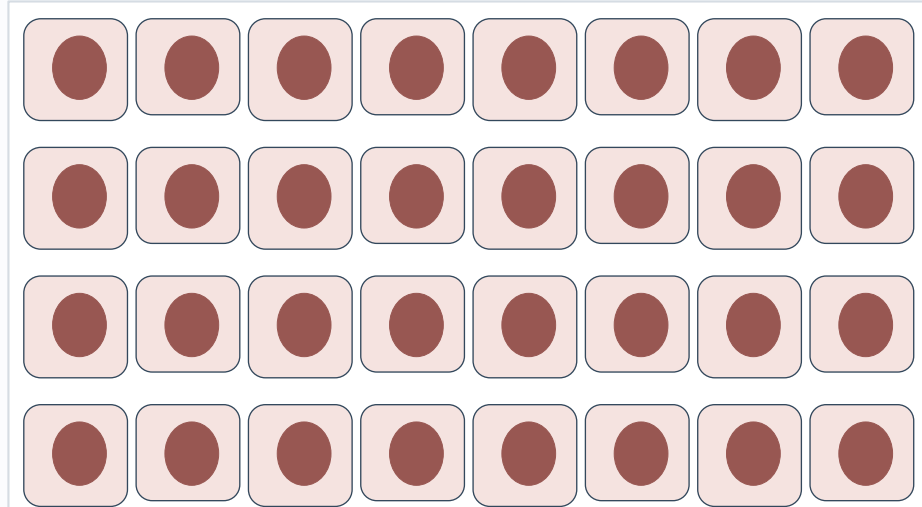


# Flat carcinoma in situ lacks an exophytic mass

- CIS is cytologically malignant but confined to the urothelium.
- It may occupy a flat mucosal surface rather than form a discrete tumor.
- A grossly inconspicuous lining therefore can contain malignant epithelium.

*Schematic*

Cytologic atypia within urothelium

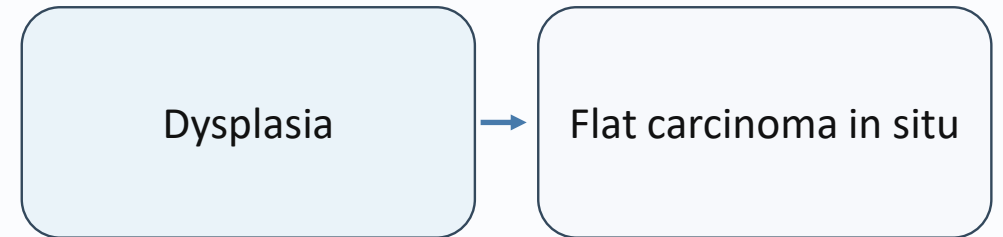


Basement membrane

# WHO 2022: Flat noninvasive lesions

- Urothelial dysplasia is listed among flat lesions.
- Urothelial carcinoma in situ is the malignant flat noninvasive category.
- The architecture remains flat; Invasion is not part of the diagnosis of CIS.

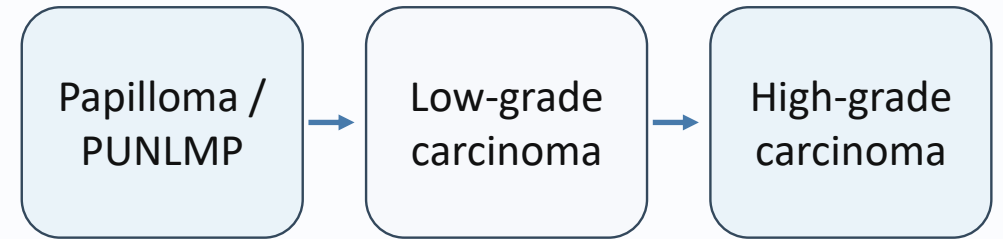
*Schematic*



# WHO 2022: Exophytic noninvasive lesions

- Papilloma and papillary urothelial neoplasm of low malignant potential (PUNLMP).
- Papillary urothelial carcinoma, low grade.
- Papillary urothelial carcinoma, high grade.

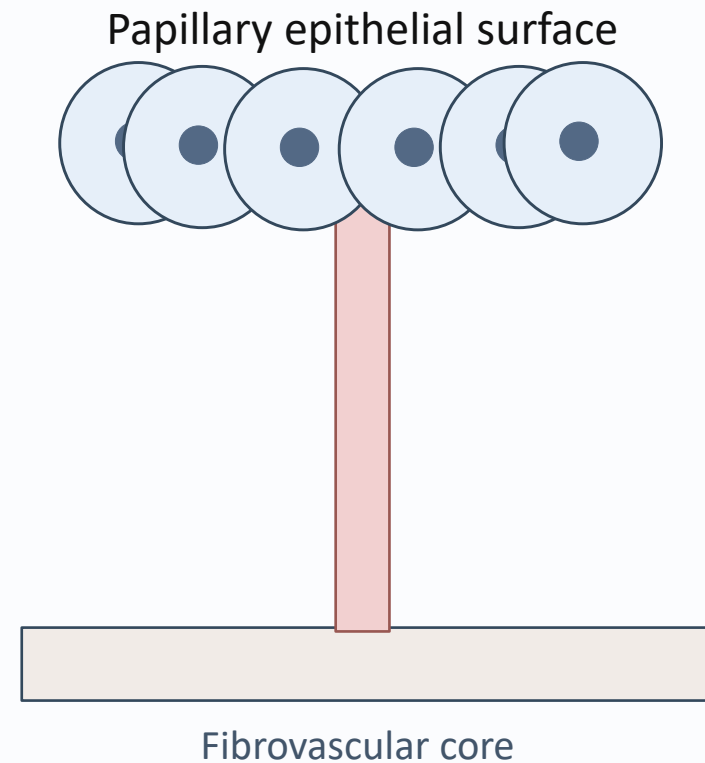
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# Exophytic papilloma: A delicate benign papilla

- Typically a small lesion with slender papillary stalks.
- Each fibrovascular core is lined by near-normal urothelium.
- Recurrence and progression are rare in the bladder descriptions.

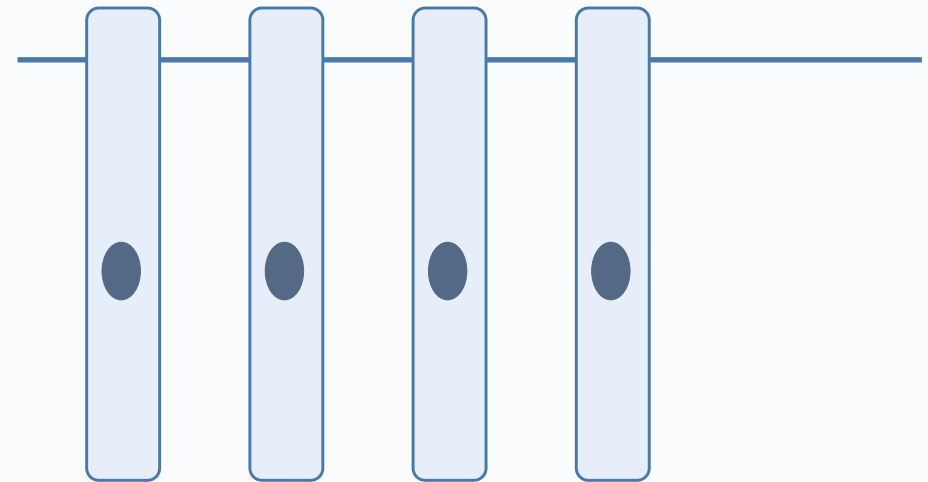
*Schematic*



## Inverted papilloma may simulate invasion

- Bland urothelial cords extend downward into the lamina propria.
- The lesion is architecturally endophytic rather than exophytic.
- Its cytologic blandness distinguishes it from infiltrative carcinoma.

*Schematic*



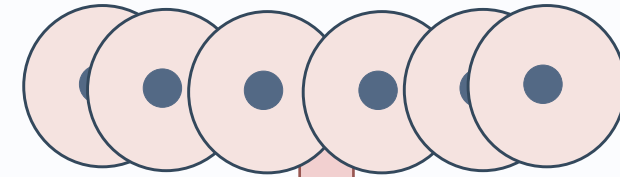
Bland urothelial cords extend downward

## PUNLMP: Thicker urothelium without overt high grade

- A papillary lesion resembles papilloma but has increased epithelial thickness.
- Cell density is increased while severe disorganization is absent.
- Recurrences are possible; Higher-grade progression is described as rare.

*Schematic*

Thickened papillary urothelial covering

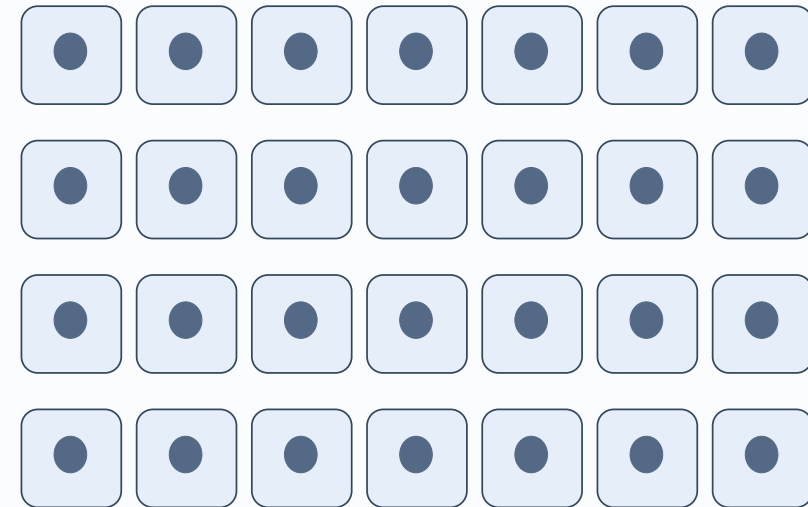


Fibrovascular core

# Low-grade papillary carcinoma preserves organization

- Cells remain cohesive with relatively even spacing and polarity.
- Nuclear size and shape vary slightly; Scattered hyperchromatic nuclei occur.
- Mitoses are infrequent and tend to be basal.

*Schematic*

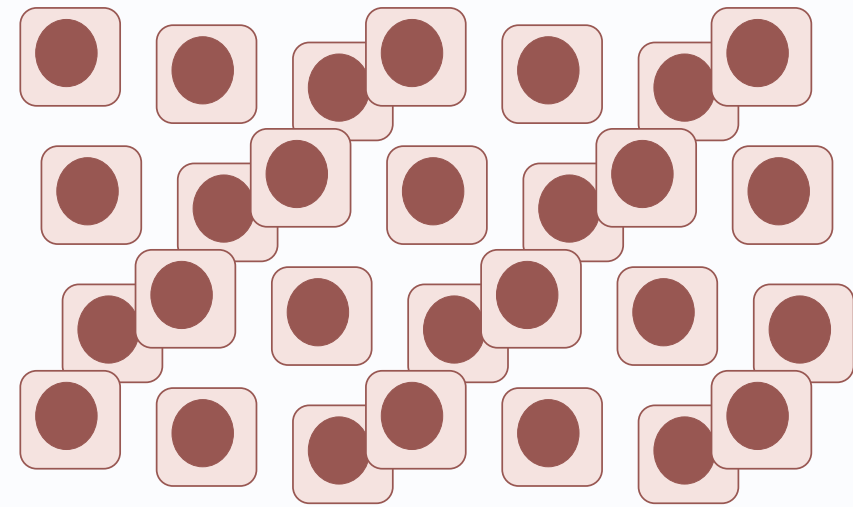


Polarity retained · mild variation · cohesion

# High-grade papillary carcinoma loses organization

- Cells are less cohesive with marked nuclear atypia.
- Nuclear chromatin is irregular; Nucleoli may be prominent.
- Mitoses may be frequent or atypical, with loss of polarity.

*Schematic*



Marked atypia · loss of order · variable nuclei

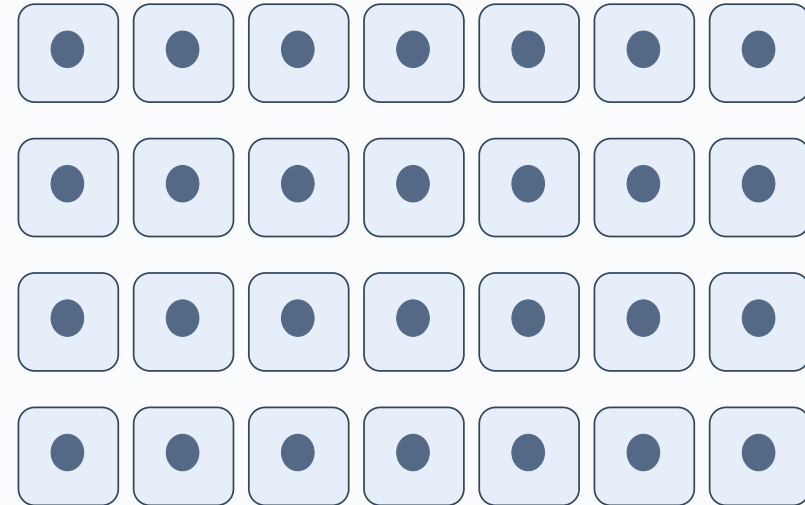
## Low versus high grade: Discriminating features

| Feature         | Low-grade papillary                       | High-grade papillary                     |
|-----------------|-------------------------------------------|------------------------------------------|
| Architecture    | Ordered, polarity retained                | Disorganized, polarity lost              |
| Cohesion        | Generally cohesive                        | Often discohesive                        |
| Nuclei          | Mild variation, occasional hyperchromasia | Marked pleomorphism; Irregular chromatin |
| Mitotic figures | Few; Often toward base                    | Frequent; Can be atypical                |

# Polarity is a microscopic clue to grade

- Low-grade tumors generally retain a basal-to-luminal cellular orientation.
- High-grade tumors show disordered arrangement and reduced cohesion.
- An architectural observation complements—rather than replaces—nuclear assessment.

*Schematic*



Polarity retained · mild variation · cohesion

# Papillary architecture does not equal low risk

- Both low-grade and high-grade carcinomas can form papillary fronds.
- High-grade cytology changes the biologic interpretation of that architecture.
- Extent of invasion must be assessed independently.

*Schematic*

|            | Noninvasive | Invasive          |
|------------|-------------|-------------------|
| Low grade  | Possible    | Assess separately |
| High grade | Possible    | Possible          |

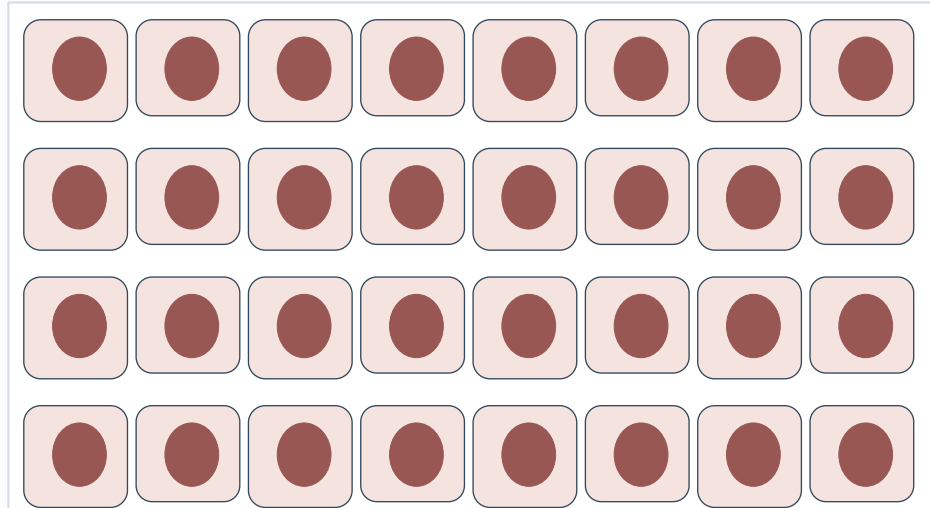
Grade and depth are independent descriptors

# Carcinoma in situ: Malignant cells confined to epithelium

- CIS is noninvasive by definition despite severe cytologic atypia.
- The malignant epithelium may be widespread or patchy.
- A preserved basement-membrane boundary separates CIS from invasive cancer.

*Schematic*

Cytologic atypia within urothelium



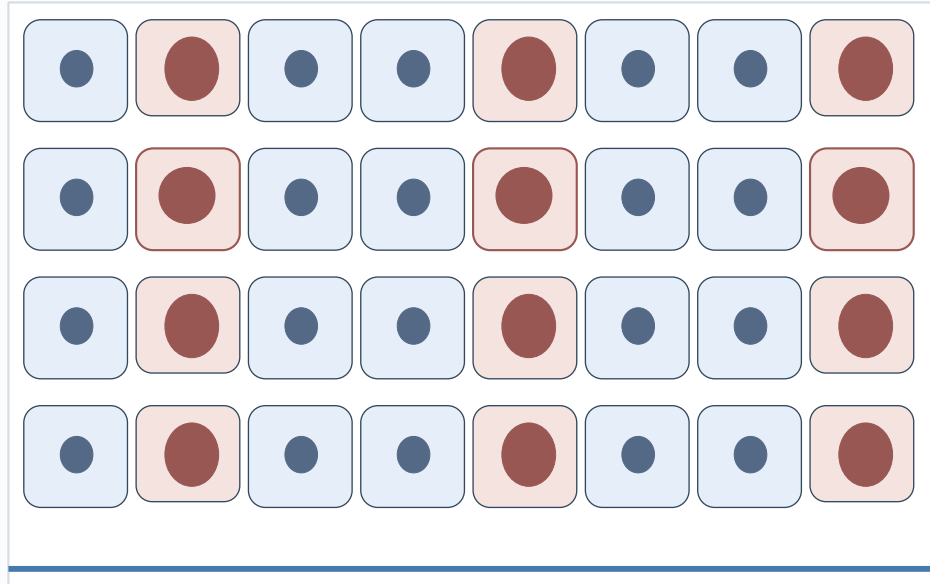
Basement membrane

## CIS can be partial-thickness or pagetoid

- CIS need not replace every layer of the urothelium.
- Scattered malignant cells among near-normal epithelial cells are described as pagetoid spread.
- Thus, a superficially bland field can contain focal malignant cytology.

*Schematic*

Focal malignant cells in otherwise bland lining



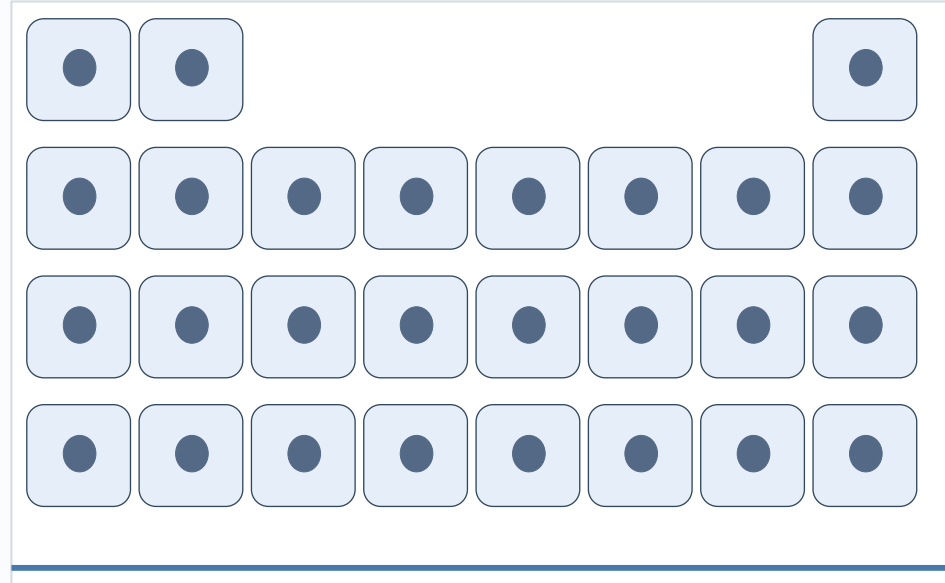
Basement membrane

## Denudation can conceal a CIS focus

- Malignant urothelial cells may lose cohesiveness and detach.
- Extensive shedding can leave only a sparse residual malignant lining.
- The loss of surface cells complicates recognition of a flat lesion.

*Schematic*

Cell shedding leaves a denuded surface

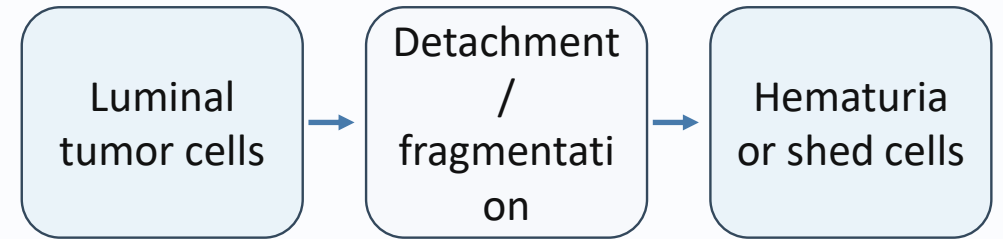


Basement membrane

# High-grade lesions shed cells into urine

- Discohesion promotes epithelial cell shedding.
- This helps explain abnormal urothelial cells within urinary samples.
- Cell shedding can coexist with either a visible tumor or flat carcinoma.

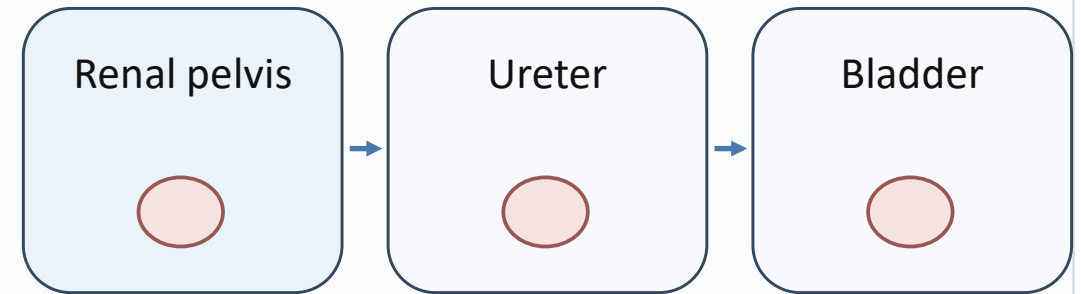
*Schematic*



# Grossly normal urothelium need not be normal microscopically

- Remote foci of atypia or CIS near pelvic tumors.
- Those abnormalities may be beyond the visible mass.
- This separates the extent of visible disease from the extent of epithelial alteration.

*Schematic*



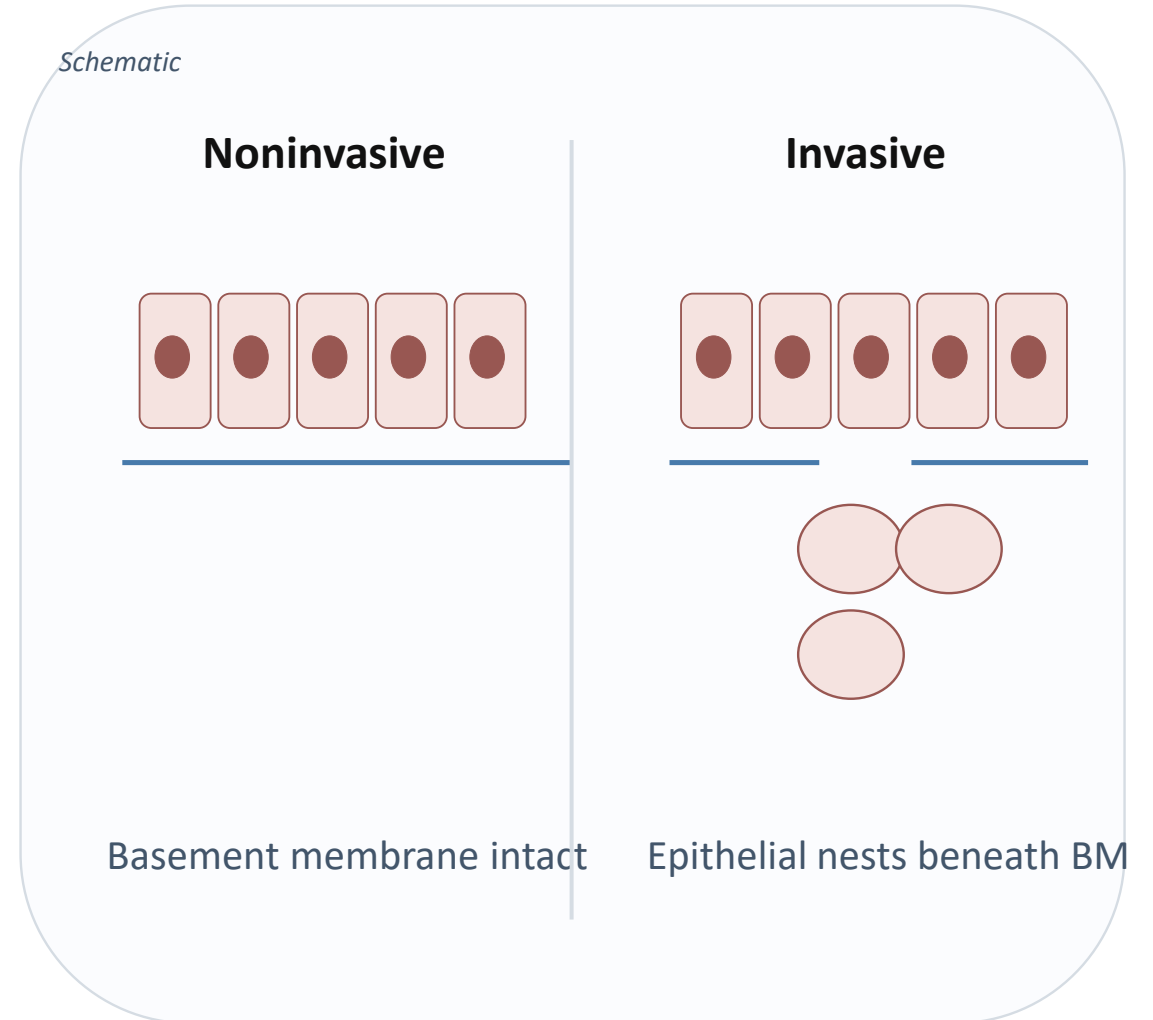
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Remote atypia / CIS can be microscopic

# Noninvasive versus infiltrating disease

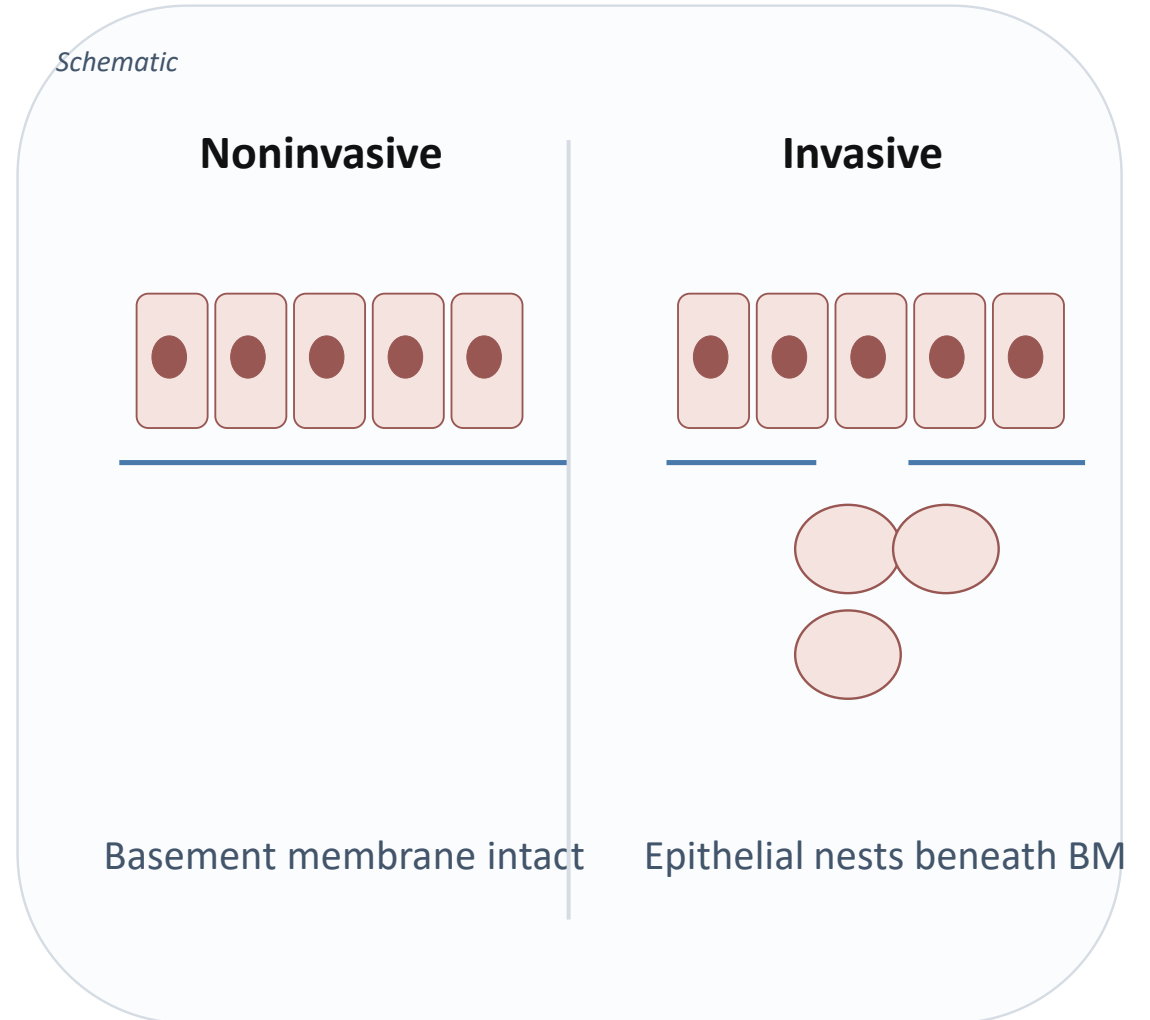
- A noninvasive lesion remains superficial to the basement membrane.
- Infiltrating carcinoma involves supporting tissues of the pelvic wall.
- The deceptively small gross lesion may coexist with significant wall invasion.

*Schematic*



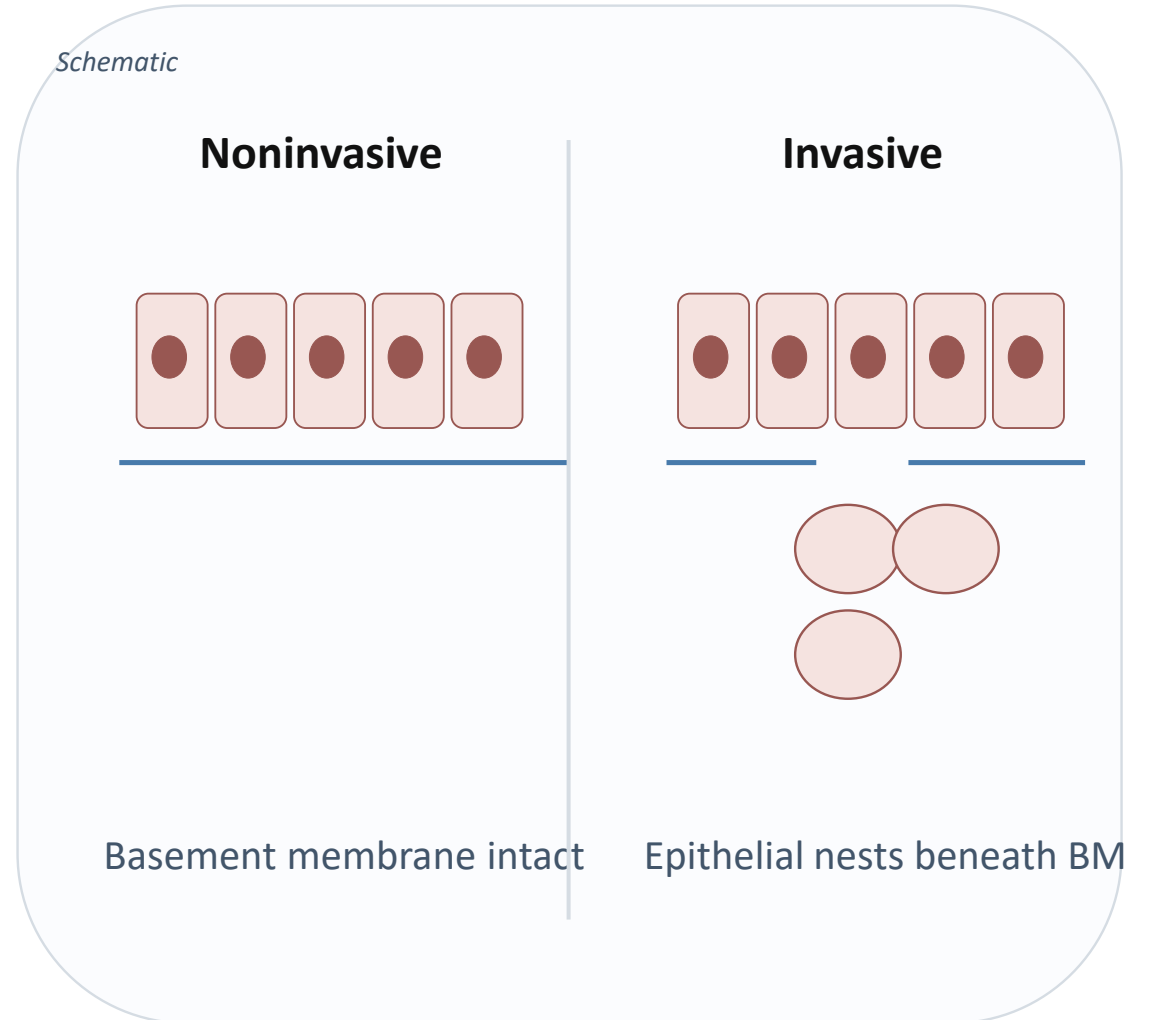
# Wall infiltration is common in renal-pelvis carcinoma

- Pelvic and calyceal walls may already be infiltrated at discovery.
- The lesion can appear limited within the lumen yet extend into the wall.
- Anatomic depth is therefore essential to clinicopathologic interpretation.



# Papillary and invasive components may coexist

- Invasive carcinoma may occur adjacent to papillary carcinoma.
- Invasive carcinoma may also occur with associated flat CIS.
- Both the epithelial precursor and deep component are diagnostically relevant.

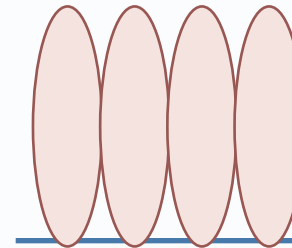


# Gross morphology: Papillary, nodular, or flat

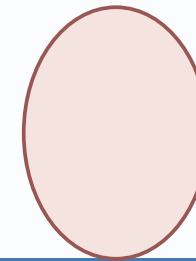
- Papillary lesions protrude into the lumen as fronds.
- Nodular growth may form an irregular luminal mass.
- Flat CIS can be inconspicuous without a large exophytic tumor.

*Schematic*

**Papillary**



**Nodular**



**Flat (CIS)**

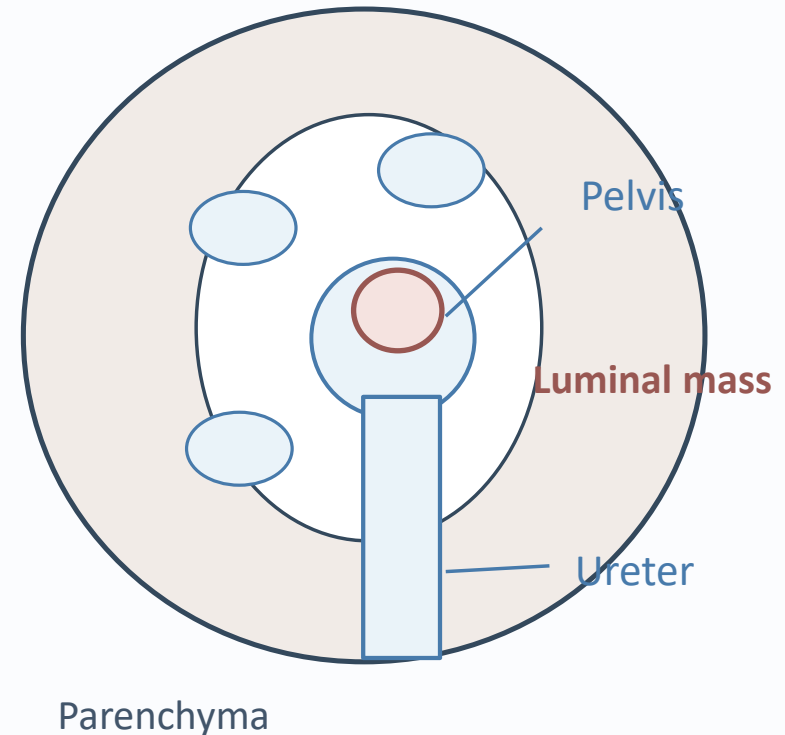


Schematic profiles—not photographs or scale drawings

## A source-described gross pelvic tumor

- Robbins Fig. 20.49 depicts an opened renal pelvis.
- Its caption identifies a nodular irregular neoplasm proximal to the ureter.
- The gross location places the lesion in the upper urinary collecting system.

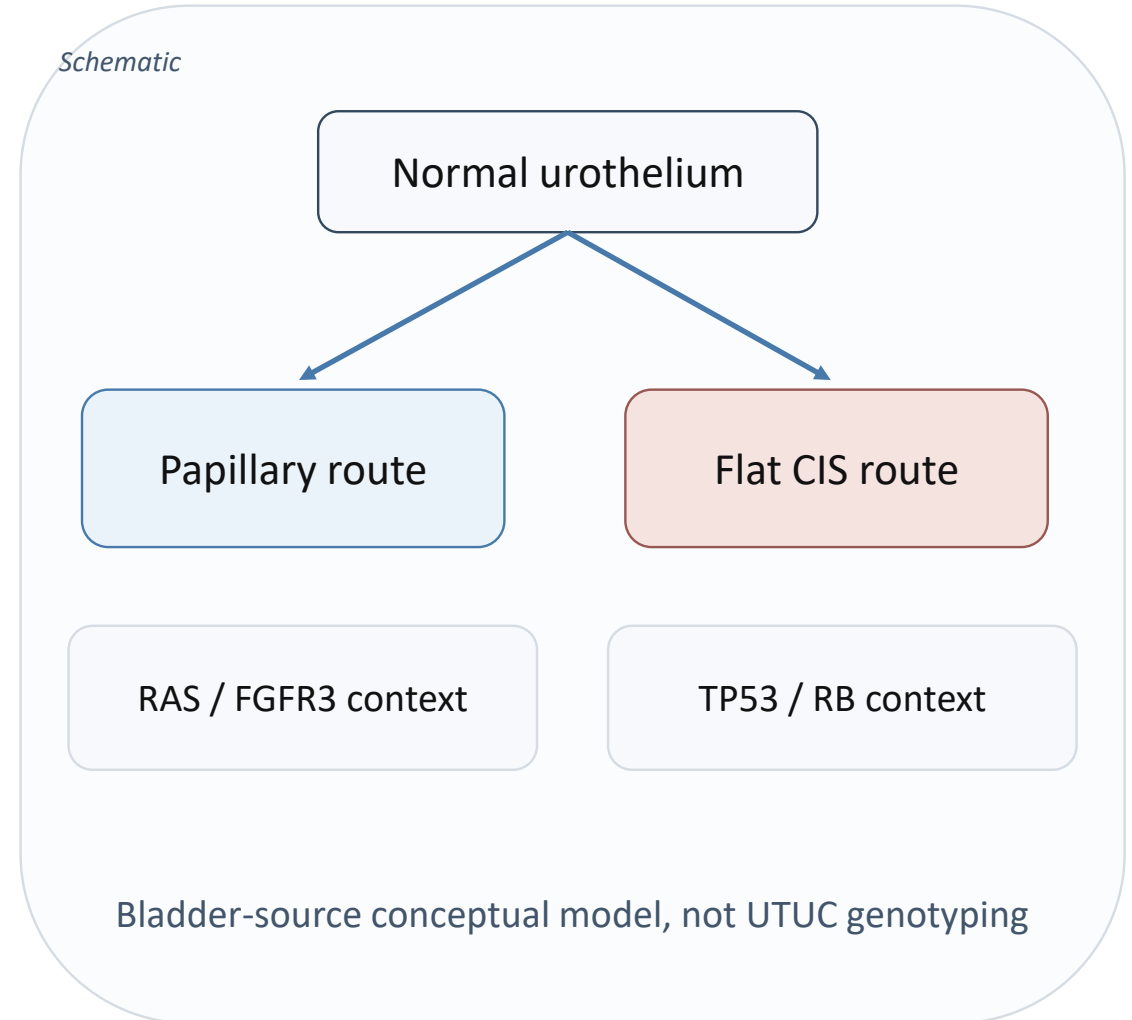
*Schematic*



# Anatomic exposure does not specify molecular genotype

- Robbins Chapter 21 presents a bladder carcinogenesis schematic.
- Papillary and CIS routes are associated with differing genetic alterations in that model.
- The diagram is teaching context, not a quantified mutation map for renal-pelvis tumors.

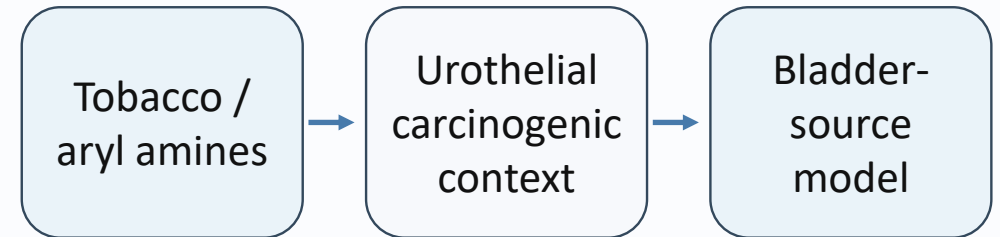
*Schematic*



## Shared urothelial carcinogenic context

- Chapter 21 implicates tobacco smoke in bladder urothelial carcinogenesis.
- Industrial aryl amines are another bladder urothelial exposure category.
- These bladder-derived exposure estimates are not presented as renal-pelvis-specific risks.

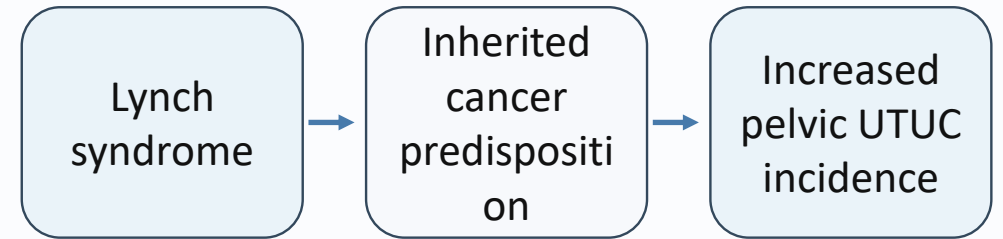
*Schematic*



# Lynch syndrome: An upper-tract association

- Increased renal-pelvis urothelial carcinoma incidence in Lynch syndrome.
- The observation is a hereditary predisposition signal.
- A pelvic urothelial carcinoma may therefore warrant attention to hereditary context.

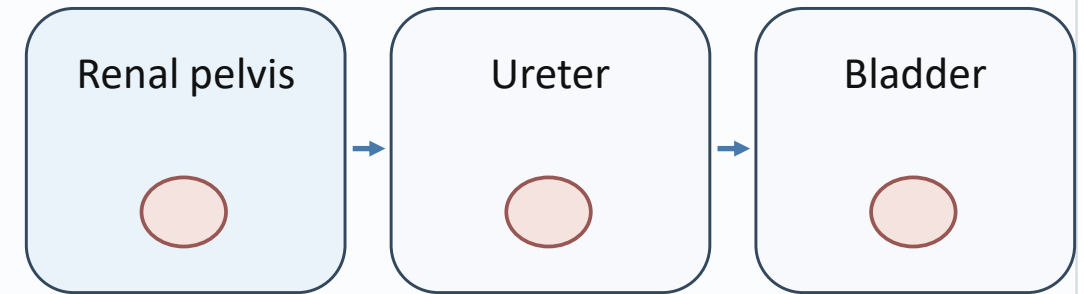
*Schematic*



# Multifocal disease reflects a continuous epithelial field

- Separate urothelial lesions can involve several urinary tract sites.
- The renal pelvis, ureter, and bladder may all be involved.
- Multiplicity cannot be inferred from the index mass alone.

*Schematic*



Multiple epithelial sites; Not three renal masses

## Pelvic carcinoma and bladder tumors often coexist

- A preexisting or concomitant bladder urothelial tumor in 50% of renal-pelvis tumor cases.
- This is a source-specific textbook figure, not a current individualized prediction.
- The finding makes lower-tract history directly relevant.

*Schematic*

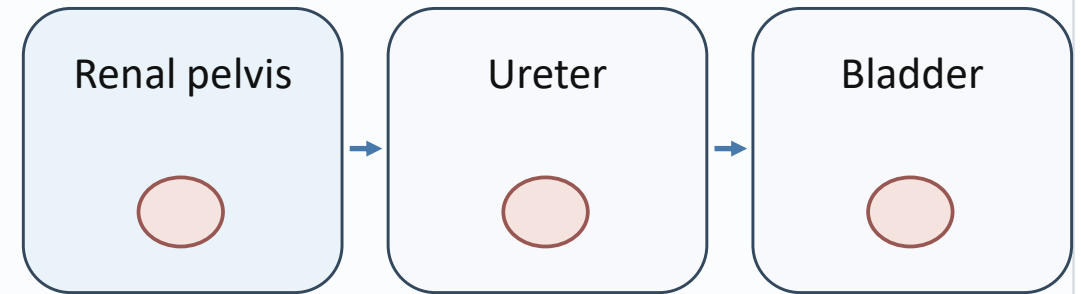
**50%**

Preexisting or concomitant bladder  
urothelial tumor (Robbins)

## Ureteral involvement adds another site of disease

- Urothelial carcinoma may occur in ureter as well as pelvis and bladder.
- Chapter 21 describes ureteral malignant tumors as commonly papillary.
- They may cause luminal obstruction and coincide with tumors elsewhere.

*Schematic*

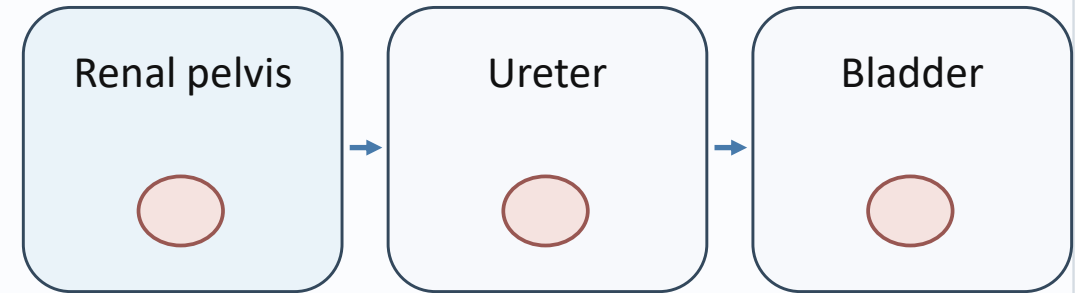


Multiple epithelial sites; Not three renal masses

# Visible multifocal tumors and microscopic field changes differ

- Multiple masses represent grossly apparent multicentric lesions.
- Remote atypia or CIS may be microscopic without a corresponding mass.
- A complete disease map considers both types of distribution.

*Schematic*

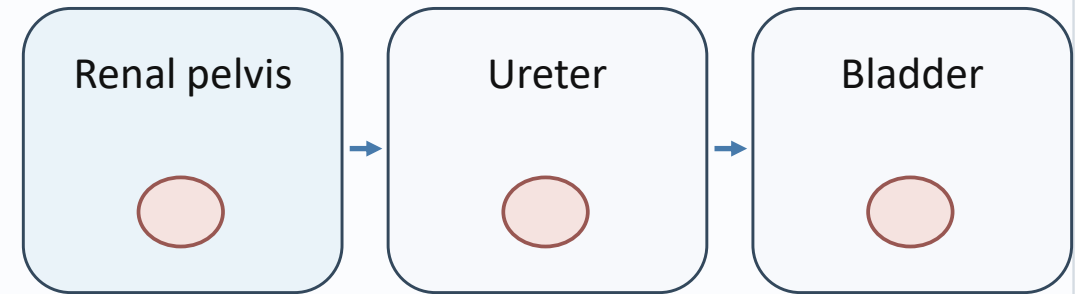


Remote atypia / CIS can be microscopic

# Field involvement affects interpretation of a single specimen

- A specimen may display both invasive carcinoma and flat mucosal abnormalities.
- Separate foci must not be mistaken for an extension of one visible papilla alone.
- Pathologic description should preserve site and pattern distinctions.

*Schematic*

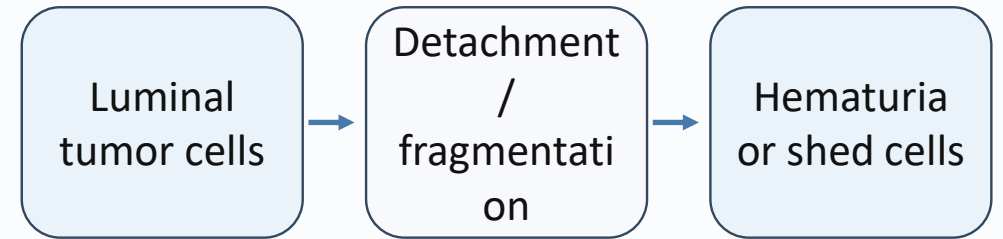


Remote atypia / CIS can be microscopic

# Why hematuria is an early clinical clue

- Pelvic tumors lie in direct contact with flowing urine.
- Tumor fragmentation can produce noticeable blood in urine.
- Robbins observes that this often draws attention to relatively small lesions.

*Schematic*



## A small pelvic tumor can be symptomatic

- Location adjacent to the urine stream favors early bleeding.
- Clinical detection may occur before a bulky mass has developed.
- Small gross size does not exclude high grade or wall infiltration.

*Schematic*

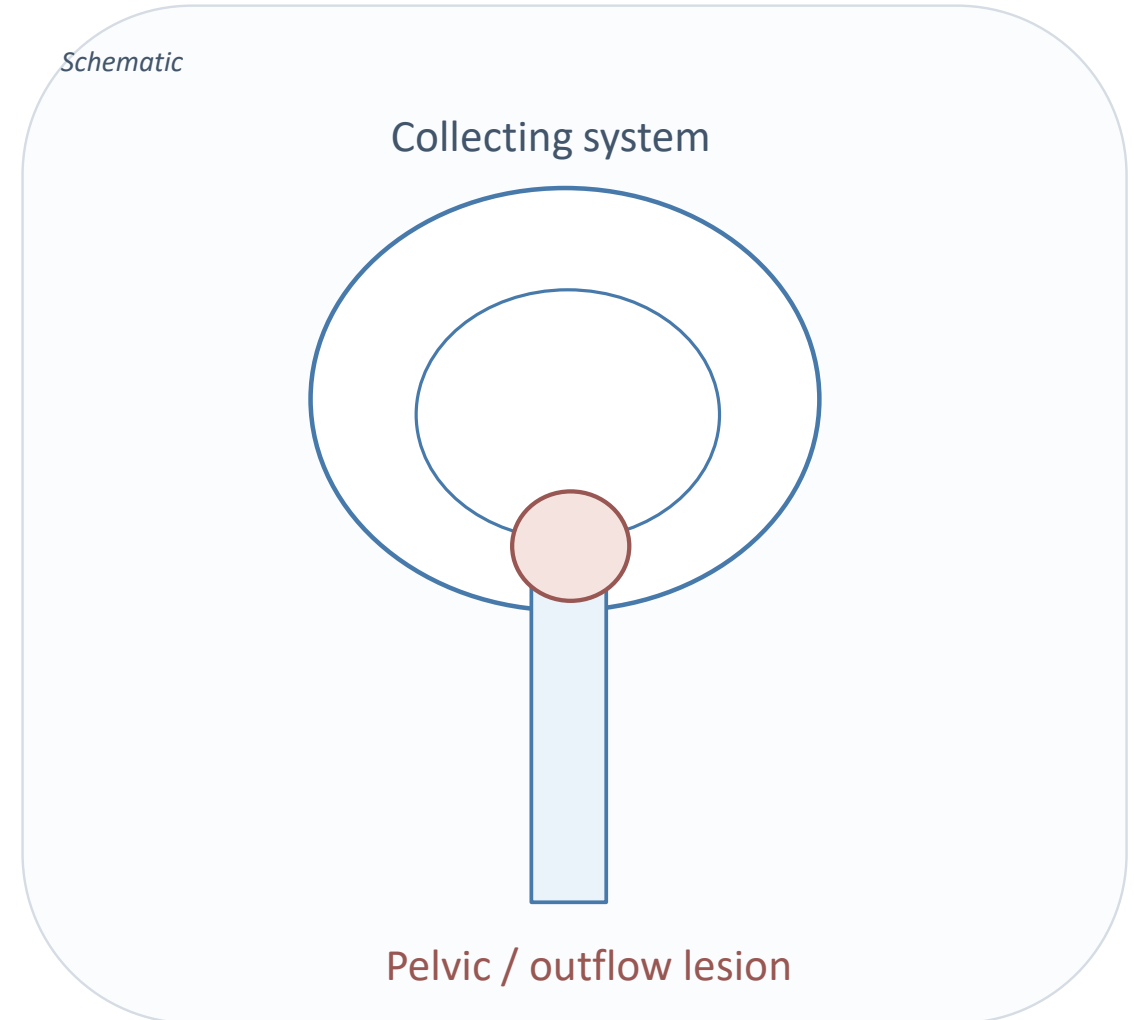
**Small ≠ superficial**

Gross size cannot establish mural invasion

## Outflow obstruction is a second clinical mechanism

- A neoplasm at the collecting-system outflow can narrow the urinary passage.
- Urinary drainage is impaired proximal to the obstruction.
- A large or palpable hydronephrotic collecting system may result.

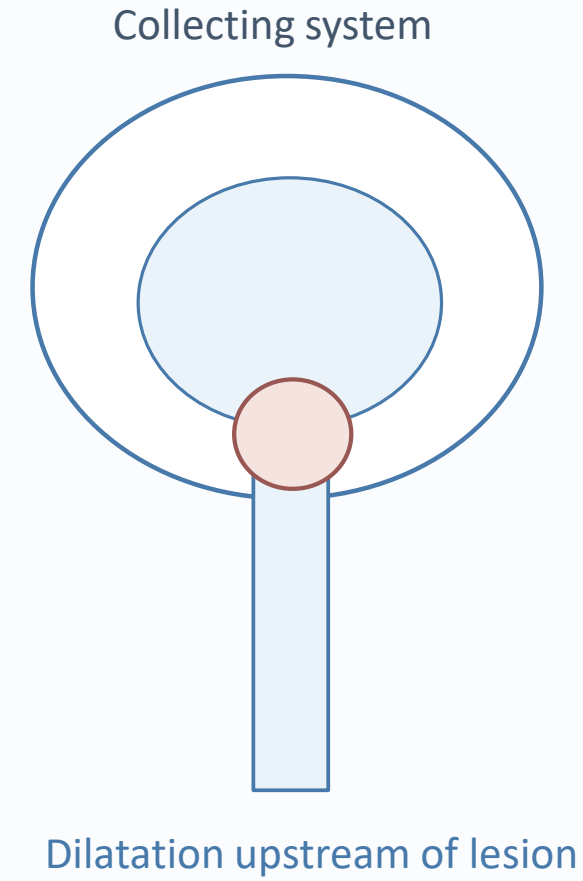
*Schematic*



# Hydronephrosis: Back-pressure from impaired drainage

- Urine accumulates upstream of the narrowed outflow tract.
- The collecting system dilates.
- The enlarged system may contribute to flank pain and clinical presentation.

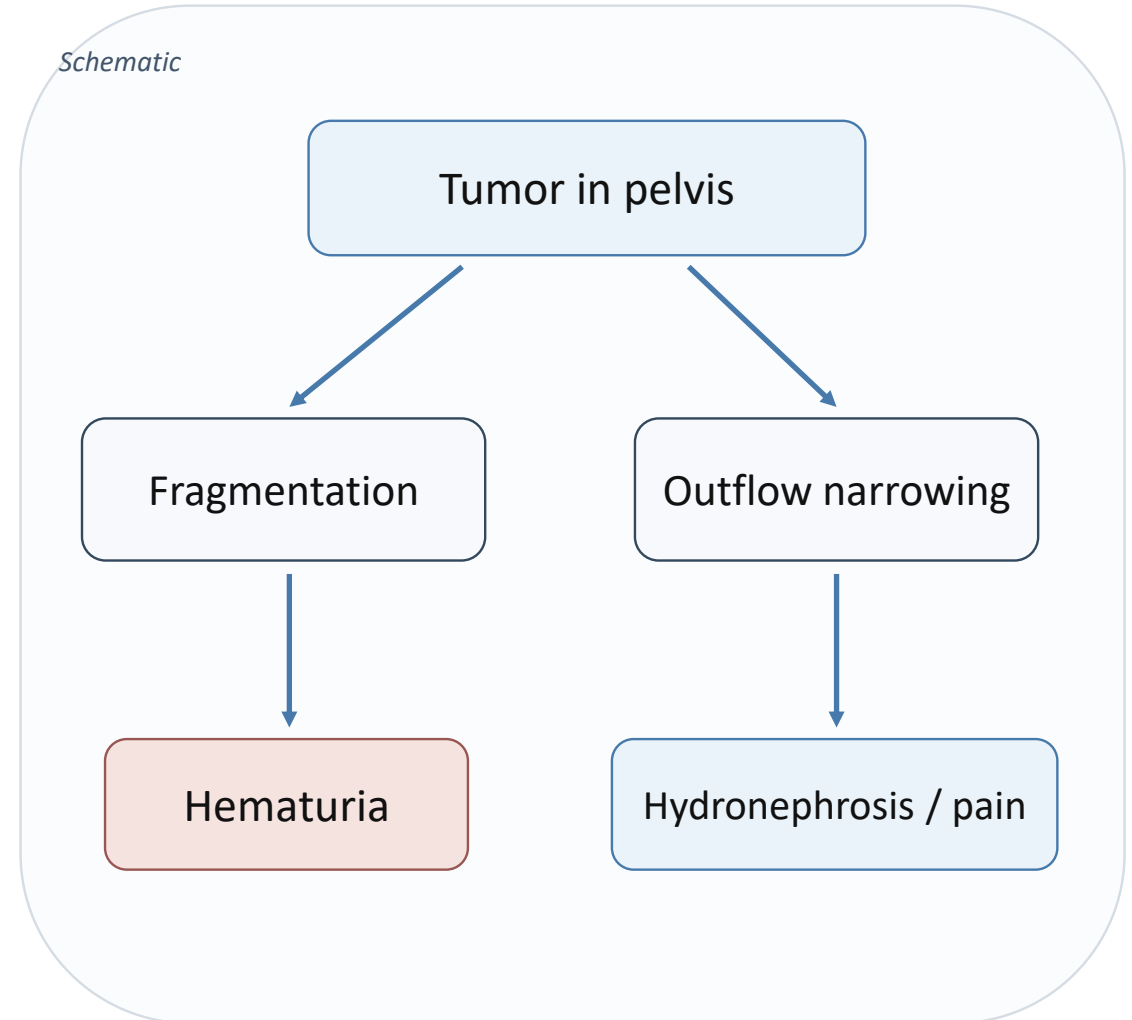
*Schematic*



## Two pathways to presentation

- Surface fragmentation and bleeding → hematuria.
- Luminal obstruction → collecting-system dilatation → flank pain.
- The pathways may occur independently or together.

*Schematic*



## Pain and hematuria identify consequences—not grade

- Hematuria describes a luminal bleeding effect.
- Flank pain can reflect outflow obstruction.
- Neither symptom by itself establishes histologic grade or invasion depth.

*Schematic*

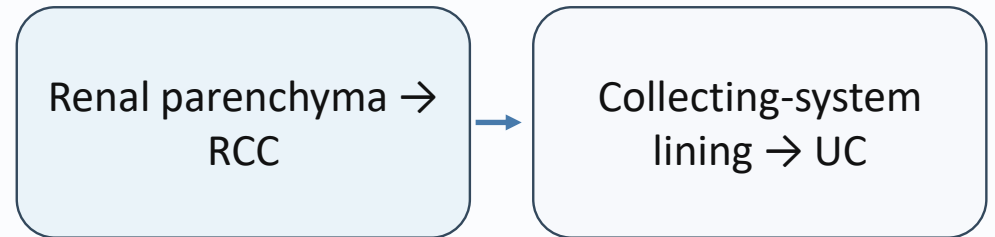
|            | Noninvasive | Invasive          |
|------------|-------------|-------------------|
| Low grade  | Possible    | Assess separately |
| High grade | Possible    | Possible          |

Grade and depth are independent descriptors

## Kidney-region mass: Begin with the site of origin

- Renal-parenchymal tumor and collecting-system urothelial tumor are different entities.
- A pelvic-based lesion directs attention to urothelial morphology.
- Location helps prevent application of the wrong tumor framework.

*Schematic*



# Describe configuration, grade, and invasion separately

- Configuration: Papillary, flat, nodular, or a combination.
- Grade: Degree of cytologic and architectural atypia.
- Invasion: Whether malignant cells have entered subepithelial tissues.

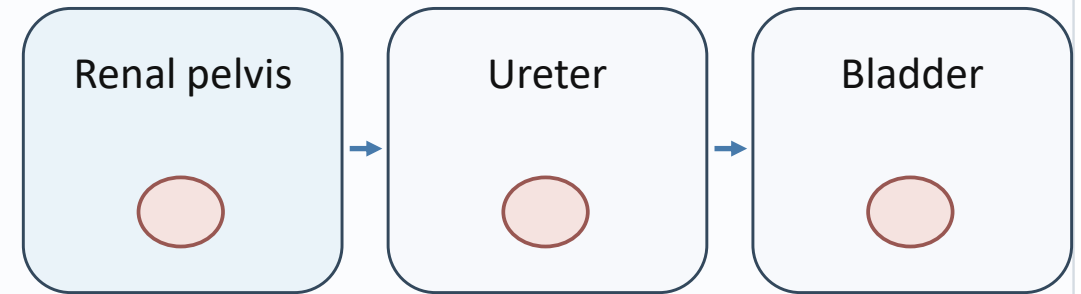
*Schematic*



# The visible lesion and the surrounding urothelium

- Inspect the dominant mass for architecture and invasive growth.
- Interpret adjacent mucosa for separate flat CIS when represented.
- Record additional involved urothelial sites when identified.

*Schematic*



Remote atypia / CIS can be microscopic

# Bladder depth rules must not be transplanted unchanged

- Muscularis propria invasion for bladder prognosis.
- Renal pelvis and calyces have different wall anatomy from the bladder.
- Use site-appropriate staging sources rather than assigning bladder TNM criteria to the renal pelvis.

*Schematic*

Bladder wall

Pelvicalyceal wall

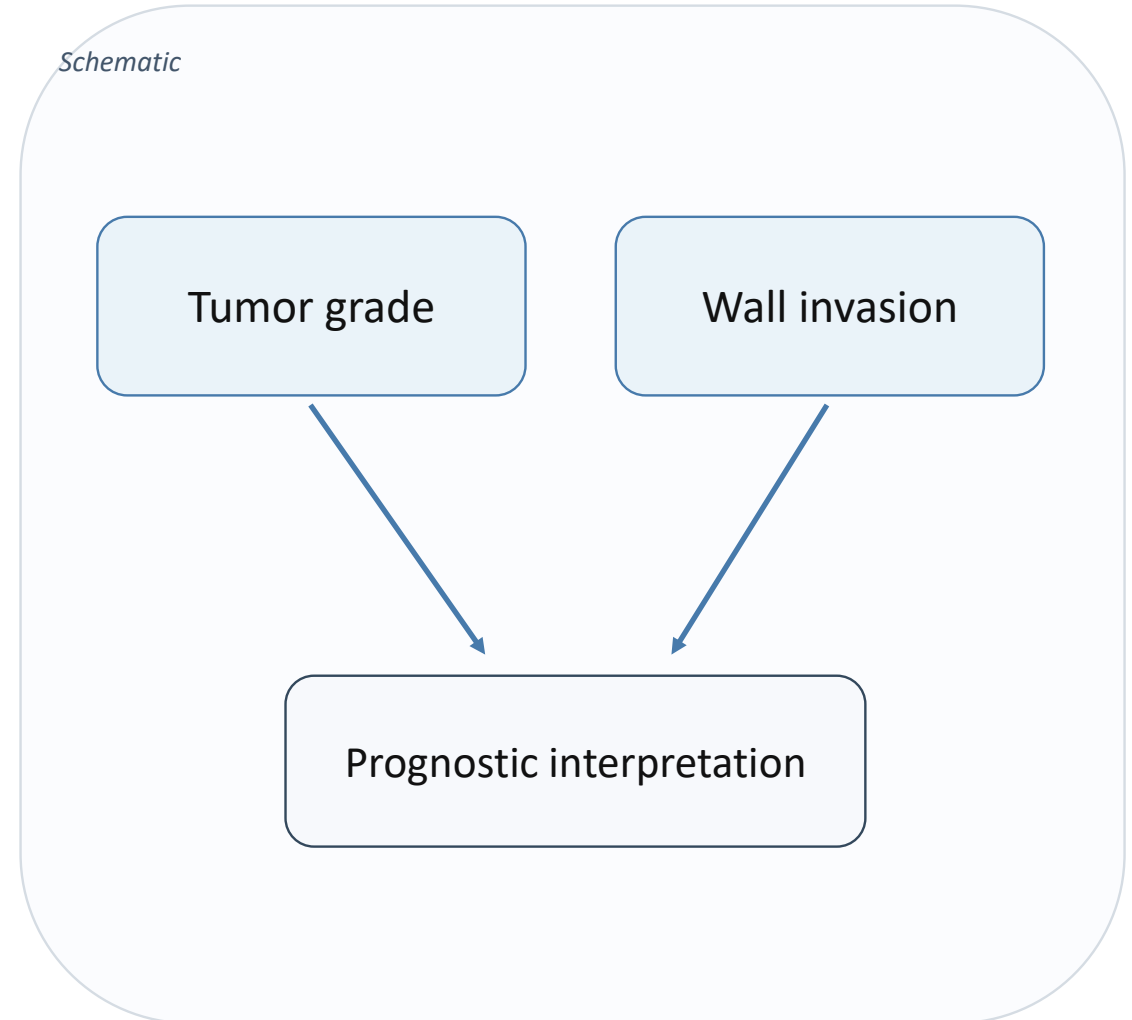
**Different site anatomy**

Do not copy bladder-specific depth thresholds

# Renal-pelvis prognosis depends on tumor biology and spread

- Low-grade noninvasive and high-grade infiltrating tumors behave differently.
- Pelvic wall infiltration contributes to the guarded outlook.
- Apparently limited intraluminal size can underrepresent risk.

*Schematic*



## Survival figures: Interpret with context

- 5-year survival of 50%–100% for low-grade noninvasive lesions.
- For high-grade infiltrating tumors, it reports survival as low as 10%.
- These broad literature figures are not contemporary calibrated risk estimates.

*Schematic*

Low-grade noninvasive

**50%–100%**

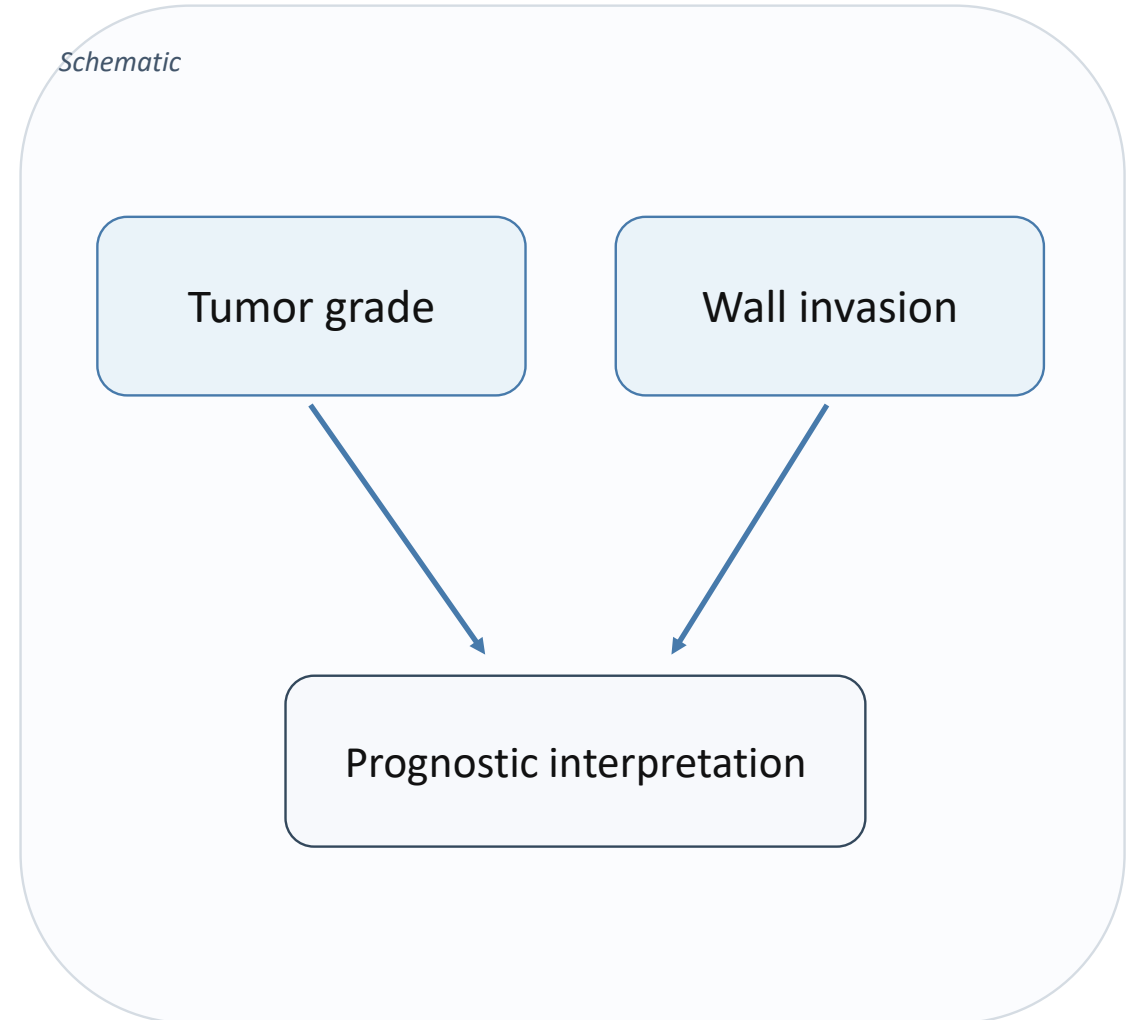
High-grade infiltrating

**As low as 10%**

# Grade and depth have different prognostic roles

- Grade reflects the biologic aggressiveness visible in tumor cytology.
- Invasion records extension beyond the epithelium.
- A full interpretation requires both, not gross appearance alone.

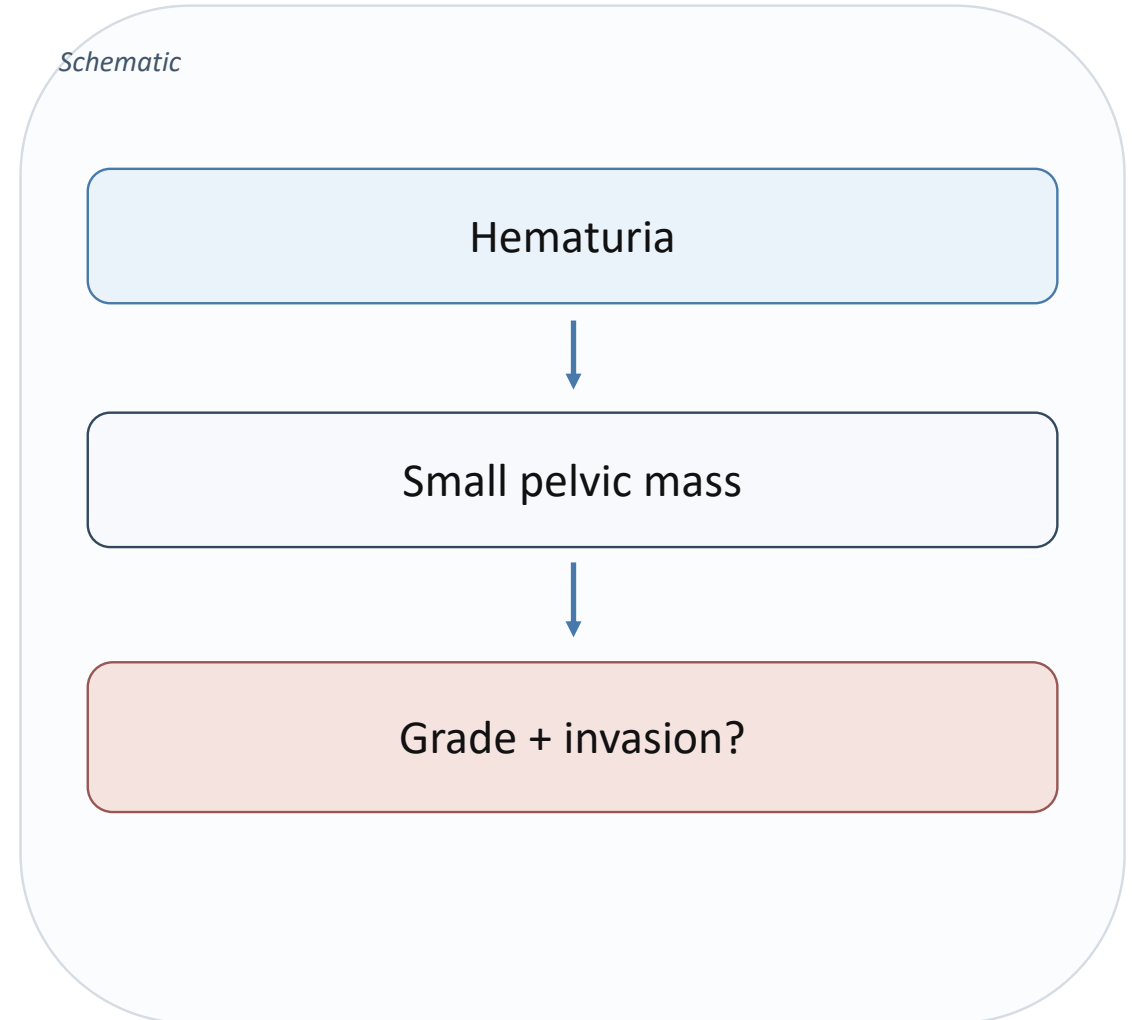
*Schematic*



## Case 1: Hematuria and a small pelvic lesion

- A patient presents with hematuria and an irregular renal-pelvis mass.
- The mass is small on gross inspection.
- Question: Which two pathologic assessments remain essential?

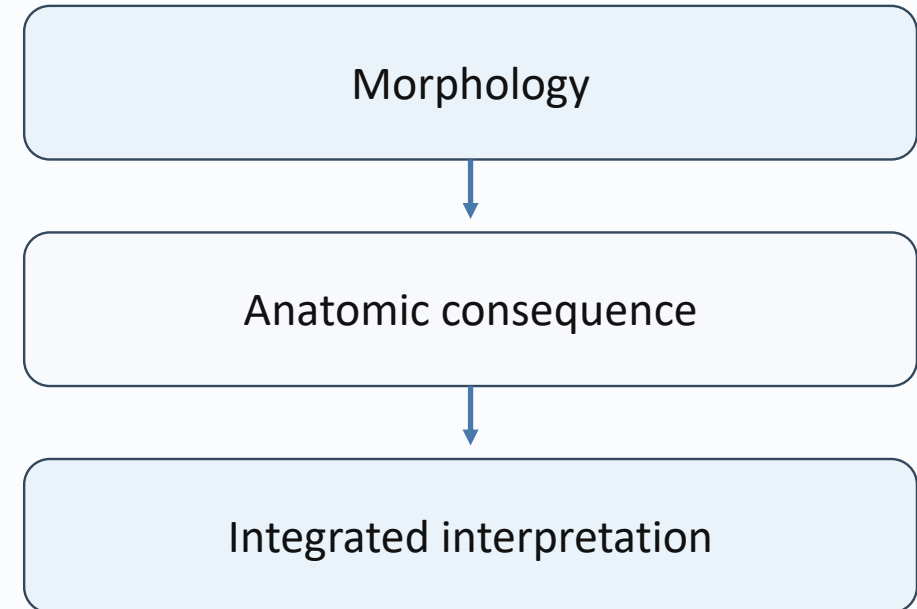
*Schematic*



## Case 1: The small size is not reassuring

- Determine cytologic grade in the urothelial lesion.
- Assess the pelvic wall for invasive carcinoma.
- The bleeding mechanism explains presentation but not biologic stage.

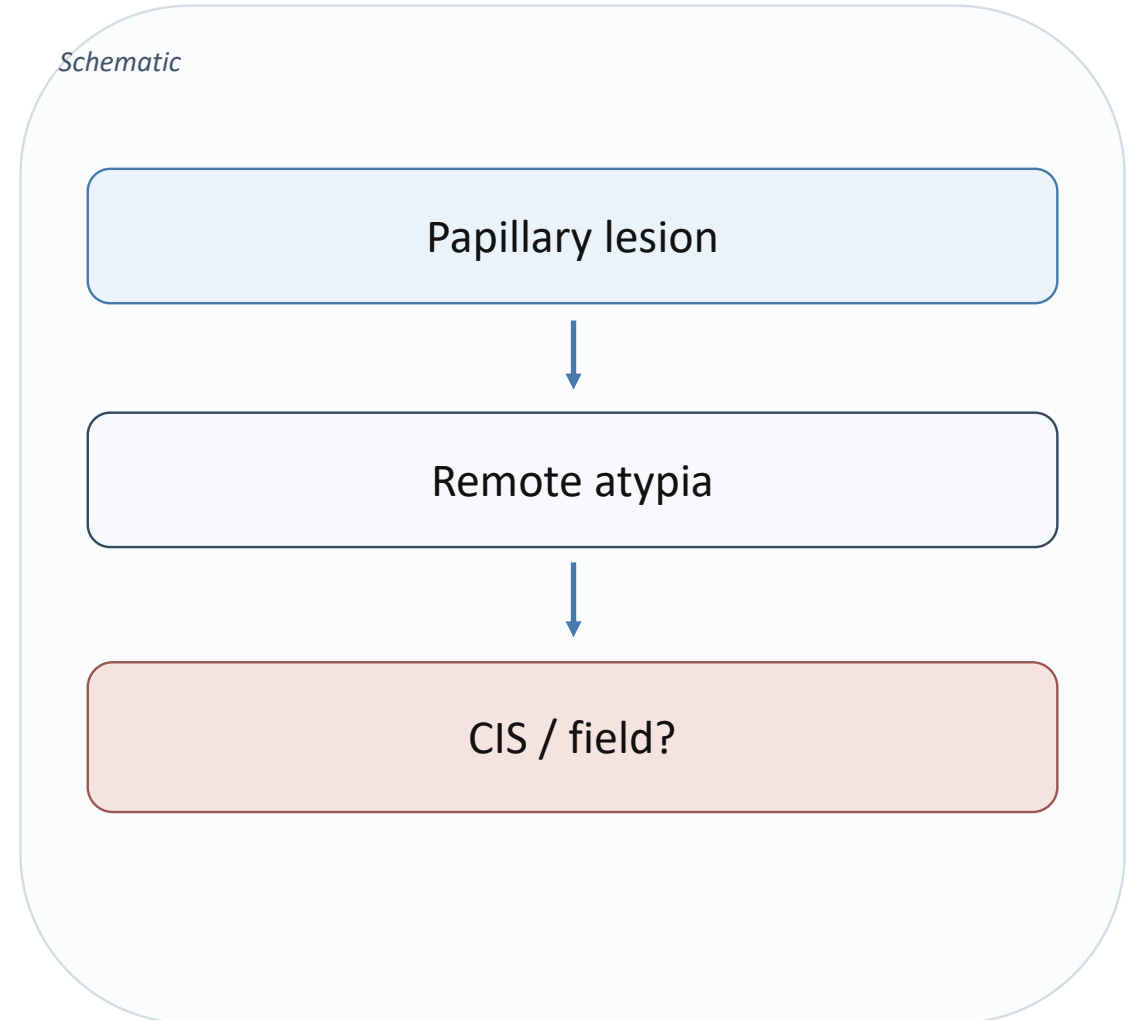
*Schematic*



## Case 2: Tumor plus flat mucosal atypia

- A papillary renal-pelvis tumor is accompanied by atypia in remote urothelium.
- Question: What precursor category may explain the remote abnormality?
- Question: Why is the remote mucosa diagnostically relevant?

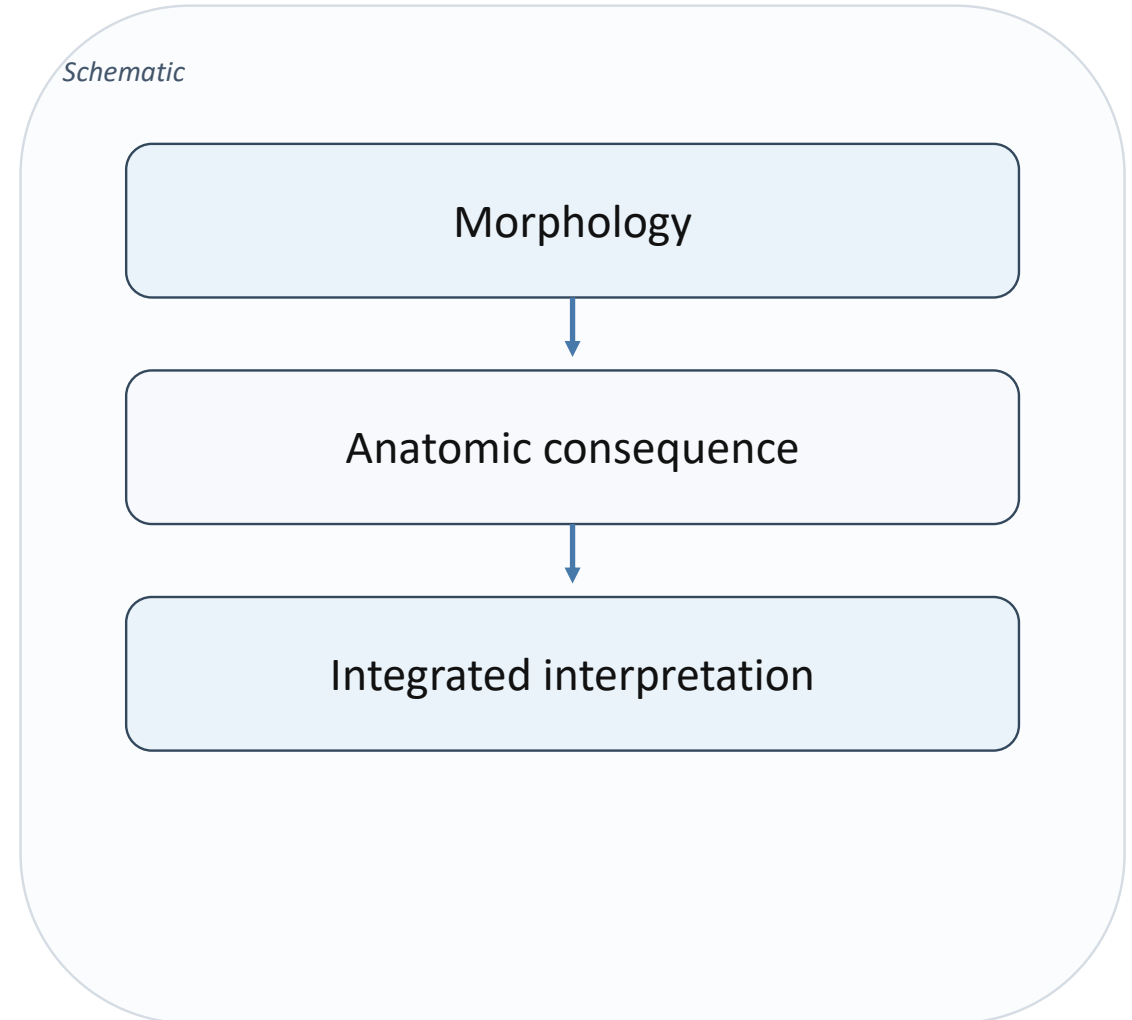
*Schematic*



## Case 2: Recognize a possible field lesion

- Flat high-grade intraepithelial malignancy is termed CIS.
- Remote CIS shows that disease extent may exceed the obvious mass.
- Pelvis, ureter, and bladder can be involved at separate sites.

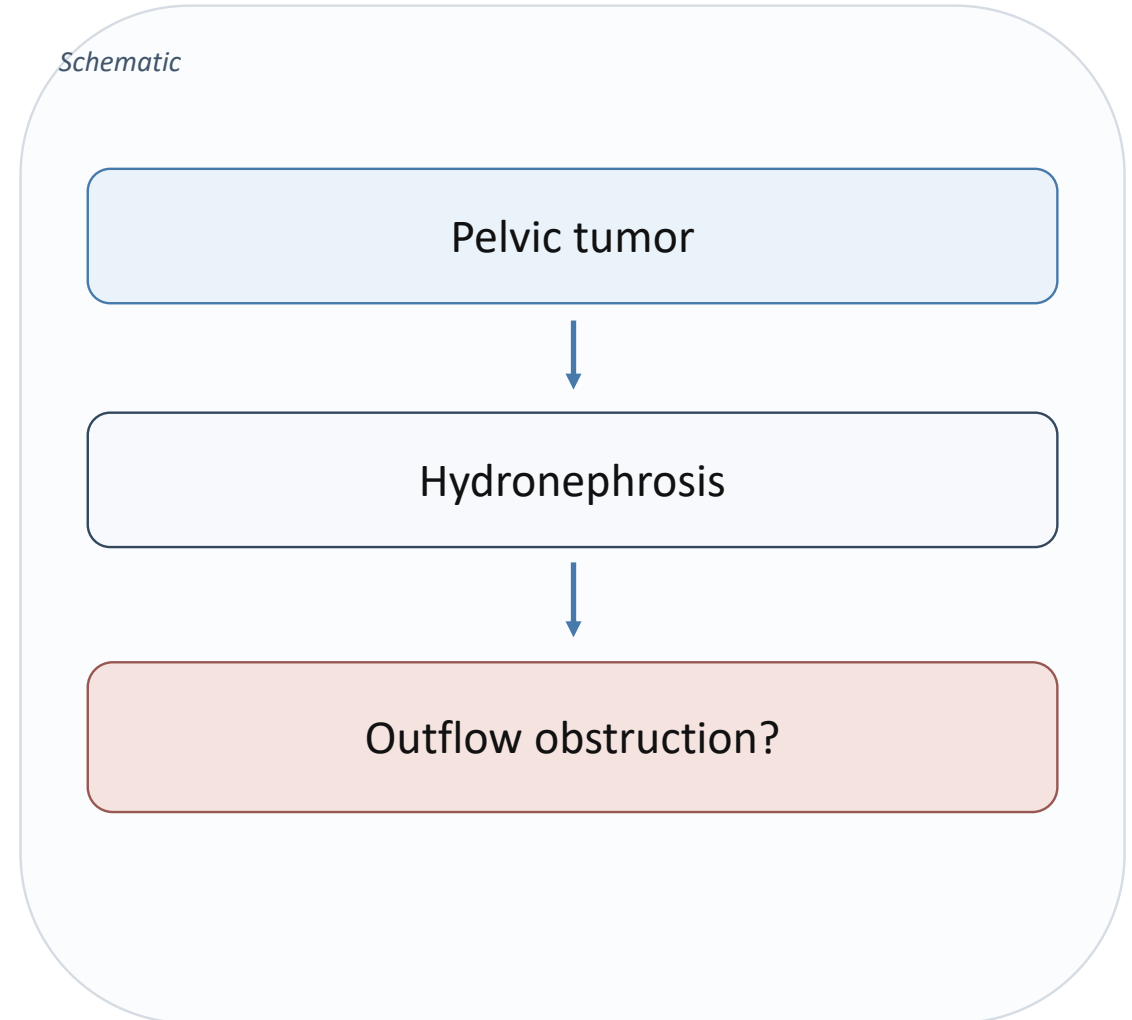
*Schematic*



## Case 3: Flank pain with collecting-system dilatation

- A renal-pelvis lesion coincides with hydronephrosis and flank pain.
- Question: What anatomic event links the tumor to these findings?
- Question: Does obstruction prove histologic high grade?

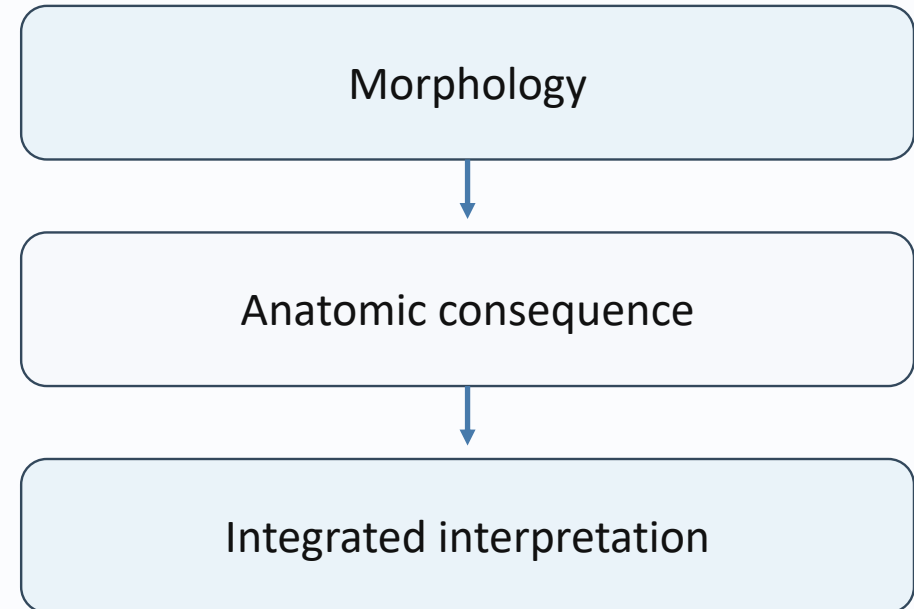
*Schematic*



## Case 3: Obstruction is the causal link

- Pelvic or ureteral narrowing impairs urine outflow.
- Upstream collecting-system dilatation can produce flank pain.
- Obstruction alone does not establish cytologic grade.

*Schematic*



## Integrated comparison of key entities

| Lesion               | Principal architecture | Defining observation                     |
|----------------------|------------------------|------------------------------------------|
| Papilloma            | Exophytic papillary    | Bland, normal-like urothelial lining     |
| PUNLMP               | Exophytic papillary    | Thickened urothelium; Limited atypia     |
| Low-grade carcinoma  | Papillary              | Orderly architecture; Low-grade cytology |
| High-grade carcinoma | Papillary ± invasive   | Marked atypia and disarray               |
| CIS                  | Flat mucosa            | High-grade cytology without invasion     |
| Invasive carcinoma   | Wall-infiltrating      | Tumor crosses epithelial boundary        |

# Consolidated pathologic reasoning

- Identify collecting-system origin before classifying morphology.
- Separate papillary grade, flat CIS, and wall invasion.
- Relate multifocality and remote dysplasia to the urothelial field.
- Use bleeding and obstruction to explain presentation—not to infer grade.

*Schematic*



# Primary sources and scope limits

## **Core text: Robbins 11th edition (2026)**

- Robbins, Cotran & Kumar: Pathologic Basis of Disease, 11th ed. (2026), Chapters 20–21.
- Topic section: renal-pelvis urothelial carcinoma; histologic context: urothelial neoplasms.
- Images are original editable schematics; no textbook micrographs or gross specimens have been reproduced.