

Clinical Manifestations of Renal Diseases

Syndrome recognition, mechanisms, and clinicopathologic interpretation

A clinicopathologic approach to renal presentation patterns

Dr Abu Suraih Sakhri

MBBS, MD (Pathology)

www.abusuraihsakhri.com

Learning outcomes

At the end of the lecture, identify a renal syndrome before naming a specific disease.

- Distinguish azotemia and uremia; Recognize prerenal and postrenal patterns.
- Differentiate nephritic, nephrotic, and asymptomatic glomerular presentations.
- Recognize acute kidney injury, chronic kidney disease, and their systemic effects.
- Identify manifestations of tubular defects, infection, obstruction, and stones.

Renal disease produces recognizable clinical syndromes

Anatomical injury and functional change often converge into a small set of presentations.

Glomerular

Nephritic syndrome
Nephrotic syndrome
Isolated urinary abnormalities

Global functional

Azotemia and uremia
Acute kidney injury
Chronic kidney disease

Tubular / interstitial

Polyuria and nocturia
Electrolyte disturbances
Acid–base defects

Urinary tract

Bacteriuria and pyuria
Obstruction-related symptoms
Colic and hematuria

Four renal compartments shape the presentation

The chapter organizes disease by the structure most directly affected.

Glomeruli

Filtration barrier injury

Hematuria and/or proteinuria

Tubules

Abnormal urine formation

Electrolyte and concentration defects

Interstitium

Often accompanies tubular injury

Infectious or toxic processes

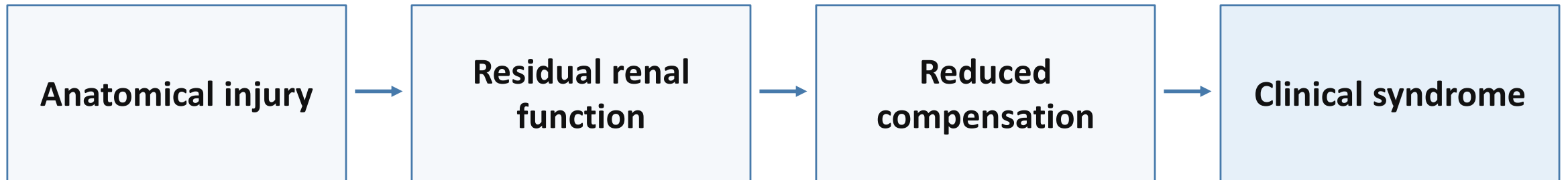
Blood vessels

Reduced tissue perfusion

Secondary injury to other components

Clinical abnormalities may emerge late

Large functional reserve can mask structural injury until sufficient nephron function is lost.



- Primary injury in one compartment can secondarily affect the other three.
- A normal-looking early clinical course does not exclude significant renal disease.

Two broad routes to a renal presentation

Urine findings identify local filtration/tubular abnormalities; Systemic findings reflect functional consequences.

Urinary manifestations

- Blood and protein in urine
- Altered urine output
- Bacteriuria or pyuria
- Severe colic with stones

Systemic manifestations

- Rise in BUN and creatinine
- Hypertension or edema
- Fluid and electrolyte imbalance
- Uremic multisystem disease

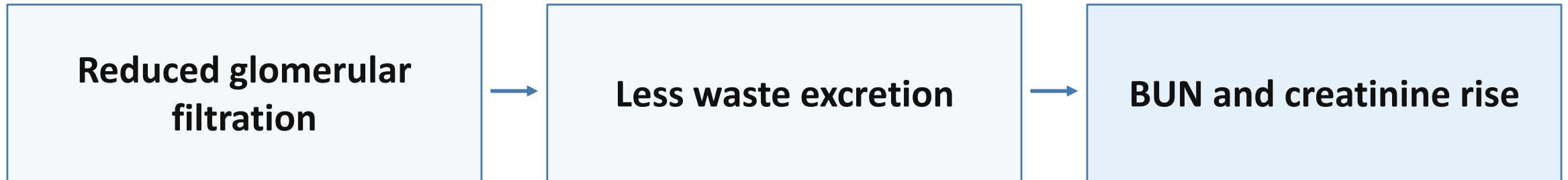
Azotemia is a biochemical abnormality

Azotemia denotes increased blood urea nitrogen and creatinine, usually related to decreased GFR.

- BUN and serum creatinine are the named biochemical markers.
- The abnormality can occur in acute or chronic renal injury.
- Its origin can also be extrarenal; An elevated value does not localize the lesion.
- Clinical symptoms are not required for the term azotemia.

How reduced filtration produces azotemia

The defining sequence involves filtration failure and retention of excreted waste products.



- Measure the biochemical disturbance separately from the clinical syndrome.
- The decline in filtration may be hemodynamic, obstructive, or due to renal injury.

Prerenal azotemia: Impaired perfusion

The kidney is hypoperfused, with impaired function in the absence of initial parenchymal damage.



- A functional disturbance can arise before demonstrable renal tissue damage.
- This is a mechanism-based designation, not a particular histologic lesion.

Recognized causes of prerenal azotemia

The same filtration defect follows several different circulatory disturbances.

Hypotension

Systemic pressure falls

Renal perfusion becomes inadequate

Fluid loss

Effective circulating volume falls

Kidney receives less blood flow

Shock

Circulatory failure

Renal hypoperfusion

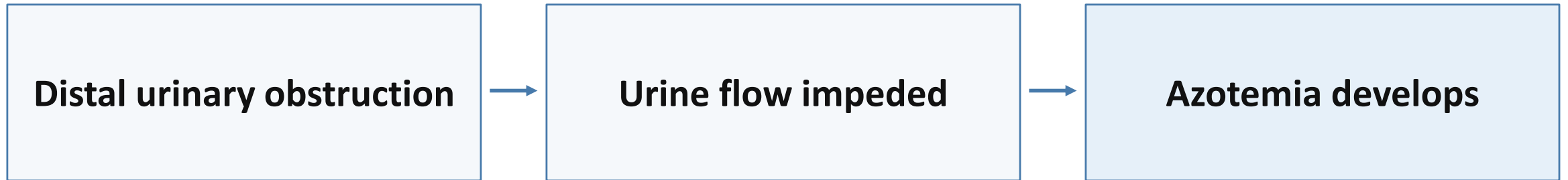
Congestive heart failure

Reduced effective intravascular volume

Renal filtration impaired

Postrenal azotemia: Obstruction to urine flow

Urinary outflow obstruction distal to the kidney produces a distinct pathway to azotemia.



- Relief of obstruction can correct the associated azotemia.
- Recognize the location and reversible mechanism before assigning intrinsic disease.

Prerenal and postrenal azotemia are not synonyms

Different mechanisms can yield the same biochemical finding.

Feature	Prerenal azotemia	Postrenal azotemia
Primary disturbance	Renal hypoperfusion	Urinary outflow obstruction
Site of mechanism	Circulatory / hemodynamic	Distal to the kidney
Parenchymal damage	Absent at the outset (definition)	Not required for the mechanism
Illustrative context	Fluid loss, shock, heart failure	Obstructed urinary flow

Uremia is the symptomatic clinical syndrome

Uremia occurs when azotemia is accompanied by clinical signs and symptoms.

- Reduced excretory function is only part of the disturbance.
- Renal damage also causes metabolic and endocrine alterations.
- These changes produce secondary effects in multiple organ systems.
- Azotemia alone does not establish the clinical syndrome of uremia.

Uremia involves more than retained solutes

The chapter explicitly identifies major extra-renal manifestations.

Gastrointestinal

Uremic gastroenteritis

Nausea, vomiting, mucosal involvement

Neurologic

Peripheral neuropathy

Other neuromuscular disturbances in advanced disease

Cardiac

Uremic fibrinous pericarditis

Cardiopulmonary manifestations

Systemic

Metabolic/endocrine abnormalities

Fluid, electrolyte, and bone effects

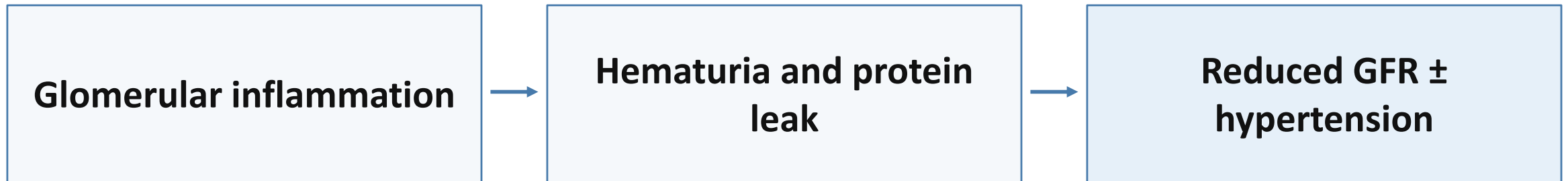
Nephritic syndrome signals inflammatory glomerular disease

An acutely appearing constellation of hematuria, reduced filtration, proteinuria, and hypertension.

- Hematuria may be grossly visible or detected only microscopically.
- GFR is diminished, producing impaired excretory function.
- Proteinuria is usually mild to moderate.
- Hypertension accompanies the syndrome.

Why nephritic disease changes urine and filtration

Inflammation of the glomerulus simultaneously affects capillary integrity and effective filtration.



- The nephritic phenotype is defined by its combined urinary and hemodynamic findings.
- The flow is a simplified clinicopathologic schematic, not a histologic image.

Hematuria can be visible or microscopic

Visible or microscopic hematuria can accompany a nephritic presentation.

Gross hematuria

- Blood is apparent in the voided urine
- A clinical observation may be the first clue
- Occurs in nephritic glomerular disease

Microscopic hematuria

- Detected by urine examination
- May occur without visible urine discoloration
- Can also appear as an isolated finding

Reduced GFR is central to the nephritic pattern

Nephritic syndrome combines inflammation with a measurable decline in renal filtration.

- Azotemia may accompany the fall in GFR.
- Hypertension forms part of the characteristic presentation.
- Proteinuria is typically less prominent than in nephrotic syndrome.
- Interpret the abnormalities as a pattern rather than as isolated test results.

Proteinuria differs across glomerular syndromes

The amount of protein loss helps distinguish the dominant pattern.

Nephritic syndrome

- Proteinuria is mild to moderate
- Hematuria is dominant
- Decreased GFR and hypertension are important

Nephrotic syndrome

- Proteinuria is heavy
- Textbook threshold: >3.5 g/day
- Hypoalbuminemia, edema, and lipid abnormalities follow

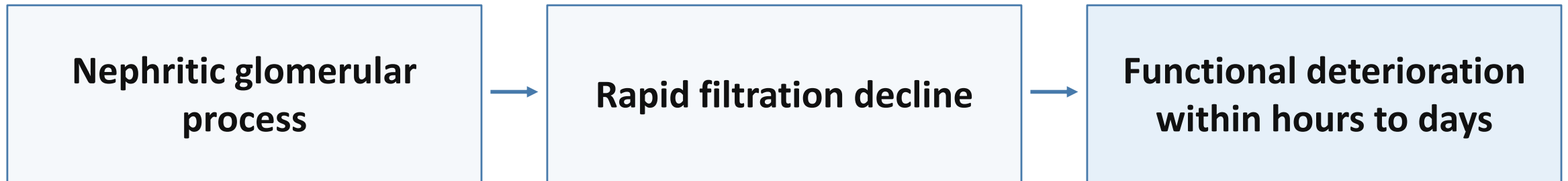
Acute poststreptococcal glomerulonephritis

This disease is the classic prototype of an acute nephritic syndrome.

- The clinical syndrome is acute and inflammatory.
- Hematuria may be gross or microscopic.
- Reduced GFR, hypertension, and moderate proteinuria define the presentation.
- A specific etiologic diagnosis requires additional disease-level evaluation.

Rapidly progressive glomerulonephritis

RPGN is a nephritic presentation with a particularly rapid fall in GFR.



- Time course is the crucial distinguishing feature emphasized in this section.
- The underlying pathology and causes are developed in separate chapter topics.

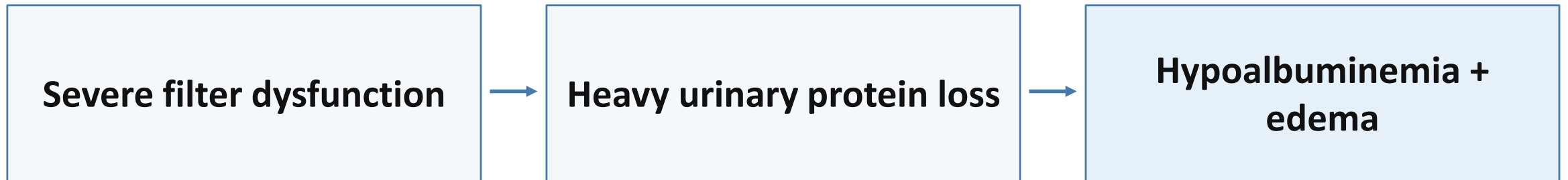
Nephrotic syndrome reflects severe filtration-barrier dysfunction

The syndrome is defined by heavy protein loss plus characteristic systemic consequences.

- Heavy proteinuria exceeds 3.5 g/day.
- Hypoalbuminemia accompanies substantial urinary protein loss.
- Severe edema is a characteristic clinical effect.
- Hyperlipidemia and lipiduria complete the classic constellation.

Nephrotic syndrome: Filtration defect to systemic findings

Glomerular filter dysfunction is linked to heavy protein loss and reduced serum albumin.



- Hyperlipidemia and lipiduria are additional defining features.
- A normal renal filtration barrier retains most plasma proteins.

Heavy proteinuria is the quantitative hallmark

The heavy-proteinuria threshold is greater than 3.5 grams per day.

- This is a daily urinary protein quantity, not a serum protein concentration.
- The threshold is a quantitative hallmark, not the entire syndrome.
- The threshold alone should be interpreted with albumin, edema, and lipid findings.
- Subnephrotic proteinuria can occur in other renal disease presentations.

Protein loss and hypoalbuminemia

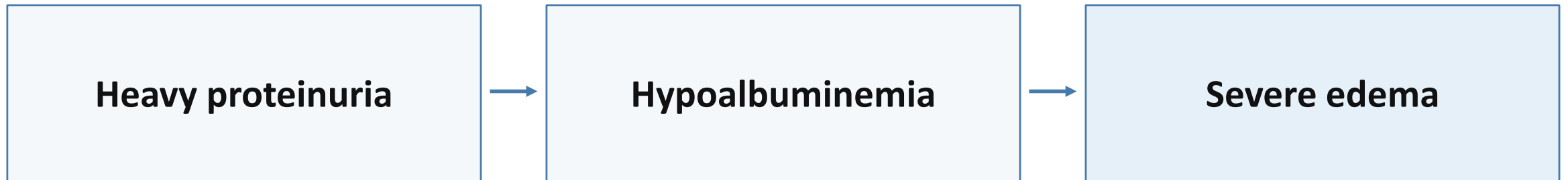
The nephrotic phenotype links impaired glomerular selectivity to lower circulating albumin.



- Hypoalbuminemia is a named consequence of heavy proteinuria.
- Interpret serum and urine protein findings together.

Severe edema is a systemic nephrotic manifestation

A urinary filtration defect presents with a prominent whole-body fluid finding.



- Edema is a major clinical clue even when the lesion is glomerular.
- The sequence is schematic: Renal sodium handling and other factors can also affect edema.

Nephrotic syndrome includes lipid abnormalities

Both plasma and urinary lipid findings belong to the characteristic presentation.

Hyperlipidemia

- Increased circulating lipid levels
- A systemic metabolic feature of nephrotic syndrome
- Interpreted with protein loss and edema

Lipiduria

- Lipids appear in the urine
- A urinary finding, distinct from proteinuria
- Characteristic accompaniment of nephrotic syndrome

Nephritic versus nephrotic syndrome

Use the dominant constellation rather than a single abnormal value.

Feature	Nephritic	Nephrotic
Basic process	Inflammatory glomerular disease	Severe filtration-barrier dysfunction
Dominant urine finding	Hematuria	Heavy proteinuria >3.5 g/day
Proteinuria	Mild to moderate	Marked
Filtration / pressure	Reduced GFR; Hypertension	Not the dominant defining pattern
Systemic pattern	Azotemia may occur	Hypoalbuminemia, edema, lipid changes

Asymptomatic urinary abnormalities can be glomerular

The absence of symptoms does not exclude clinically meaningful hematuria or proteinuria.

- Microscopic hematuria may be found incidentally.
- Proteinuria can likewise be detected without a symptomatic syndrome.
- Either finding, or the combination, often reflects a subtle or mild glomerular abnormality.
- This pattern is distinct from overt nephritic or nephrotic syndrome.

Isolated urine findings deserve their own category

Do not automatically assign every abnormal urine test to a fully developed syndrome.

Asymptomatic hematuria

- Blood detected without a major clinical syndrome
- May indicate a mild glomerular lesion
- Assess alongside proteinuria and renal function

Asymptomatic proteinuria

- Urinary protein detected without symptoms
- May signal a subtle glomerular abnormality
- Can coexist with microscopic hematuria

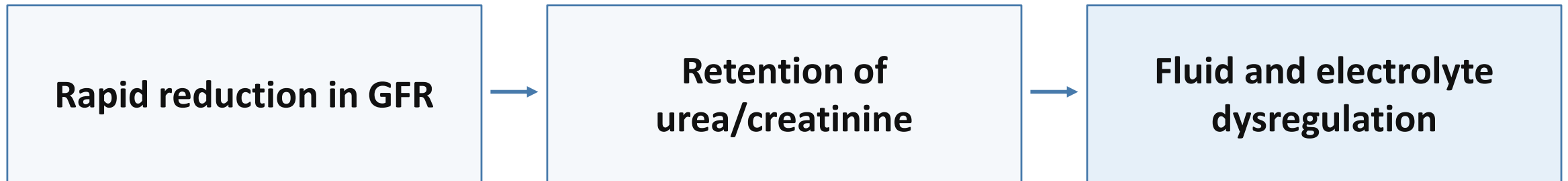
Acute kidney injury is a rapid decline in renal function

AKI, formerly called acute renal failure, develops over hours to days.

- GFR falls rapidly.
- Metabolic waste products normally excreted by the kidney accumulate.
- Fluid and electrolyte balance becomes dysregulated.
- Severe AKI can produce oliguria or anuria.

The AKI phenotype combines filtration and regulation failure

A short time course and multiple functional consequences distinguish AKI.



- The short time course is central to recognizing AKI.
- Urine volume may fall in severe cases, but output is not the sole defining feature.

AKI can originate in several renal components

The functional syndrome does not uniquely identify a structural source.

Glomerular

Acute glomerular injury

Rapid filtration impairment

Tubular

Acute tubular injury (ATI)

Defective tubular function

Interstitial

Acute interstitial injury

Inflammatory or other processes

Vascular

Acute vascular injury

Impaired renal perfusion and function

Oliguria and anuria mark severe output disturbance

These output disturbances can accompany the most severe AKI.

Oliguria

- Reduced urine flow
- Can accompany severe acute functional decline
- An output descriptor, not a histologic diagnosis

Anuria

- Absent or near-absent urine output
- Represents an extreme output disturbance
- Calls attention to severe dysfunction or obstruction

AKI and CKD differ chiefly in time course

Both may cause azotemia, but rapidity and persistence separate the syndromes.

Dimension	Acute kidney injury	Chronic kidney disease
Time course	Hours to days	At least 3 months for defining abnormalities
Renal function	Rapid fall in GFR	Persistent reduced GFR and/or albuminuria
Clinical onset	Often abrupt functional imbalance	May be clinically silent initially
Potential course	May recover or progress	Usually persistent; Advanced uremia possible

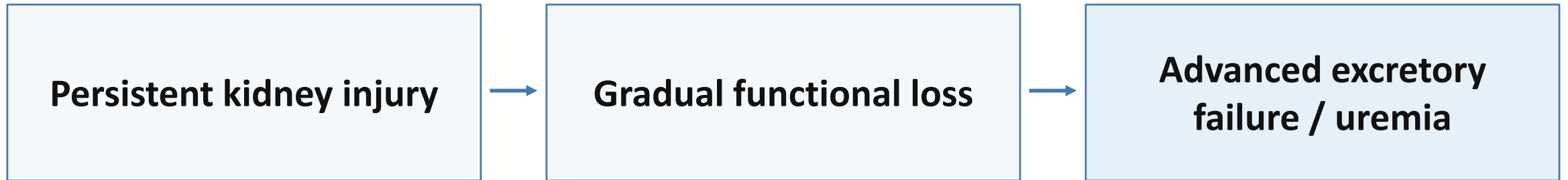
CKD is defined by persistent abnormalities

CKD is defined by persistent decreased GFR and/or albuminuria.

- GFR persistently <60 mL/min/ 1.73 m² for at least 3 months is a stated criterion.
- Persistent albuminuria is an alternative defining feature.
- Milder disease may show a clinically silent decline in excretory function.
- More severe CKD can be associated with prolonged uremic manifestations.

CKD may progress silently before uremia emerges

The substantial reserve of the kidney helps explain delayed symptom appearance.



- Do not use symptoms alone to rule out chronic kidney disease.
- Progression of chronic disease can produce abnormalities across multiple renal components.

Common routes to chronic renal disease

Many renal disorders converge on the chronic disease phenotype.

- Diabetic kidney disease is highlighted as a common cause.
- Vascular kidney disease is another major cause.
- Chronic damage may eventually involve glomeruli, tubules, interstitium, and blood vessels.
- The terminal pathway is function loss, not a single specific renal morphology.

CKD and uremia have systemic manifestations

Manifestations extend beyond the kidney into multiple organ systems.

Water/electrolytes

Dehydration or edema

Hyperkalemia and metabolic acidosis

Mineral and bone

Phosphate/calcium disturbance

Hyperparathyroidism and osteodystrophy

Blood/cardiopulmonary

Anemia, bleeding

Hypertension, failure, pericarditis

Other systems

Gastrointestinal injury

Neuromuscular and skin changes

CKD may present with opposite volume states

The table lists both dehydration and edema as possible manifestations.

Dehydration

- A recognized volume abnormality in CKD
- Reflects disordered fluid handling in relevant patients
- Not every patient is volume overloaded

Edema

- Also a recognized fluid manifestation
- May coexist with hypertension or cardiac complications
- Needs interpretation with the overall renal syndrome

Hyperkalemia and metabolic acidosis are major complications

Both abnormalities are part of the CKD/uremia systemic profile.

Hyperkalemia

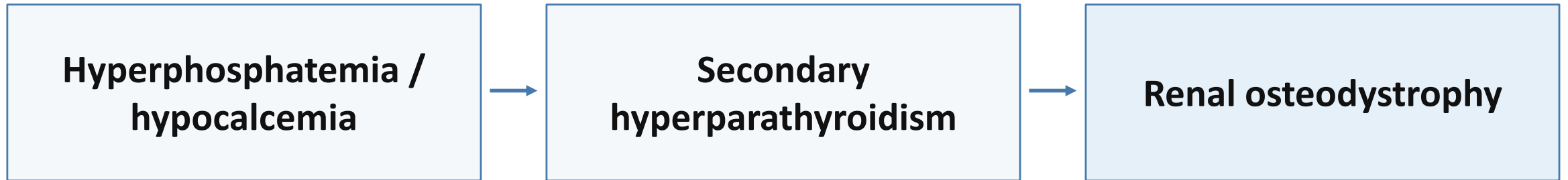
- Disturbance of potassium balance
- A potentially consequential electrolyte abnormality
- Recognized systemic complication of CKD and uremia

Metabolic acidosis

- Defect in systemic acid–base homeostasis
- Also appears with certain tubular disorders
- Interpret with the clinical time course

Chronic kidney disease disrupts mineral–bone homeostasis

Phosphate, calcium, parathyroid, and skeletal disturbances occur together in CKD.



- These abnormalities cluster among the mineral-and-bone consequences of CKD.
- The arrows indicate a simplified clinical association, not a quantitative physiologic model.

Renal osteodystrophy is a systemic manifestation

Mineral metabolism abnormalities can accompany major skeletal consequences in CKD.

- Hyperphosphatemia and hypocalcemia are listed in the same category.
- Secondary hyperparathyroidism is another associated manifestation.
- Renal osteodystrophy summarizes the bone consequences described by the text.
- These are systemic effects, not defining primary glomerular urine findings.

CKD produces hematologic abnormalities

Anemia and abnormal bleeding are distinct hematologic manifestations.

Anemia

- A systemic manifestation of chronic kidney disease
- May coexist with otherwise subtle urinary abnormalities
- Relevant to the burden of chronic disease

Abnormal bleeding

- A second hematologic complication
- Part of the uremic systemic phenotype
- Different from glomerular hematuria

Cardiopulmonary manifestations are prominent

The CKD/uremia table includes both pressure-volume and myocardial/pericardial problems.

Hemodynamic

Hypertension

Congestive heart failure

Pulmonary

Pulmonary edema

Fluid-related respiratory involvement

Myocardial

Cardiomyopathy

Cardiac organ dysfunction

Pericardial

Uremic pericarditis

Specific uremia-associated process

Uremic pericarditis is a specific cardiac manifestation

Uremic fibrinous pericarditis is a characteristic extra-renal manifestation.

- It demonstrates that uremia is a multisystem clinical condition.
- It complements hypertension, cardiac failure, and pulmonary edema in the systemic profile.
- Do not treat an elevated BUN value alone as equivalent to this clinical manifestation.
- The disorder has a distinctive pericardial involvement rather than a urinary symptom.

Gastrointestinal manifestations of uremia

Uremia may cause digestive symptoms, mucosal inflammation, and bleeding.

Upper symptoms

Nausea

Vomiting

Hemorrhagic

Gastrointestinal bleeding

Recognized systemic complication

Upper mucosa

Esophagitis

Gastritis

Lower mucosa

Colitis

Uremic gastroenteritis

Neuromuscular involvement in CKD and uremia

The manifestations include peripheral and central nervous system effects.

Muscle

Myopathy

Systemic neuromuscular complication

Peripheral nerves

Peripheral neuropathy

Frequently cited with uremia

Central nervous system

Encephalopathy

Advanced systemic neurologic involvement

Clinical implication

More than filtration loss

Search for multisystem consequences

Dermatologic clues may accompany uremia

Skin symptoms and visible changes contribute to the multisystem picture.

Color

Sallow coloration

Altered appearance

Sensation

Pruritus

Itching

Inflammation

Dermatitis

Skin involvement

Interpretation

Nonspecific individually

More suggestive in a multisystem context

End-stage kidney disease is the terminal uremic state

This terminal stage is described by GFR less than 5% of normal.

- This is the terminal end of severe chronic renal functional decline.
- Uremic manifestations may affect multiple body systems.
- The threshold here is a fraction of normal GFR, not an absolute eGFR value.
- ESKD is a functional stage, not a unique etiologic diagnosis.

Tubular defects produce a different clinical profile

Polyuria, nocturia, and electrolyte disorders dominate.

- Polyuria refers to excessive urine formation.
- Nocturia is a frequent or notable nighttime urinary manifestation.
- Metabolic acidosis is a named example of an electrolyte/acid–base disorder.
- Tubular disease may occur despite the absence of classic nephritic or nephrotic findings.

Polyuria and nocturia suggest impaired tubular function

Abnormal urine production may dominate the presentation rather than blood or protein leakage.

Polyuria

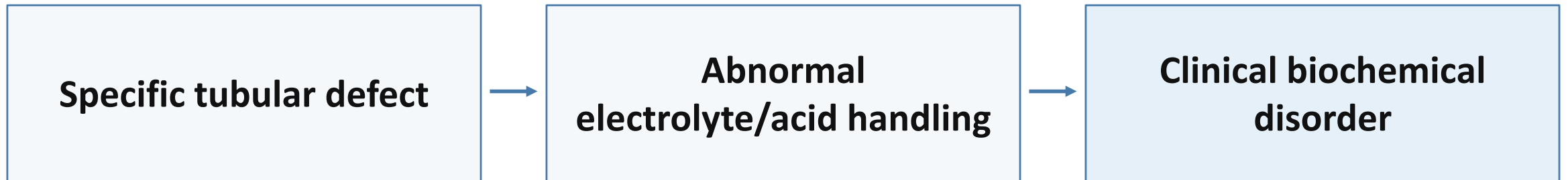
- Excessive urine production
- A dominant clue to tubular dysfunction
- Different from severe AKI with oliguria

Nocturia

- Urinary symptom occurring at night
- Often grouped with polyuria
- May draw attention to tubular dysfunction

Tubular dysfunction affects solute and acid–base control

A defect in a particular tubular function can produce a distinctive systemic abnormality.



- Metabolic acidosis is a characteristic possible biochemical defect.
- The dominant finding may be biochemical instead of inflammatory urinary sediment.

Tubular disorders may be structural or functional

Tubular disease may damage the tubules or impair a specific transport function.

Direct tubular involvement

- Primary involvement of tubular structures
- Nephronophthisis is an example
- May lead to polyuria, nocturia, or other defects

Specific tubular-function defect

- Can be inherited or acquired
- Altered solute or acid–base transport
- Produces a syndrome defined by affected function

Examples of inherited tubular-function disorders

Selected inherited defects illustrate distinct tubular functional targets.

Familial nephrogenic diabetes

Inherited defect in tubular function

Associated with excessive urine formation

Cystinuria

Inherited tubular transport disorder

An example of selective tubular dysfunction

Renal tubular acidosis

Tubular acid–base defect

Metabolic acidosis is a central manifestation

Principle

An inherited disorder may affect a single function

Syndrome need not be glomerular

Acquired tubular defects are also possible

Lead nephropathy exemplifies an acquired tubular defect.

- The cause of a tubular defect need not be inherited.
- Acquired exposure-related injury may disturb specific renal functions.
- The clinical phenotype depends on the tubular process affected.
- A tubular-pattern syndrome should not automatically be labeled glomerulonephritis.

Urinary tract infection has a characteristic urine signature

Bacteriuria and pyuria indicate bacteria and leukocytes in urine.

- Bacteriuria: Bacteria are present in urine.
- Pyuria: Leukocytes are present in urine.
- Infection may be symptomatic or asymptomatic.
- Both upper urinary tract and bladder infections are included.

Pyelonephritis and cystitis differ by location

The chapter makes an anatomical distinction without equating location with a specific symptom count.

Pyelonephritis

- Infection involves the kidney
- An upper urinary tract localization
- May present with bacteriuria and pyuria

Cystitis

- Infection involves the bladder
- A lower urinary tract localization
- May also show bacteriuria and pyuria

Obstruction and tumors show variable manifestations

Clinical presentation depends on the lesion's nature and its anatomic location.

- Urinary tract obstruction is not a single symptom pattern.
- Renal tumors likewise have varied clinical manifestations.
- Urine flow obstruction is also a cause of postrenal azotemia.
- Use anatomical localization alongside laboratory findings.

Nephrolithiasis links pain with a urinary finding

Renal stones are classically associated with episodic severe pain and hematuria.



- Stone formation may recur after an initial episode.
- Colic contrasts with the often clinically silent glomerular urinary abnormalities.

Distinguish major renal clinical presentations

A focused matrix helps localize the dominant functional disturbance.

Presentation	Dominant findings	Central interpretation
Nephritic	Hematuria, ↓GFR, hypertension	Inflammatory glomerular process
Nephrotic	Heavy protein, edema, lipid changes	Glomerular filter dysfunction
AKI	Rapid functional decline	Acute kidney injury
CKD	Persistent eGFR/albumin abnormality	Long-term kidney disease
Tubular	Polyuria, nocturia, acidosis	Tubular functional defect
UTI / stones	Bacteria + WBC / colic + blood	Infection / nephrolithiasis

Clinical application: Inflammatory glomerular pattern

Clinical vignette

A patient develops visible hematuria, elevated serum creatinine, hypertension, and mild proteinuria over a short interval.

Which syndrome best unifies this presentation?

Nephritic syndrome

The dominant combination is hematuria, reduced GFR, mild-to-moderate proteinuria, and hypertension.

Clinical application: Filtration-barrier syndrome

Clinical vignette

A patient has marked edema, urine protein exceeding 3.5 g/day, low serum albumin, and lipiduria.

Which presentation is most consistent with these findings?

Nephrotic syndrome

Heavy urinary protein loss, hypoalbuminemia, edema, and lipid abnormalities define the syndrome.

Clinical application: Time course of dysfunction

Clinical vignette

One patient has a marked fall in filtration over two days; Another has persistent low GFR for four months.

What is the principal distinction?

AKI versus CKD

AKI develops over hours to days; CKD requires persistent functional/albumin abnormalities over at least three months.

Clinical application: Urinary presentation

Clinical vignette

One patient reports repeated spasms of severe flank-region pain and hematuria; Another has bacteriuria and pyuria.

Which categories should lead the initial syndromic assessment?

Nephrolithiasis versus urinary tract infection

Renal colic plus hematuria suggests stones; Bacteria and leukocytes in urine characterize infection.

Syndrome recognition: What to look for first

The clinical pattern guides subsequent testing and localization.

First abnormality	Prioritize	Typical accompanying features
Hematuria	Nephritic / mild glomerular	GFR fall, pressure, or asymptomatic
Protein loss + edema	Nephrotic	Hypoalbuminemia, lipids
Creatinine rise	Azotemia / AKI / CKD	Time course and cause
Polyuria / acidosis	Tubular defect	Nocturia, electrolyte imbalance
Bacteria + WBC	Urinary infection	Kidney or bladder location
Severe colic + blood	Nephrolithiasis	Often recurrent

Clinical manifestations: Integrated principles

A renal diagnosis begins with physiology, duration, and pattern recognition.

- Azotemia is biochemical; Uremia adds systemic symptoms and signs.
- Inflammatory glomerular disease produces the nephritic pattern; Severe filter dysfunction produces nephrotic syndrome.
- AKI is rapid; CKD is persistent and may be silent before systemic complications appear.
- Tubular defects, infection, obstruction, and stones may present very differently.

Reading and consolidation

Use the renal pathology chapter to connect these syndromes with structural disease.

- Robbins, Cotran & Kumar: Pathologic Basis of Disease, 11th edition (2026).
- Review the glomerular filtration barrier when comparing nephritic and nephrotic patterns.
- Revisit the systemic manifestations of CKD and uremia as linked organ-system findings.
- Use the disease-specific renal sections for morphology and etiologic differentials.