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Nakhon Pathom Rajabhat University

Pathophysiology of Urinary System Disorders

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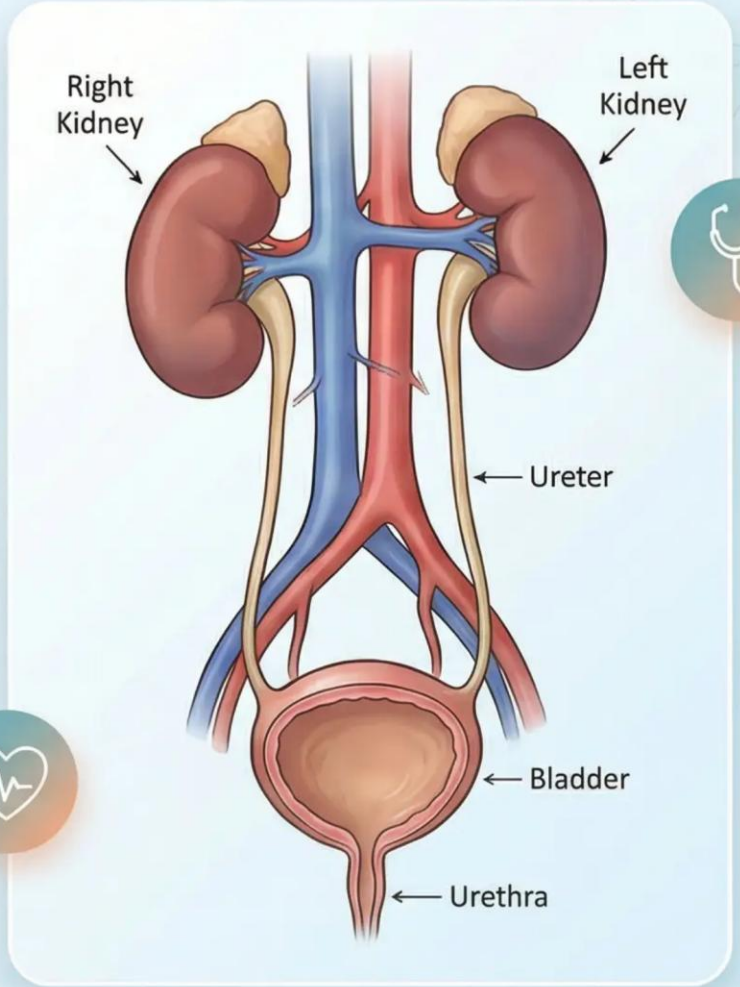
Start Learning



Core Functions of the Kidney

Waste Excretion

- Filters urea and creatinine from blood
- Prevents accumulation of metabolic waste (Azotemia)

Fluid-Electrolyte Balance

- Controls water balancevia ADH hormone
- Maintains Na+, K+, and phosphate levels

Blood Pressure Regulation

- Releases renin when blood flow decreases
- Activates RAAS system for vasoconstriction

Hormone Production

- Erythropoietin: stimulatesRBC production
- Active Vitamin D: enhances calcium absorption

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Related Topics

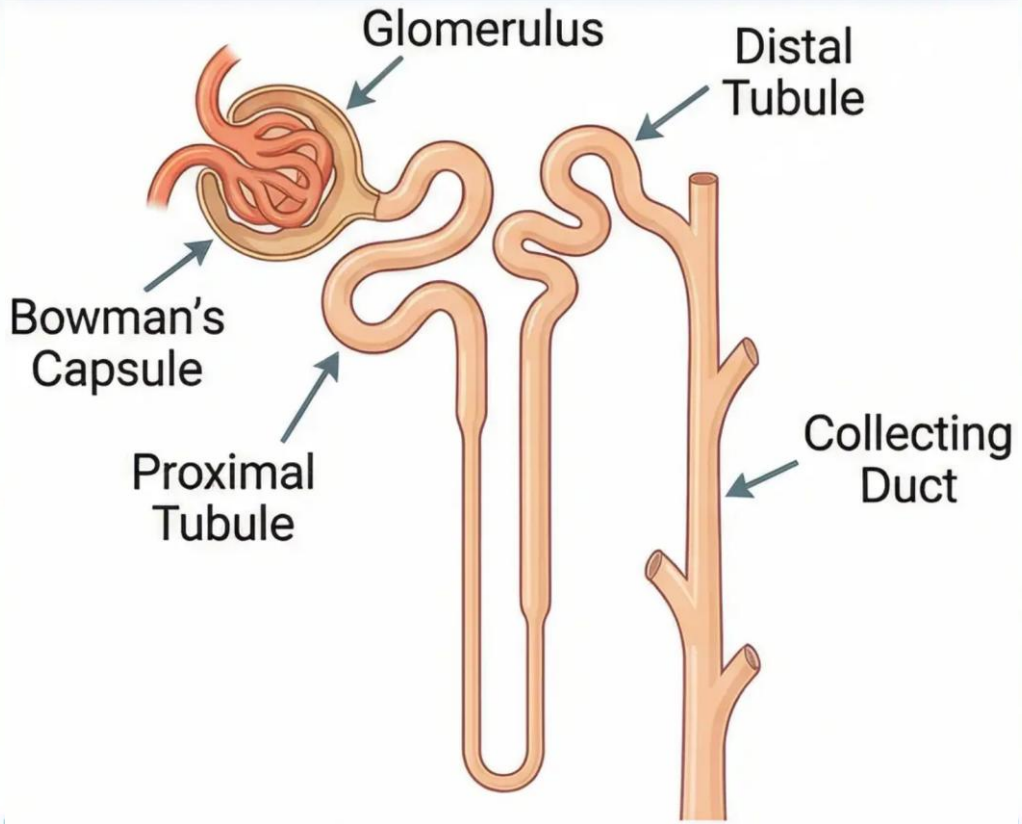
Kidney Function Tests

Urinalysis Interpretation

Fluid Balance Management

The Nephron and Normal Urine Characteristics

Nephron Components



Normal Urine Characteristics

Volume:

- 0.5-1 ml/kg/hr
- 1000-1500 ml/day

Physical Properties:

- Color: Light to dark yellow
- Clarity: Clear, no sediment

Chemical Composition:

- Protein: <150-200 mg/day
- No glucose or ketones

Microscopic:

- RBC: <3 cells/HPF
- WBC: <4 cells/HPF

Pathophysiology of Abnormal Urine Components

Understanding Key Indicators of Renal Health.

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Proteinuria

- Normal: 40-80 mg/day; Abnormal: >150-200 mg/day
- Glomerular damage: Loss of charge barrier (>3.5 g/day in NS)
- Tubular dysfunction: Impaired reabsorption
- Overflow: Excess small proteins (Bence Jones, Myoglobin)

Hematuria

- Normal: <3 RBC/HPF; Abnormal: >3 RBC/HPF
- Glomerular source: Dysmorphic RBCs + RBC casts
- Non-glomerular source: Normal RBCs, no casts
- Indicates bleeding anywhere in urinary tract

Urinary Casts

- RBC casts: Glomerular bleeding (GN)
- WBC casts: Renal inflammation (Pyelonephritis)
- Hyaline casts: May be normal after exercise

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Keronuria

Ketone bodies
(Fat metabolism, DKA, or starvation)

Glycosuria

Sugar in urine
(Common in Diabetes Mellitus)

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Alterations in Urine Volume

Understanding Changes in Urine Output

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Polyuria

> 1,500 ml/day

- Diabetes Insipidus (ADHdeficiency)
- Osmotic diuresis (glucose, urea)

Oliguria

<400 ml/day or
<0.5 ml/kg/hr

- Prerenal: dehydration, heart failure, shock
- Intrinsic: GN, ATN, nephrotoxins
- Postrenal: obstruction, enlarged prostate

Anuria

<100 ml/day

- Complete obstruction (bilateral)
- Severe acute kidney injury

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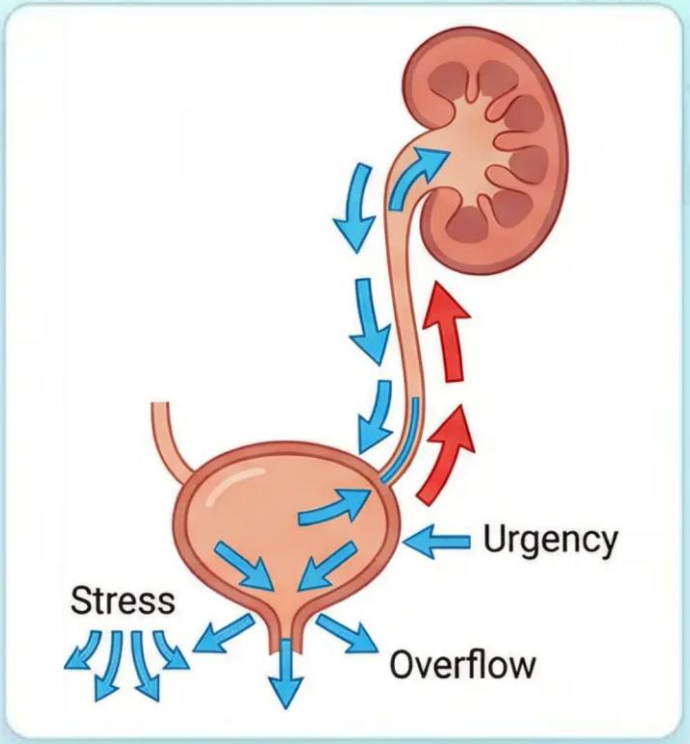
Voiding Dysfunctions and Incontinence

Stress Incontinence
- Weakness of pelvic muscles or external sphincter
- Urine leaks during coughing, sneezing, or laughing

Urgency Incontinence
- Overactive detrusor muscle contractions
- Caused by bladder irritation (cystitis) or nerve disorders

Overflow Incontinence
- Bladder overfills and pressure exceeds sphincter resistance
- Continuous dribbling due to urinary retention

Urinary Retention & Hydronephrosis
- Obstruction causes backpressure to kidneys
- Leads to kidney pelvis dilation and potential kidney damage



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Dysuria & Micturition

Dysuria

Painful voiding from urethral inflammation.

Difficulty

Hesitancy or weak stream due to obstruction.

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Clinical Signs: Renal Edema and Pain

Renal vs Cardiac Edema

Characteristic	Renal Edema	Cardiac Edema
Initial Location	• Periorbital and face	• Lower extremities (feet, ankles)
Timing	Morning (after lying down)	Evening (after standing)
Characteristics	Pitting edema, generalized	Lower body only, with dyspnea

Mechanisms of Renal Pain

Flank Pain

- Renal capsule tension from swelling
- CVA tenderness in pyelonephritis

Renal Colic

- Severe colicky pain from stone movement
- Radiates to groin and genitalia

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Glomerulonephritis and Nephrotic Syndrome

Understanding Key Differences

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Glomerulonephritis (GN)

Pathophysiology:

- Immune complex deposition in glomeruli
- Inflammatory response damages filtration barrier
- Complement activation and cell proliferation

Clinical Features:

- Hematuria (tea-colored urine)
- Oliguria (< 400 ml/day)
- Hypertension and edema
- Proteinuria < 3.5 g/day
- RBC casts in urine

Nephrotic Syndrome (NS)

Pathophysiology:

- Severe glomerular filtration barrier damage
- Loss of negative charge selectivity
- Massive protein leakage

Clinical Features:

- Massive proteinuria > 3.5 g/day
- Hypoalbuminemia
- Generalized edema (anasarca)
- Hyperlipidemia/ Hypercholesterolemia
- Foamy urine

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Acute Kidney Injury and Chronic Kidney Disease

Acute Kidney Injury (AKI)

Oliguric Phase
- Urine output <400 ml/day
- Hyperkalemia, acidosis, uremia

Diuretic Phase
- Urine output up to 1,500 ml/day
- Risk of dehydration, hypokalemia

Recovery Phase
- GFR returns to normal
- May take 6-12 months

Chronic Kidney Disease (CKD)

Stage 1: GFR 50% - Usually asymptomatic

Stage 2: GFR 20-50% - Azotemia, nocturia, mild anemia

Stage 3: GFR 5-25% - Acidosis, oliguria, edema

Stage 4: GFR <5% - End-stage renal disease

Uremic Syndrome Effects:

Neurological: confusion, seizures
Respiratory: Kussmaul breathing
Cardiovascular: hypertension, heart failure
Hematologic: anemia, bleeding

Urinary Tract Infections and Urolithiasis

Urinary Tract Infections and Urolithiasis

Urinary Tract Infections

Urinary Tract Infections

Lower UTI (Cystitis)	E. coli bacteria from intestinal tract Bladder wall inflammation and swelling Symptoms: frequency, urgency, dysuria WBC >4-5 cells/HPF in urine
Upper UTI (Pyelonephritis)	Infection spreads to kidney tissue Infection spreads to kidney tissue High fever, chills, CVA tenderness WBC casts in urine (diagnostic)

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Urolithiasis (Kidney Stones)

(Kidney Stones)

Formation from concentrated urine

Supersaturation of calcium, phosphate, uric acid

Urinary stasis promotes crystal formation

Severe colicky pain when stones move

Hematuria from urinary tract irritation

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Kidney Health Resources Diagnosis Methods Treatment Options

Case Study: Cystitis

Urinary Tract Infections

Urinary Tract Infections

Age: 22-year-old Female

Chief Complaint: Dysuria and suprapubic pain

Vital Signs & Physical Findings

T 37.2 °C, PR 80 bpm, BP 110/70 mmHg

Physical Exam Suprapubic area

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History of Present Illness

Duration: Symptoms present for 2-3 days.

Frequency: Urinating every hour in small amounts.

Urine Quality: Cloudy appearance with a foul odor.

Sensation: Persistent suprapubic discomfort

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Kidney Health Resources | Diagnosis Methods | Treatment Options

Case Study: Cystitis

Hydration

Increase fluid intake to flush bacteria out of the urinary tract.

Hygiene

Maintain proper perineal hygiene to prevent bacterial entry.

Technique

Always wipe from front to back after using the restroom.

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Kidney Health Resources Diagnosis Methods Treatment Options

Case Summary

This 22-year-old patient presents with classic **uncomplicated cystitis**.

- Localized symptoms (Dysuria, Frequency).
- No systemic signs (No fever/CVA pain).
- Focus on behavioral changes for prevention.

Early intervention prevents upper UTI complications.

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