

# RENAL AND UROLOGIC DISORDERS

# 11

## GERIATRIC APPROACH

### Normal Changes of Aging

#### PRERENAL CHANGES

- Impaired thirst perception predisposes patient to dehydration

#### RENAL CHANGES (see Table 11-1 for consequences of changes)

- **Renal blood flow decreased** due to sclerosis of pre- and postglomerular arterioles
  - Decrease in renal blood flow by 50% by age 80
  - The kidneys compensate by increased arteriolar resistance to maintain filtration; however, stress can cause the compensatory mechanism to fail.
- **Glomerular filtration rate (GFR) decreased** due to increased number of sclerotic and non-functioning glomeruli
  - After age 40, GFR declines; Most have a decrease of  $\geq 30\%$  GFR by age 70
  - However, one third of older persons, who are free of renal and cardiovascular disease, have well-preserved kidney function.
  - Leads to reduced clearance of toxins, some electrolytes, and medications

#### POSTRENAL CHANGES IN ELDERLY PREDISPOSE TO RENAL DAMAGE (See Table 11-1)

- Females commonly experience mucosal atrophy, increasing risk of incontinence and infection.
- In males, enlargement of the prostate may cause urethral obstruction.

### Clinical Implications

#### *History*

- Chronic medical conditions, such as diabetes or hypertension, that affect renal function
- Medications for hypertension and other nephrotoxins to which they have been exposed
- Genitourinary symptoms
- Symptoms that are impacted by renal function, such as cardiovascular, respiratory, neurologic, and hematologic
- Fatigue, edema, and change in mental or functional status
- Allergies, especially antibiotics and dyes

#### *Physical*

- Complete physical exam
- Detection of prerenal problems (e.g., dehydration skin turgor, condition of mucous membranes, daily weight record)
- Detection of postrenal problems (e.g., BPH, mucosal atrophy)

### Assessment (See Table 11-2)

- Assessment Principles
  - Identification of risk of renal insufficiency in elders prior to any surgical procedures is crucial as mortality is as high as 60%.

**Table 11-1: Age-Related Changes in the Renal System Due to Decreased Renal Blood Flow and GFR**

Function	Age-Related Change Noted by the Eighth Decade	Consequences
Maximum Concentration of Urine Dilutional Capacity	20%–30% decrease Decreased	Increased risk of volume loss May predispose to overhydration and hyponatremia after vigorous fluid administration, causing pulmonary or cerebral edema
Sodium Handling	Impaired	Increased risk of volume, acidosis, and either hypernatremia or hyponatremia
Formation of NH <sub>4</sub> <sup>+</sup> (ammonia) Synthesis of Renin	Secretion decreased 20% Decreased	Impaired ability to correct acidosis Serum abnormalities, such as hyperkalemia, hypocalcemia, and elevated parathyroid activity
Renin Response to Volume Loss	Decreased	Inability to autoregulate in effort to maintain acceptable perfusion when renal blood flow decreases

**Table 11-2: Possible Implications of Renal Symptoms**

Symptom	Possible Implication
Pain or Urgency in Lower Urinary Tract	Acute inflammatory process (can occur even when very small quantities of urine are in bladder)
Pain in Upper Urinary Tract	Usually secondary to distention of a hollow viscus, such as obstruction in a ureter or the urethra, or the capsule of an organ (as in pyelonephritis or nephrolithiasis)
Constant Pain	Usually an infection
Colicky Pain	Obstruction
Urinary Frequency	Excess fluid intake, caffeine, diuretics, hyperglycemia Lesions of bladder or urethra Detrusor overactivity
Suprapubic Ache	Bladder distention
Perineal Pain	Prostate pain is often perineal and may radiate to the lumbosacral spine or to the groin Women—prolapse
Weight Loss and Malaise	May be associated with a malignancy (pain is usually a late sign of malignancy)
Urgency	Occurs secondary to trigonal or posterior urethral irritation produced by inflammation, stones, or tumor; most commonly occurs with cystitis, urinary incontinence
Dysuria	Infection or inflammation
Frequency, Hesitancy, Urgency and Strangury (slow, painful urination)	Commonly associated with micturition disorders
Hematuria	Should be considered an indication of malignancy until proven otherwise

- Evaluate renal function prior to procedures or surgery due to increased risk of post-op renal failure.
- Diagnostic tests requiring contrast dyes are seldom used because of adverse reactions.

### Treatment

- Avoid administration of nephrotoxic drugs or drugs cleared by the kidneys (digoxin, some calcium channel blockers, NSAIDs, aminoglycoside) that may accelerate and cause side effects.
- Careful administration of most pharmacologic agents due to decreased renal clearance and narrowed therapeutic index; elders are also at increased risk of adverse drug reactions due to altered volume of distribution and impaired renal clearance of medications.

## ASYMPTOMATIC BACTERIURIA

### Description

- Significant (>100,000 bacteria/mL of urine) bacterial count in urine of a patient who has no symptoms

### Etiology

- Most commonly caused by *E coli*
- Other gram-negative bacteria include *Proteus mirabilis*, *Klebsiella pneumoniae*, and *Staphylococcus saprophyticus*.

### Incidence and Demographics

- Asymptomatic bacteriuria common in elders (especially in institutionalized elderly: 15% to 50%)

### Risk Factors

- Female gender
- Aging
- Incontinence
- Structural abnormalities in urinary tract
- Prostatic hypertrophy
- Asymptomatic calculi
- Indwelling urinary catheters

### Prevention and Screening

- Hygiene
- Hydration
- Encourage complete voiding
- Avoid use of catheters, even condom catheters

### Assessment

#### History

- No symptoms

#### Physical

- Usually no findings

#### Diagnostic studies

- Urinalysis reveals bacteria without WBCs
- Urine culture may be positive

### Differential Diagnosis

- Contaminated specimen
- UTI

### Management

#### Nonpharmacologic Treatment

- Increase fluids to flush urinary tract
- Empty bladder fully and frequently to avoid stasis

#### Pharmacologic Treatment

- None

- Consider antibiotic therapy if patient is immunosuppressed, as in AIDS or malignancy

**When to Consult, Refer, Hospitalize**

- Usually not required

**Follow-up**

*Expected Course*

- Uneventful

*Complications*

- UTI, Sepsis

**URINARY TRACT INFECTION**

**Description**

- Infection of one or more of the structures of the lower urinary tract
- May involve the ureter(s), bladder and/or urethra

**Etiology**

- Most commonly caused by *E coli*; many strains now resistant to many drugs
- Other gram-negative bacteria from gastrointestinal tract, such as *P mirabilis*, *K pneumoniae*, *Enterobacter*, and *Staphylococcus*
- In institutionalized elderly, staff may inadvertently transfer organisms that colonize perineum due to inadequate infection control measures.

**Incidence and Demographics**

- Most frequent bacterial infection and most common reason for antibiotic use in the elderly
- Prevalence reported to be 15% to 30% of females and 5% to 15% of males. Prevalence may rise to 50% in institutionalized elderly
- When indwelling catheters are used, biofilm collects on the foreign body and creates medium for bacterial growth.

**Risk Factors**

- Female gender
- History of prior UTIs
- Diabetes mellitus or other immunocompromised state
- Structural urinary tract abnormalities (structures, stones, tumors, neuropathic bladder)
- Procedures: catheterization, recent surgery
- Relaxation of pelvic supporting structures
- BPH or prostatitis
- Incontinence of urine/stool
- Cognitive impairment
- Altered barriers: use of catheters, age-related changes in genital and urethral mucosa
- Underlying neurologic conditions (stroke)

**Prevention and Screening**

- Meticulous perineal care
- Avoidance of long-term indwelling catheters in all elders and condom catheters in males whenever possible. In patients who must have indwelling catheters, maintain closed systems.
- Drinking cranberry juice/cranberry capsules may reduce pyuria and bacilluria.
- In postmenopausal women, systemic or topical estrogen therapy markedly reduces the incidence of recurrent UTI.
- For those that can void spontaneously, encourage complete voiding.

**Assessment**

*History*

- Burning or pain during voiding, nocturia, frequent small voids, urgency, hematuria and/or cloudy

- urine, suprapubic/lower abdominal or low back pain
- Fever, chills
- Nonspecific complaints: fatigue, malaise, weakness, or confusion
- New or worsening incontinence of urine (especially in patients with underlying neurologic impairment or cognitive function)

### *Physical*

- Fever, suprapubic tenderness to palpation
- CVA tenderness if upper-tract infection
- Mental status changes may be the only sign
- Males should have careful GU exam with rectal to evaluate prostate

### *Diagnostic Studies*

- Bacteria and WBCs in adequate clean-caught urine or in-and-out cath specimen
- Urine culture shows greater than 100,000 bacteria/1 mL of urine
- Consider reculture after antibiotics completed
- Repeat or refractory infections: urine culture, renal/bladder ultrasound, or IVP
- Other tests if indicated
  - CBC with differential
  - Serum electrolytes
  - Serum BUN and creatinine
  - Blood cultures in septic appearing patients
- If bladder outlet obstruction suspected, do in-and-out catheter to determine postvoid residual
- Suspicion of obstruction with an upper tract-infection requires emergent ultrasound

### **Differential Diagnosis**

- Urethritis
- Diabetes
- Pyelonephritis
- Renal calculi
- Vaginitis
- Female urethral syndrome
- Chemical vaginitis
- Prostatitis
- Meatal stenosis

### **Management**

#### *Nonpharmacologic Treatment*

- Hygiene measures
- Hydration
- Remove bladder catheters as soon as possible
- In patients with indwelling catheters, change catheter prior to initiating antibiotic therapy
- Surgical correction of known anatomic abnormalities
- If no contraindications, may encourage use of cranberry juice or tablets to acidify urine

#### *Pharmacologic Treatment*

- If symptoms mild, consider waiting to treat until culture results are available
- Treat moderate symptoms with empiric therapy until culture is available.
- Dysuria (some with involuntarily retention): consider phenazopyridine (Pyridium)
- Antibiotics
  - Quinolones such as ciprofloxacin 250–500 bid, norfloxacin 400 mg bid or ofloxacin 200–400 mg bid
  - Trimethoprim/sulfamethoxazole (TMP/SMZ) DS (160/800 mg) bid
  - Nitrofurantoin 100 mg bid x 10 days
  - Cephalosporins such as Cephalexin or Cefaclor 500 mg qid; Cefadroxil 1g/d or bid

#### *How Long to Treat*

- Uncomplicated first UTI in women 3 days; men usually receive 10–14 day courses

- In recurrent infection, longer courses of antibiotics are necessary
- Patients with indwelling catheters treated only until asymptomatic (usually 5–7 days) as it is impossible to sterilize their urine, prolonged antibiotic use promotes resistance

### **Special Considerations**

- Uncomplicated cystitis is rare in men; men require further investigation of symptoms to rule out pathological process
- Vaginal estrogen in postmenopausal women may decrease frequency of UTIs

### **When to Consult, Refer, Hospitalize**

- Consult for recurrent infections, if suspect anatomic abnormality
- Refer men to Urology due to likelihood of concomitant prostatic involvement
- Hemodynamically unstable patients, or those in whom urosepsis is a potential concern, may require hospitalization or intravenous antibiotics.
- Patients with signs/symptoms of fever, nausea, vomiting, confusion, or increased WBC generally require admission for IV antibiotics and close observation.

### **Follow-up**

- Check urine culture to determine susceptibility of bacteria to antibiotic.

### *Expected Course*

- If using correct antibiotic (per culture and sensitivity) signs and symptoms should dissipate at 72 hours
- Bacterial cure rates of 70% to 80% are expected for ambulatory elderly
- Patient may have asymptomatic bacteriuria
- Reculture those with atypical course
- Indwelling catheters increase morbidity for UTI

### *Complications*

- Pyelonephritis, recurrent or relapse of infection, renal abscess, urosepsis

## **PYELONEPHRITIS**

### **Description**

- Infection of renal parenchyma or other portion of upper urinary tract

### **Etiology**

- 75% due to *E coli* organism
- 10% to 15% is due to other gram-negatives (*P mirabilis*, *K pneumoniae*, *Enterobacter*).  
10%–15% due to *S aureus* or *S saprophyticus*
- Most common route of infections is ascension from bladder

### **Incidence and Demographics**

- Estimated at 10 to 15 hospitalizations for acute pyelonephritis per 10,000 persons over 70

### **Risk Factors**

- Urinary tract structural abnormalities
- Instrumentation
- Stones
- Catheters
- Diabetes or other immunocompromised states
- BPH
- Fecal incontinence

### **Prevention and Screening**

- Hygiene
- Hydration

- Avoid catheters when possible
- May require prophylactic antibiotics if have frequent UTIs

## Assessment

### History

- Fever, shaking chills, flank pain, myalgias, abdominal pain, hematuria, dysuria, frequency, urgency, nausea and vomiting

### Physical

- Classic: acutely ill, shaking chills, high fever with CVA tenderness
- Subacute: low-grade fever, low back pain

### Diagnostic Studies

- Urinalysis—bacteria, WBCs, + leukocyte esterase on dipstick, also present in UTI
- Urinalysis—proteinuria, casts indicates renal involvement
- Leukocytosis on CBC indicates systemic involvement
- Urine culture and sensitivity
- Urologist may order voiding cystourethrogram, renal scan, cystoscopy

## Differential Diagnosis

- Stones in renal pelvis or proximal ureter
- Prostatitis
- TB
- Any acute abdominal infection (diverticulitis, cholecystitis, appendicitis, pancreatitis)
- Tumors
- Lower urinary tract infection
- Lower-lobe pneumonia

## Management

- Acute: refer immediately for probable hospitalization
- Subacute: may be treated at home

### Nonpharmacologic Treatment

- Fluids
- Nonpharmacologic relief measures for symptoms: sitz baths, warm packs, or heating pads

### Pharmacologic Treatment

- Antibiotics
- Oral regimens for outpatient treatment
  - Ciprofloxacin 500 mg q 12 h or other fluoroquinolone for 7 days
  - Amoxicillin/clavulanate 875/125 mg bid or 500/125 mg tid for 14 days

### How Long to Treat

- Oral regimens treat 7–21 days, depending on severity of illness
- Chronic pyelonephritis—therapy required for 3–6 months
- If obstruction cannot be eliminated and recurrent UTI is common, long-term therapy is useful

## Special Considerations

- Rule out mass lesion if no improvement in 3 days

## When to Consult, Refer, Hospitalize

- Inpatient management required if patient appears toxic or is hemodynamically unstable
- Outpatient management if able to tolerate oral therapy, adequate renal reserve, reliable supervision, immediate access to health care services if condition worsens
- Refer for urologic consultation

## Follow-up

- Repeat culture 2 weeks after completion of therapy and again at 12 weeks

### Expected Course

- Symptoms should resolve within 72 hours of initiation of appropriate therapy

- Advanced age may lead to less favorable outcome
- Recurrence rates as high as 15%

### *Complications*

- Sepsis, chronic renal insufficiency, chronic pyelonephritis

## URINARY INCONTINENCE

### **Description**

- Involuntary, accidental loss of urine on a regular basis
- Not a disease state, but a clinical symptom of an underlying disease process

### **Etiology**

- Multiple disorders interact to cause UI
- Age-related changes contribute
- Drugs—sedatives, hypnotics, diuretics, opioids, anticholinergics (antidepressants, antihistamines, psychotropics) and cardiac medications (calcium channel blockers, alpha-adrenergic blockers/agonists, ACE inhibitors, beta-adrenergic agonists)
- *Acute incontinence*—sudden onset, related to an acute process or iatrogenic problem, resolves with resolution of problem
  - D—delirium, anything that can cause delirium, depression
  - R—restricted mobility, retention (acute)
  - I—infection, inflammation (atrophic vaginitis or urethritis), impaction (stool)
  - P—pharmaceuticals, polyuria (hyperglycemia, excess fluid intake, volume overload due to venous insufficiency or CHF)
- *Persistent Incontinence*
  - Stress incontinence—normal changes of aging (estrogen deficiency in women) combined with pelvic floor muscle weakness, urethral hypermobility, and bladder outlet or urethral sphincter weakness
  - Urge incontinence—due to detrusor instability without local genitourinary conditions, CNS disorders, such as stroke, dementia, parkinsonism, spinal cord injury: UTI acute or chronic, irradiation of bladder, normal changes of aging
  - Overflow incontinence—due to anatomic obstruction from prostatic enlargement, stricture, cystocele, acontractile bladder from diabetes mellitus, or spinal cord injury; neurogenic bladder from MS and other spinal cord and from anticholinergic medications
  - Functional incontinence—due to physical (immobility) or cognitive disability, environmental barriers

### **Incidence and Demographics**

- Occurs in 30% elderly women and 15% elderly men in community setting
- 60% to 80% of nursing home residents
- Overall affects 12 million adults
- Over 10 billion dollars per year in the US are spent on the management of incontinence
- Underreported because many consider it an inevitable consequence of aging

### **Risk Factors**

- Age
- Depends on type of incontinence

### **Prevention and Screening**

- Kegel exercises for women, regular pelvic examination to detect pathology early
- Monitor prostate for BPH and initiate therapy before symptom presents

**Table 11-3: Assessment of the Four Types of Persistent Incontinence**

Type of Incontinence	History	Physical	Test
Stress	Leakage of small amounts precipitated by increased intra-abdominal pressure, as in cough	Leaks when upright, not supine, cough test when standing—loose urine atrophic vaginitis	Normal urodynamic studies, minimal postvoid residual if needed to rule out mixed incontinence
Urge	Urgency with loss of large amount of urine; inability to delay voiding Unrelated to activity or position	Prolapse, atrophic vaginitis	Urodynamic testing shows detrusor instability
Overflow	Leak small amounts of urine, a persistent dribbling, no precipitating factor	Suprapubic dullness to percussion, tenderness, may find prolapse in women, enlarged prostate in men	Postvoid residual >100 ml
Functional	Urinary accidents due to inability to toilet	Dementia, immobility	None

**Assessment**

- Confirm urinary incontinence, identify type, and identify factors that might contribute or exacerbate problem (see Table 11-3)

**History**

- Requires specific questions such as “Do you have trouble with your bladder?”
- Urgency, leaking, dribbling, burning, hesitancy, nocturia, hematuria
- Assess exposure to medications and other provoking factors, such as caffeine or alcohol
- Bladder habit pattern/record; fluid intake pattern
- GYN history

**Physical**

- Complete physical
- Mental status exam
- Exam abdomen for masses, suprapubic tenderness or fullness
- Observe voiding to detect problems with hesitancy, dribbling, or interrupted stream
- Pelvic exam to assess perineal skin, cystocele, uterine prolapse, pelvic mass, perivaginal muscle tone, atrophic vaginitis
- Estimate postvoiding residual by abdominal palpation and percussion and/or bimanual exam
- Rectal exam for perineal sensation, resting and active sphincter tone, rectal mass and fecal impaction; assess consistency and contour of prostate
- Neurological exam with deep tendon reflex, sensation; normal sphincter tone indicates intact neurological system to the bladder
- Musculoskeletal exam for secondary causes, such as weakness, ambulation problems

**Diagnostic Studies**

- Urinalysis and culture to rule out UTI, glycosuria
- Serum BUN and creatinine may reveal decreased renal function
- Serum glucose to rule out diabetes
- Measure postvoid residual urine (less than 100 mL is adequate)
- Additional tests may include

**Table 11-4: Treatment for Specific Causes of Incontinence**

Type of Incontinence	Treatments, in Order of Preference
Stress	Pelvic floor muscle training (Kegel) Bladder training Vaginal cones Biofeedback Alpha-adrenergic agonists Estrogen Surgery
Urge	Bladder relaxants Estrogen Bladder training Pelvic floor muscle training (Kegel)
Overflow	Surgical removal of obstruction Bladder retraining Intermittent catheterization Indwelling catheter
Functional	Behavioral interventions Environmental changes Incontinence undergarments

- Urodynamic testing
- Pelvic ultrasound may reveal source of obstruction
- Other tests as indicated by suspected etiology

### **Differential Diagnosis**

- Type of incontinence
- Urinary tract infection
- Urinary retention/obstruction
- Diabetes mellitus
- Neurologic disease

### **Management (See Table 11-4)**

- Good hygiene, frequent voiding, complete voiding, and Kegel exercises

### *Nonpharmacologic Treatment*

- Increase access to toilet or commode
- Limit use of diuretics
- Dietary modifications (avoid caffeine and alcohol)
- Condom catheters in males (only as last resort)
- Incontinence pads (minimize use)

### *Pharmacologic Treatment*

See Tables 11-5 and 11-6.

### *How Long to Treat*

- Indefinitely or until surgical correction

### **When to Consult, Refer, Hospitalize**

- Consult specialist for patients with stress and urge incontinence who fail to respond to behavioral therapy and initial drug treatment.
- Refer atrophic vaginitis with prolapse to GYN
- Refer overflow incontinence or suspected BPH to urologist
- Refer neurologic abnormalities to neurologist

**Table 11-5: Pharmacologic Treatment for Urge Incontinence**

Class	Drug	Dosage
Anticholinergic and Smooth Muscle Relaxant	Oxybutynin (Ditropan)	2.5–5.0 mg tid/qid
	ORXL	5–10 mg PO qd
	Tolterodine (Detrol)	1–2 mg bid
	ORLA	2–4 mg PO qd
Estrogen Plus Progestin if Intact Uterus	See GYN Chapter 12	Vaginal

**Table 11-6: Pharmacologic Treatment of Stress Incontinence**

Class	Drug	Dosage
Alpha-Adrenergic Agonists	Pseudoephedrine (Sudafed)	30–60 mg tid
HRT, See GYN Chapter 12	HRT, see GYN chapter 12	0.3–1.25 mg/d PO or vaginal

(Ouslander & Johnson, 1999)

### Follow-up

- Weekly visits until symptom controlled

### Expected Course

- Prognosis is poor

### Complications

- Physical: recurrent UTI, falls, skin breakdown
- Psychological: depression, social isolation, leads to nursing home placement
- Economic costs

## HEMATURIA

### Description

- The presence of red blood cells (RBCs) in the urine
- May be microscopic (greater than 3 RBCs/high-power field) or gross (visible to naked eye)

### Etiology

- Infection is a frequent cause and can be renal, bladder, or urethral
- Neoplasms anywhere in tract—blood in the urine necessitates a workup for GU cancer
- Glomerulonephritis
- Kidney stones
- Benign prostatic hypertrophy, prostatitis, epididymitis
- Tuberculosis
- Connective tissue diseases (lupus)
- Medications (anticoagulants—heparin, warfarin, aspirin, NSAIDs)

### Incidence and Demographics

- Dependent on etiology
- Hematuria due to UTI is common in women

### Risk Factors

- Depends on etiology

## Prevention and Screening

- Prevention of infections

## Assessment

### *History*

- Determine onset and appearance
- Associated systemic symptoms—fever, chills, myalgias, weight loss or gain
- Local symptoms dysuria, nocturia, discharge

### *Physical*

- Vital signs, hypertension may indicate renal disease, fever may indicate infectious etiology
- Genitourinary exam—lesions, tenderness, discharge
- Rectal exam—prostate enlargement, bogginess
- Abdominal exam—note tenderness, organomegaly, masses, bruits, percuss for CVA tenderness
- Extremities—lesions, rashes, edema

### *Diagnostic Studies*

- Urinalysis, urine culture, microscopic exam of urinary sediment
- Renal function studies—BUN, creatinine
- CBC/differentia, ESR—rule out infection, inflammation
- Additional testing may be ordered by GU—IVP, renal ultrasound or cystourethrogram

## Differential Diagnosis

- See Etiology

## Management

- Dependent on etiology

## When to Consult, Refer, Hospitalize

- Unexplained hematuria for invasive testing

## Follow-up

- Depends on etiology

## EVALUATING RENAL FUNCTION

See Table 11-7.

- GFR is the standard measure of renal function
  - It is best measured by creatinine clearance, from a 24-hour urine
  - Creatinine clearance is not sensitive to early disease
  - It can also be estimated from serum creatinine concentration, a blood test
  - It can be calculated by the following formula:  
(140 – age) x body weight in kg divided by 72 x serum creatinine concentration  
It is then multiplied by 0.85 for women

### ELEVATED BUN/CREATININE

- Azotemia is increased urea (nitrogen compounds) in the blood measured by BUN (blood urea nitrogen).
- Prerenal azotemia is high BUN not caused by kidney disease but caused by CHF or volume depletion, as in dehydration; the most common cause of acute renal failure
- Uremia is increased urea in the urine, an older term for azotemia/elevated BUN.
- Uremic syndrome is a term for advanced renal failure (end-stage renal disease), when patient has large amounts of urea in the urine—an older term, from when urea in urine was an important lab test. We now rely on serum BUN and creatinine to assess renal function.
- Urea and creatinine are end products of protein metabolism. Both are used as measures of kidney function; creatinine is more accurate because it is less affected by other factors.

**Table 11-7: Interpretation of Renal Function Studies**

Test	Normal	Renal Insufficiency	Renal Failure	Uremic Syndrome (End-Stage Renal Disease)	Nephrotic Syndrome
BUN	7–22	Increases after 50% loss of renal function	Increases by 10–20 mg/dL	60–100	Normal
Creatinine	Less than 1.0 for women; less than 1.2 for men	1.5–3	Above 3	5–6	Normal
24-Hour Urine for Protein	Less than 200 mg/24 h	Greater than 200 mg/24 h		Over 3 g/24 h	over 3.5 g/24 h
For Creatinine Clearance	Men 85–125 mL/min; Women 75–115 mL/min	50–90 mL/min	10–50 mL/min	<10 mL/min	
Change in GFR	Men 100–140 mL/min Women 85–115 mL/min	30–50 50% of normal	Less than 30 29% of normal	Less than 15 mL/min 10%–15% of normal	

- Serum creatinine tends to remain stable despite decreased GFR due to decreased muscle mass in the elderly.
- BUN/creatinine ratio is used to help decide if the problem is extra renal (pre- or post-) or from intrinsic renal disease. The ratio decreases when the disease is in the kidney, because creatinine rises more than the BUN. For example, when patient is dehydrated, mainly the BUN rises, the creatinine just a little, but in renal disease the creatinine goes up a lot too. Prerenal failure BUN/creatinine ratio >20:1; in intrinsic renal disease less than 15:1

#### PROTEINURIA

- The presence of proteinuria means the kidney is leaking protein, usually from glomerular disease; also some nonrenal causes
- Nephrotic syndrome is proteinuria of more than 3.5 g of protein in 24-h urine, with casts in urine, has a variety of causes
- Sediment/casts
- Sediment is what is in the bottom of the test tube after urine has been spun in a centrifuge.
  - The two important constituents of sediment are
    - Casts: gel-like substances that form in the renal tubules and collecting ducts. They are an indication of serious renal disease.
    - Crystals: not usually important in renal disease

## GLOMERULAR DISEASE

### Description

- Immune complex-mediated damage to glomeruli that produces thickening of the glomerular basement membrane, and an associated decrease in glomerular surface area, which decreases glomerular filtration rate
- Characterized by diffuse inflammatory changes in the glomeruli and clinically by the nephrotic syndrome
- The nephrotic syndrome is the abrupt onset of hematuria, RBC casts, and proteinuria in association with hypoalbuminemia, hypercholesterolemia, and peripheral edema

### Etiology

- Postinfection—poststreptococcal, infections in surgical implants especially salmonella, endocarditis, hepatitis B and C
- Renal vasculitis
- Multisystem disorders—SLE, lymphoma, amyloidosis, carcinoma of lung, bladder, prostate
- Drug reactions—allopurinol, hydralazine, rifampin, captopril, lithium, probenecid, NSAIDs

### Incidence and Demographics

- Unknown

### Risk Factors

- Unknown

### Prevention and Screening

- Early and aggressive treatment of underlying cause

### Assessment

#### *History*

- Edema
- Malaise, fatigue
- Hematuria, oliguria, or anuria

#### *Physical*

- Edema, hypertension

### *Diagnostic Studies*

- Urinalysis will demonstrate proteinuria, hematuria
- Serum creatinine, albumin, and cholesterol
- 24-hour urine to measure proteinuria and creatinine clearance
- Serum protein electrophoresis and immunophoresis
- Total serum complement
- Renal biopsy with ultrasonographic guidance

### **Differential Diagnosis**

- Acute renal failure
- Chronic renal failure
- Cancer

### **Management**

- Refer to nephrologist for renal biopsy and management

### **When to Consult, Refer, Hospitalize**

- Refer to nephrologist

### **Follow-up**

#### *Complications*

- Hypertensive encephalopathy or retinopathy.
- Rapidly progressive glomerulonephritis, acute renal failure, CHF

## **ACUTE RENAL FAILURE (ARF)**

### **Description**

- Rapid reduction of renal function associated with azotemia (elevated BUN)
- Classified by etiology as prerenal, intrarenal, or postrenal
- Commonly, but not exclusively, associated with oliguria (decreased/absent urine)

### **Etiology**

#### PRERENAL—AMOUNT OF BLOOD FLOW TO KIDNEYS DECREASED, MOST COMMON CAUSE OF ARF

- Hypovolemia from fluid loss due to diarrhea, vomiting, hemorrhage, diuretics, inappropriate fluid restriction
- CHF—decreased cardiac output

#### RENAL—INTRINSIC ARF

- Acute glomerulonephritis
- Collagen vascular diseases affecting kidney (systemic lupus erythematosus—SLE) scleroderma, Wegener's granulomatosis, polyarteritis nodosa)
- Drugs (ACE inhibitors, allopurinol, ampicillin, trimethoprim and sulfamethoxazole, cimetidine, phenytoin, methicillin, thiazides, NSAIDs, aminoglycosides)
- Infection—acute pyelonephritis, others
- Infiltrative conditions—leukemia, lymphoma, sarcoidosis
- Hypercalcemia
- Vascular obstructions—clots, aneurysms, atheroembolic disease

#### POSTRENAL—OBSTRUCTIVE ARF

- Ureteral and urethral obstruction due to prostatic hypertrophy, renal stones, urethral stricture

### **Incidence and Demographics**

- Three times as prevalent in the elderly as in adults

### **Risk Factors**

- See Etiology

### **Prevention and Screening**

- Early treatment of above-mentioned conditions

- ACE inhibitors have been demonstrated to decrease progression to renal failure in both diabetic and nondiabetic patients; can also precipitate ARF in dehydrated patients, may also cause elevated potassium
- Blood pressure control is crucial
- Avoid dehydration

## Assessment

### *History*

- Patients may remain asymptomatic until GFR is less than 10% of normal
- Early manifestations may include only nocturia because of inability to concentrate urine
- Later—anorexia, fatigue, weakness, edema, pruritus, nausea, vomiting, constipation or diarrhea, shortness of breath, lethargy

### *Physical*

- General—delirium, dehydration
- Vital signs—hypertension, tachycardia, tachypnea
- Skin—ecchymosis, petechiae, rash
- Lungs—crackles
- Look for evidence of infection
- Kidneys may be tender to palpation
- Bladder may be enlarged

### *Diagnostic Studies*

- Daily increase in creatinine
- Urinalysis for sediment (casts) and protein—normal in pre- and postrenal failure
- Urine osmolarity
- Elevated BUN and creatinine
- Prerenal failure BUN/creatinine ratio >20:1; in intrinsic renal disease less than 15:1
- Renal ultrasound

## Differential Diagnosis

- Glomerulonephritis
- Urinary tract obstruction
- Systemic vasculitis
- Pyelonephritis

## Management

### *Nonpharmacologic Treatment*

- Refer to nephrology for care, often with dialysis

### **Special Considerations**

- Avoid urinary catheters when feasible as they dramatically increase risk of infection

### **When to Consult, Refer, Hospitalize**

- Refer to nephrologist

## Follow-up

### *Expected Course*

- If cause corrected promptly, failure can be reversed or progression arrested

### *Complications*

- Pulmonary edema
- Hypertensive crisis
- Hyperkalemia
- Chronic kidney disease
- Death

# CHRONIC KIDNEY DISEASE (CKD)

## Description

- Decrease in glomerular filtration rate associated with progressive, irreversible damage to both kidneys

## Etiology

- Acute renal failure untreated leads to CKD
- Most common causes of CKD
  - Diabetic nephropathy
  - Hypertensive disease
  - Glomerulonephritis
  - Renovascular arteriosclerotic disease

## Incidence and Demographics

- Incidence increases with age
- Elderly, over 65, comprise over 33% of the dialysis population
- Males more than females
- Increased incidence in nonwhites

## Risk Factors

- Advancing age
- Family history

## Prevention and Screening

- Control diabetes and blood pressure
- Avoid use of NSAIDs in the elderly
- Keep patients adequately hydrated
- Avoid/monitor use of contrast dyes for diagnostic testing

## Assessment

### *History*

- Symptoms are same as ARF but present less acutely

### *Physical*

- Hypertension
- Peripheral neuropathies with sensory and motor deficits
- In late stages
  - Confusion
  - Breathlessness
  - Intractable hiccups
- Yellow-brown skin

### *Diagnostic Studies*

- Significant proteinuria and urinary casts
- Decreased creatinine clearance
- Plasma sodium concentrations may be normal or slightly reduced
- Metabolic acidosis with CO<sub>2</sub> level between 15 and 20 mmol/L
- Low levels of serum calcium and phosphorus are common
- Potassium may be elevated
- Normochromic normocytic anemia
- Reduced kidney size on ultrasound

## Differential Diagnosis

- Urinary tract obstruction
- Vasculitis
- Pyelonephritis

## Management

### *Nonpharmacologic Treatment*

- Dietary restrictions required to maintain appropriate fluid and electrolyte balance
- Protein restricted to 20 g to 25 g per day of balanced amino acid protein
- Potassium restriction to 2 g per day may be required
- Phosphate should be limited (eggs, dairy, meat)

### DIALYSIS

- Hemodialysis is the mode of choice, is equivalent to 10% to 15% of normal renal function
- Peritoneal dialysis may be better tolerated by those with unstable cardiovascular status. In these individuals, sudden volume or electrolyte shifts can cause hypotension, ischemia, and/or arrhythmias.

### TRANSPLANTATION

- In recent years, more elders have been deemed eligible for transplantation, as there have been demonstrated benefits. The major complications are infection, rejection, and cardiovascular disease.

### *Pharmacologic Treatment*

- Diuretics (e.g., furosemide) to remove excess free water if kidneys lose ability to regulate sodium; usually not problematic until late in course
- Acidosis may require treatment with sodium bicarbonate if symptomatic (fatigue, tachypnea, lethargy)
- Hyperphosphatemia may require phosphate binders, such as oral calcium acetate or calcium carbonate, to prevent development of renal osteodystrophy.
- Anemia may require erythropoietin.
- Bleeding—fresh frozen plasma may be used to correct bleeding times. Conjugated estrogens have been used for bleeding as well.
- Aldosterone resistance may require fludrocortisone and potassium-binding resins.

### *How Long to Treat*

- Indefinitely

### **Special Considerations**

- Impairments due to renal failure
- Water balance
  - Lose ability to dilute urine leads to fluid retention and decreased sodium
- Acid base balance
  - Dietary protein metabolism produces hydrogen ion (H<sup>+</sup>), causing metabolic acidosis.
  - This is compensated by respiratory alkalosis and by taking calcium from bones.
- Altered calcium and phosphate
  - Decreased phosphate excretion leads to increased calcium release from bones, which leads to osteoporosis.
- Sodium
  - Reduced ability to maintain sodium homeostasis
  - Inability to eliminate extra sodium leads to fluid retention, hypertension, and edema.
  - Too little sodium leads to hypovolemia and decreased renal blood flow.
- Potassium—becomes a problem later in CKD
  - Kidney loses ability to excrete K<sup>+</sup> leads to elevated potassium level
- Lipid disorders
  - Kidney participates in clearing fat from bloodstream
- Anemia
  - Reduction in production of erythropoietin leads to anemia

## When to Consult, Refer, Hospitalize

- Refer to nephrologist when renal failure is suspected
- May require dialysis and/or transplantation
- Refer to urologist if suspected obstruction or other surgically correctable conditions

## Follow-up

### *Expected Course*

- If untreated and creatinine rises to >10, death is imminent within 3–5 months
- Patients asking to be taken off dialysis because of poor quality of life is the leading cause of death in dialysis for patients older than 70 years

### *Complications*

- Anemia
- Malnutrition
- CHF
- Infection
- Bleeding
- Death

## CASE STUDIES

**Case 1.** Your 94-year-old demented female patient returned home from the hospital for hip surgery with a Foley catheter. She complains of hip pain but not low back or pain or suprapubic tenderness. She has been incontinent of bowel and bladder for many years. She requires total care. Patient is afebrile.

1. What lab tests would you order?

**Lab:** Her creatinine is 1.2 and her BUN is 36.

Urinalysis shows many bacteria, no WBCs

2. How do you interpret this lab work?
3. What are your initial interventions?

**Lab:** The nurse obtains a urine culture and C&S without your order. It shows 10,000 colonies each of 3 microorganisms, which are sensitive to ciprofloxacin, sulfa/trimethoprim, and Levaquin.

4. Would you treat the patient with an antibiotic?
5. What would the urinalysis show if the patient did have a UTI?
6. What are the possible complications of a UTI in this patient?

**Case 2.** When talking to your 74-year-old female patient you discover that she has stopped going downstairs for meals in her senior apartment building. She has also stopped going on trips and does not have enough groceries. She denies any pain or fatigue. Seems reluctant to talk about it. Admits to urinary frequency.

**History:** Upon questioning, patient is afraid she might not make it to the bathroom in time, so has restricted her activities. Urinates every 1–2 hours so she won't be incontinent and still has occasional accidents in which she loses a large amount of urine.

1. What is the significance of loss of a large amount of urine?
2. What risk factors would you inquire about?
3. What medications can contribute to incontinence?
4. What treatment is effective for her type of incontinence?
5. What medications would you consider?

**Case 3.** An 83-year-old man has been taking ibuprofen for 20 years for DJD. He also has hypertension for which he takes hydrochlorothiazide. His blood pressure today is 160/94. He states that is what it usually is and that is fine with him. Routine screening lab shows BUN of 64 and creatinine of 1.8.

1. What is your initial assessment?
2. What other lab tests would you order? What would you look for?
3. Which diuretic is most effective in patients with renal insufficiency?
4. What complications should you monitor for?

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