

SECTION III

Cardiovascular

Acute Coronary Syndrome

Definition^{1,3}

Acute coronary syndrome (ACS) occurs when a coronary artery becomes acutely obstructed, which can be fatal. It occurs as a result of coronary heart disease (CHD).

Classification^{1,2}

ST elevation myocardial infarction (STEMI) **OR** non-ST elevation acute coronary syndrome (NSTEMI-ACS), which includes unstable angina.

Causes^{1,3,4,5,8}

- Coronary heart disease
 - Thrombus forms, leading to an acute occlusion (partial or complete) of a coronary artery.

Risk Factors^{2,3,4,5,6,9}

- Advanced age > 65 years
- Male sex
- Family history of heart disease
- Hypertension
- Physical inactivity
- Diabetes
- Obesity
- Dyslipidemia
- Cigarette smoking
- Chronic kidney disease

Signs & Symptoms^{1,2,3,4,6,7,8,9}

- Atypical features: abdominal pain, nausea or vomiting, fatigue, confusion, dizziness
- Dyspneic
- Chest pain/discomfort
- Diaphoresis
- Anxiety
- Acute heart failure signs (e.g., pulmonary rales or increased jugular venous pressure)

Tests^{1,2,7}

- Electrocardiogram (EKG)
 - Guides decision making; fibrinolytics benefit patients with STEMI. No ST elevation will be seen with NSTEMI-ACS; look instead for ST depression and/or T-wave inversion. High prevalence of NSTEMI-ACS in older adults.
- Cardiac biomarkers (troponin I or T)
 - Gold standard in diagnosis over creatinine kinase-MB.
- Cardiac catheterization
 - Reserved in older adults who have ischemic symptoms despite medical treatment; order in those who are candidates for coronary revascularization.

Treatment & Management^{1,2,3,4,6,7,8,9,10}

- **Send patient to the appropriate hospital setting.**
Percutaneous coronary intervention (PCI)-capable hospital recommended in patients with STEMI.
 - Reperfusion with PCI (preferred) or fibrinolytic therapy is recommended within the first **12 hours** with STEMI.
 - In patients with NSTEMI-ACS, fibrinolytic therapy is contraindicated, due to complications (e.g., risk of reinfarction).
 - ACS acute management includes (*prehospital care*)
 - A one-time dose of a nonenteric-coated aspirin 162–325 mg, chewable.

- Supplemental oxygen, if saturation < 90% and in respiratory distress.
- Nitroglycerin 0.4 mg sublingual q5min (max of three tablets in 15 minutes); hold for systolic blood pressure (BP) < 90 mm Hg.
- Intravenous morphine (4–8 mg q15min PRN) for ongoing chest pain.

Management Following ACS

- **Nonpharmacological and nursing interventions:**
 - Reassess the patient's chest pain often, including the response to medications.
 - Ongoing chest pain despite optimal medication can indicate patient needs invasive management (e.g., coronary artery bypass graft).
 - Encourage lifestyle changes: physical activity, healthy eating, weight loss, stress control, and smoking cessation.
 - Monitor for signs of depression and anxiety.
 - Teach the patient to check their heart rate and blood pressure.
 - Multiple medications can reduce these.
 - Encourage the flu vaccine.
 - There is an association with influenza and ACS.
- **Pharmacological and other interventions:**
 - Treat and manage the potentially reversible risk factors of ACS, such as:
 - Hypertension, dyslipidemia, and diabetes
 - Beta blockers (e.g., metoprolol tartrate [Lopressor], atenolol [Tenormin])
 - Example: atenolol 50 mg PO daily (max: 100 mg/day).
 - Recommended indefinitely following ACS; they reduce mortality rates.

- They improve coronary blood flow, thus ameliorating chronic angina.
- Caution use in those with chronic obstructive pulmonary disease (COPD) and/or bradycardia or hypotension.
- Angiotensin-converting enzyme (ACE) inhibitors (ACEIs) or angiotensin receptor blockers (ARBs)
 - Example: enalapril 10 mg PO BID (max: 40 mg daily).
 - Used indefinitely following ACS; they prevent ventricular remodeling and reduce risk of another cardiovascular event.
 - Monitor for hyperkalemia, dry cough (ACE inhibitors), and renal impairment.
- Statin therapy (e.g., atorvastatin [Lipitor], rosuvastatin [Crestor])
 - Example: atorvastatin 10 mg PO daily (max: 80 mg/day).
 - Recommended indefinitely following ACS; they reduce recurrent cardiovascular events.
 - Statins can be combined with ezetimibe (Zetia), which is effective for secondary prevention.
 - Monitor for myopathy or myalgias (may improve with reduced dosage).
- Antiplatelet therapy (e.g., aspirin, clopidogrel)
 - Example: aspirin 81 mg PO daily, used indefinitely (use clopidogrel [Plavix] 75 mg PO daily if allergic to aspirin).
 - They reduce the risk of thrombosis formation and reinfarction.
 - Aspirin and clopidogrel combined are recommended following a myocardial infarction (MI) (includes ST and non-ST elevation), PCI, and coronary stents.
 - Monitor for upset stomach and bleeding.
- Calcium channel blockers (CCBs)
 - Although they do **not** improve mortality, they are used when beta blockers are contraindicated; effective at treating angina refractory to beta blockers.

- Can be combined with a beta blocker.
- Monitor for bradycardia (especially if nondihydropyridine CCB is combined with a beta blocker), pedal edema, and worsening heart failure.
- Referral to a cardiac rehabilitation program
- Cardiology consultation/referral
 - Assist with secondary prevention management.

Note: Beers listed items, as mentioned above, include aspirin (if dose > 325 mg/day) and nondihydropyridine CCBs. Avoid routine prescribing of an ACEI with a potassium-sparing diuretic.

Differential Diagnosis^{4,7,8}

- Arrhythmia, such as atrial fibrillation: Often asymptomatic unless heart rate goes above 100; EKG confirms rhythm type. Compared to ACS, the presenting symptom in older adults is typically dyspnea or atypical complaints (e.g., fatigue).
- Gastroesophageal reflux: Burning retrosternal pain will improve with antacids and biomarkers will be negative. Compared to ACS, cardiac biomarkers will be positive; chest pain would continue despite antacid.

CLINICAL PEARLS^{2,7}

- Following an ACS event, secondary prevention is essential to decrease the risk of morbidity and mortality.
- Monitor for known complications seen in older adults following a major myocardial infarction, such as heart failure and atrial fibrillation.

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Aortic Stenosis

Definition^{4,5}

Aortic stenosis (AS) is a narrowing of the aortic valve that obstructs blood flow, leading to impaired tissue perfusion and cardiac output.

Causes^{1,2,3,5,6,10}

- Aortic valve calcification
- Bicuspid aortic valve
- Rheumatic fever (*especially in developing nations*)

Risk Factors^{1,3,5,6}

- Advanced age
- Male sex
- Congenital heart defect

- Diabetes mellitus
- Dyslipidemia
- Hypertension
- Tobacco use
- Chronic kidney disease (*especially dialysis patients*)
- History of radiation therapy
- Rheumatic fever (*less common*)

Signs & Symptoms^{1,2,3,4,5,6,10,11}

Many patients are asymptomatic until AS becomes severe.

- Presyncope or syncope
- Angina
- Dyspnea
- Systolic ejection murmur
- Fatigue
- Palpitations
- Impaired exercise tolerance
- Heart failure symptoms (e.g., pedal edema, pulmonary congestion)

Tests^{1,2,3,4,5,6,8,10,11}

- Electrocardiogram (EKG)
 - Commonly demonstrates left ventricular (LV) hypertrophy.
- Echocardiogram, transthoracic
 - Confirms the diagnosis. Determines the degree of LV hypertrophy, along with thickening, calcification, and restricted opening of the valve leaflets.
- Exercise stress testing
 - Reserved in individuals who are asymptomatic; helps to determine severity of symptoms.
- Cardiac catheterization
 - Ordered if the echocardiogram is inconclusive.
 - Ordered with coronary angiography when aortic valve replacement is considered; many will have concomitant coronary artery disease (CAD), which requires bypass grafting.

Treatment & Management^{1,2,3,4,5,6,7,8,9,10,11,12}

- **Nonpharmacological and nursing interventions:**

- Take measures to avoid volume depletion, such as offering fluids (*hypovolemia further decreases cardiac output*).
- Encourage lifestyle changes, such as:
 - Healthier eating practices (e.g., avoiding excess saturated fats, eating more fruits and vegetables).
 - Regular physical activity; however avoid strenuous activity in individuals with moderate to severe asymptomatic AS.
 - Stress reduction (e.g., meditation, relaxation).
 - Encourage tobacco cessation and target A1C of < 7% to reduce risk of postoperative infection.
- Encourage optimal dental hygiene and routine dental care.
- Education on warfarin (Coumadin, Jantoven) if used for mechanical prosthesis.
 - Take medication at the same time daily, never double up if a dose was missed. Monitor for bleeding or unusual bruising; keep the amount of vitamin K-rich foods (e.g., broccoli, spinach) consistent each day, and avoid alcohol.

- **Pharmacological and other interventions:**

No specific medication regimen exists for the treatment of AS; none have been shown to improve survival.

- Identify and treat cardiovascular risk factors, such as:
 - Hypertension, diabetes mellitus, dyslipidemia.
- Antihypertensives (e.g., ACE inhibitors or ARBs, beta blockers)
 - Ordered in individuals with AS who are asymptomatic.
 - Important to treat comorbid hypertension because if left untreated, can lead to earlier onset of AS symptoms.
- Nitroglycerin
 - Used to relieve angina associated with CAD (monitor for hypotension).

- Statin therapy
 - Should be considered in individuals with coexisting conditions, such as CAD and dyslipidemia (to reduce cardiovascular events).
 - May slow the progression of leaflet calcification.
- Diuretics, digoxin, ACE inhibitors, or ARBs can be used for heart failure symptoms in patients who are not surgical candidates.
- Warfarin (Coumadin)
 - Reserved in individuals who undergo aortic valve replacement (AVR) with mechanical prostheses. However, most cardiac surgeons will implant a bioprosthetic valve, which does not require anticoagulation.
- Cardiology consultation/referral
 - To follow the progression of AS with frequent imaging.
- Surgical or transcatheter aortic valve replacement
 - Reserved in those with symptomatic severe AS and asymptomatic individuals with severe AS who plan on undergoing cardiac surgery, such as coronary artery bypass grafting (CABG).
 - AVR significantly improves symptoms and long-term survival.
 - In patients who are a high surgical risk, transcatheter aortic valve replacement (TAVR) is an alternative.

Note: Beers listed items, as mentioned above, include diuretics and digoxin (in doses > 125 mcg/day). If warfarin combined with NSAIDs or amiodarone, monitor INRs closely. Avoid routine prescribing of an ACEI with a potassium-sparing diuretic.

Differential Diagnosis^{1,8,11}

- CAD: Common to have Q waves; cardiac catheterization shows severity of plaque in the coronary arteries. Compared to AS, Q waves are not present and patient may have insignificant results upon cardiac catheterization (about half will have CAD).
- Aortic sclerosis: Murmur is not as intense compared to AS and echo will show insignificant pressure gradient across the

aortic valve; it can progress to AS. Compared to AS, there will be a systolic murmur usually $\geq 3/6$; echo will show elevated gradient (at least 10mm Hg) across the aortic valve.

CLINICAL PEARLS^{1,2,3,4,11}

- It is important to refer symptomatic patients for AVR to improve longevity. The 10-year survival rate is about 60% in older adults following AVR. For those who have symptoms and do not undergo AVR, the average survival rate is about 2–3 years.
- Before referring individuals for AVR to improve symptoms, consider first if the surgery would provide meaningful benefit, especially in those with poor prognosis and advanced dementia (AVR not recommended).

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Atrial Fibrillation

Definition^{1,2,5,6,7,11}

Atrial fibrillation (AF) is a common arrhythmia, characterized as an irregularly irregular atrial rhythm, which increases the risk of stroke (*by at least 5 times*) and heart failure.

Classification^{1,5,6,9,10}

Paroxysmal: AF that lasts less than a week and converts to sinus rhythm without treatment; can re-occur and become permanent.

Persistent: AF lasting more than a week; requires treatment.

Long-standing: AF lasting more than a year; carries a possibility of converting over to sinus rhythm.

Permanent: AF that is permanent; no possibility of converting over to sinus rhythm.

Causes^{1,2,5,6,7,8,9,10,11,12}

Most are idiopathic.

- Hypertension
- Coronary artery disease
- Heart failure
- Cardiomyopathy (ischemic or nonischemic)
- Valvular diseases (e.g., mitral regurgitation, mitral stenosis)
- Hyperthyroidism
- Cardiac procedures or surgeries
- Alcohol abuse

- Sleep apnea
- Chronic lung disease
- Serious infections (e.g., pneumonia)

Risk Factors^{1,2,3,4,6,7,9,10,11}

Risk factors coincide with the causes of AF.

- Advanced age
- Male sex
- European ancestry
- Obesity
- Diabetes

Signs & Symptoms^{1,2,5,6,7,11}

Often asymptomatic, especially with controlled ventricular response (60–100 beats per minute [bpm]).

- Irregular, irregular rhythm
- Heart palpitations
- Dizziness
- Chest pain or pressure
- Dyspnea
- Anxiety
- Impaired exercise tolerance
- Fatigue
- Presyncope or syncope

Tests^{1,2,3,6,7,9,12,13}

- Electrocardiography (ECG)
 - Used to diagnosis AF (*i.e.*, no P waves, disorganized atrial activity, irregular R-R intervals). Fast ventricular response = rate > 100 bpm.
- Holter monitor
 - Useful in diagnosing paroxysmal AF.
- Echocardiography
 - To assess atrial/ventricular size and function; evaluates for causes of AF, such as evidence of valvular disease.

Transesophageal echocardiography (TEE) is more specific over transthoracic in evaluating atrial thrombus (risk factor for stroke); performed prior to synchronized cardioversion.

- Comprehensive metabolic panel (CMP) (including magnesium), thyroid-stimulating hormone (TSH), hemoglobin and hemocrit (Hgb/Hct)
 - Important to determine renal and hepatic function as these influence treatment options; evaluate for hyperthyroidism. Electrolyte imbalances can exacerbate AF; anemia is important to monitor while on antithrombotic therapy.

Treatment & Management^{1,2,3,4,6,9,10,12,13,14}

- **Nonpharmacological and nursing interventions:**
 - Encourage lifestyle changes (e.g., avoid binge drinking, stress reduction, diet while on warfarin).
 - Encourage physical activity and weight reduction.
 - Educate patients on symptoms of rapid ventricular response: chest discomfort/pain, dyspnea, dizziness.
 - Monitor adverse effects of drug therapy associated with AF.
 - Monitor for bleeding with anticoagulants.
 - Bradycardia with AF rate control regimen.
- **Pharmacological and other interventions:**
 - Identify and treat the underlying cause(s), such as:
 - Treat the hyperthyroidism.
 - Treat the hypertension.
 - Rate control (goal of about < 100 bpm):
 - Beta blockers (e.g., metoprolol tartrate [Lopressor], atenolol [Tenormin])
 - Example: metoprolol tartrate at 12.5–100 mg PO BID.
 - Use in those with CAD and/or reduced systolic function.

- Nondihydropyridine calcium channel blockers (e.g., verapamil [Calan, Verelan], diltiazem [Cardizem])
 - Example: diltiazem (immediate release) 60–120 mg PO TID (max: 360 mg/day)
 - Avoid use in those with reduced systolic function.
 - Combo therapy with a beta blocker increases bradycardia.
- Digoxin (*least effective*)
 - Example: digoxin 125 mcg PO daily.
 - Can be taken with a beta blocker or calcium channel blocker.
- If the above agents are ineffective at controlling the rate, ablation of the atrioventricular (AV) node and permanent pacing are effective.
- Rhythm control (*not as important if asymptomatic*):
 - Cardioversion: Reserved for those who are hemodynamically unstable; pharmacologic cardioversion is not as effective or safe as electrical cardioversion.
 - Direction current cardioversion (*high risk of thromboembolism/stroke*).
 - Recommended in nonvalvular AF that started within 48 hours and low risk of a thromboembolic event.
 - Not advised if AF present > 48 hours.
 - Will need to be anticoagulated for 3 weeks prior to cardioversion.
 - Need anticoagulation for a minimum of a month following cardioversion, possibly for lifetime.
 - Most effective in those with AF with an irreversible cause and/or short duration AF.
 - Antiarrhythmic therapy for long-term maintenance of sinus rhythm:
 - Class 1a (e.g., quinidine)
 - Not used often due to limited efficacy.
 - Class 1c (e.g., flecainide, propafenone [Rhythmol])
 - Class III (e.g., amiodarone [Pacerone], dronedarone [Multaq], sotalol [Betapace])

- Amiodarone is effective and is commonly prescribed.
- Use antiarrhythmics once rate control has been maintained by a beta blocker or a nondihydropyridine calcium channel blocker.
- There is currently no standard/optimal rhythm control drug therapy in older adults with symptomatic AF.
- Catheter ablation: Success rate is high in paroxysmal AF.
- Surgical Maze procedure: Success rate is high in refractory AF; reduces strokes.
- Thromboembolism prevention (ordered based on CHA2DS2-VASc score):
 - Anticoagulation is recommended with score ≥ 2 .*
 - Warfarin (e.g., Coumadin, Jantoven)
 - Used in patients with AF and mechanical heart valve (INR goal 2.5–3.5).
 - INR goal of 2.0–3.0 in those with nonvalvular AF.
 - Use fresh frozen plasma as emergent reversal with life-threatening bleeding; the antidote is vitamin K.
 - Newer anticoagulants (e.g., apixaban [Eliquis], dabigatran [Pradaxa], rivaroxaban [Xarelto])
 - Used in patients with nonvalvular AF.
 - **PROs:** not inferior to warfarin, alternative to warfarin when INRs are difficult to maintain; have short half-lives and fewer drug-drug interactions; do not require INR monitoring and no dietary restrictions.
 - **CONs:** no reversal agent; avoid with creatinine clearance < 15 mL/min.
 - Dabigatran may cause life-threatening bleeding in patients > 80 years old.
 - Apixaban is superior to warfarin and has reduced bleeding events.
 - Aspirin (75–325 mg/day)
 - Used in nonvalvular AF and CHA2DS2-VASc score of 1.

- Use this when anticoagulants are contraindicated. It can be combined with clopidogrel (Plavix); however risk of bleeding is comparable to warfarin.
- Factors that increase the risk of bleeding while taking antithrombotic therapy: uncontrolled hypertension, impaired liver or renal function, history of bleeding, concomitant use of an NSAID or antiplatelet, and age > 65–75 years.
- Cardiology consultation/referral
 - For appropriate selection of antiarrhythmic therapy and/or for procedures (ablation, pacemaker placement).

NOTE: Beers listed items, as mentioned above, include anticoagulants, amiodarone, dronedarone, digoxin, and nondihydropyridine calcium channel blockers.

Differential Diagnosis^{2,5}

- Myocardial infarction: Key symptoms are chest pain (characterized by squeezing or intolerable pressure) and/or dyspnea. Key symptoms are heart palpitations or fluttering in AF.
- Other supraventricular arrhythmias: Can present with similar symptoms as AF. 12-lead ECG can determine the correct arrhythmia.

CLINICAL PEARLS^{2,4,6,10}

- Treatment of AF focuses on rate control, rhythm control, and thromboembolism prevention. In older adults who are asymptomatic, rate control and thromboembolism prevention are preferred.

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Dyslipidemia

Definition^{1,5,6}

Dyslipidemia is an increase in serum cholesterol, triglycerides, or a combination of the two, with a decreased high-density

lipoprotein (HDL). This condition contributes to atherosclerotic cardiovascular disease (ASCVD).

Classification¹

Isolated hypercholesterolemia: elevated cholesterol levels only

Isolated hypertriglyceridemia: elevated triglyceride levels only

Mixed hyperlipidemia: elevated cholesterol and triglycerides levels

Causes^{1,2,3,5,10}

- Primary causes:
 - Genetics (e.g., familial combined hyperlipidemia)
- Secondary causes:
 - Sedentary lifestyle
 - Unhealthy eating habits (i.e., *excessive caloric intake, saturated fat, cholesterol*)
 - Obesity
 - Diabetes
 - Alcohol abuse
 - Cigarette smoking
 - Chronic kidney disease
 - Nephrotic syndrome
 - Hypothyroidism
 - Liver diseases
 - Medications
 - Thiazide diuretics, beta blockers, protease inhibitors, estrogens, some atypical antipsychotics, and corticosteroids

Risk Factors

Risk factors of dyslipidemia coincide with causes.

Signs & Symptoms^{1,4}

There are usually no signs or symptoms associated with dyslipidemia.

- Arcus senilis.

- Xanthomas.
 - Can appear anywhere, especially on elbows, hands, feet, joints, or buttocks.
- They, however, lead to symptoms associated with CAD (*e.g.*, *angina*, *dyspnea*), cerebrovascular accidents, and peripheral arterial disease.
- Triglyceride levels $> 1,000$ mg/dL leads to acute pancreatitis (*i.e.*, *abdominal pain*, *nausea*)

Tests^{1,5,6,8,9}

- Lipid panel
 - Values are affected by acute illness, recent myocardial infarction, and/or eating 12 hours prior to the test being drawn.
 - Repeat lipid panels are ordered at least every 12 weeks after prescribing or changing dyslipidemia medication therapies (to evaluate anticipated response). Once levels have normalized, repeating a lipid panel quarterly to annually is reasonable.
- Reasonable to also order: fasting serum glucose, TSH, liver panel, serum creatinine, and urine protein
 - To evaluate for secondary causes of dyslipidemia, such as diabetes, hypothyroidism, and/or liver or renal disease.
 - Baseline liver function is recommended with statin therapy.
- Coronary artery calcium score (≥ 300), C-reactive protein (≥ 2 mg/L or 19.05 nmol/L), or ankle-brachial index (< 0.9)
 - Useful when a treatment decision is uncertain.

Treatment & Management^{1,3,5,6,7,9,10}

- **Nonpharmacological and nursing interventions:**
 - Encourage lifestyle changes:
 - Increase physical activity.
 - Promote healthy eating habits.
 - Decrease intake of saturated fats and cholesterol.
 - Increase dietary fiber.

- Weight loss.
- Smoking cessation.
- Glycemic control in diabetics.
- Encouraging alcohol is not recommended, given its adverse effects.
- Educate on the adverse effects of medications used in dyslipidemia.
- **Pharmacological and other interventions:**
 - Identify and treat secondary causes of dyslipidemia, such as:
 - Diabetes: Metformin (Glucophage, Fortamet, Glumetza) not only improves glycemic control, but lowers triglycerides.
 - Hypothyroidism: Dyslipidemia will eventually improve with treatment.
 - Reducing or discontinuing drugs contributing to dyslipidemia
 - Statins (e.g., atorvastatin [Lipitor], rosuvastatin [Crestor])
 - Example: Start atorvastatin 20–40 mg PO QD (max: 80 mg/day).
 - Recommended for primary and secondary prevention of ASCVD events. They are the most effective at treating dyslipidemias, especially in lowering LDL levels.
 - Statins are recommended based on the cardiovascular risk. Risk calculators are available to get an idea of the estimated 10-year risk of ASCVD in those *without* ASCVD.
 - www.cvriskcalculator.com
 - www.qrisk.org/
 - Statin therapy in adults > age 75 years for primary prevention should be individualized (current evidence is insufficient). If > age 75 years old with known ASCVD, moderate-intensity therapy is recommended.
 - Statin therapy is beneficial in the following: high risk of ASCVD (10-year risk $\geq 7.5\%$ – 10%), known ASCVD (e.g., acute coronary syndrome, stroke, or transient

ischemic attack [TIA], peripheral artery disease), diabetes with LDL level of 70–189 mg/dL, LDL level \geq 190 mg/dL, and chronic kidney disease (not requiring dialysis).

- Musculoskeletal complaints can occur and is dose dependent; liver toxicity is uncommon.
- It is reasonable to use the lowest dose of statin therapy to prevent complications in older adults.
- Consider the following nonstatin medications in those who do not tolerate or respond as expected to statin therapy (e.g., high-intensity statin not producing a \geq 50% reduction in LDLs):
 - Ezetimibe (Zetia)
 - Example: Start ezetimibe 10 mg PO QD (max: 10 mg/day).
 - Decreases LDL levels; minimally increases HDL.
 - Commonly combined with a statin.
 - Usually well tolerated.
 - Bile acid sequestrants (e.g., cholestyramine [Questran, Prevalite], colestevlam [Welchol], colestipol [Colestid])
 - Example: cholestyramine 4 g PO QD-BID (max: 24 g/day).
 - Lowers LDL; increases triglycerides transiently.
 - Commonly prescribed with a statin.
 - Monitor for gastrointestinal (GI) disturbances (e.g., nausea, cramping, constipation).
 - PCSK9 inhibitors (e.g., evolocumab [Repatha], alirocumab [Praluent])
 - Example: evolocumab 140 mg SC q2weeks or 420 mg SC qmonth.
 - Used as adjunct to treat heterozygous familial hypercholesterolemia.
 - Expensive.
 - Nicotinic acid (niacin), fibrates, and omega-3 fatty acids
 - Although these medications reduce lipid levels, it is recommended to avoid routine prescribing of these agents (A evidence rating).

- To reduce the risk of pancreatitis in individuals with high triglycerides ($>1,000$ mg/dL), fibrates or fish oil are recommended.
- Dietitian consultation/referral
 - For nutritional guidance

CLINICAL PEARLS^{1,6}

- The goal of dyslipidemia treatment is to prevent future ASCVD events. In those with known ASCVD, treatment is recommended.
- Do not prescribe statins or nonstatins in older adults with limited life expectancy.
- If statin therapy does not produce the desired effect (e.g., atorvastatin 40–80 mg daily not reducing LDL level by more than 50%), consider a nonstatin medication such as ezetimibe (*try first*), a bile acid sequestrant, or a PCSK9 inhibitor.

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Heart Failure

Definition^{1,2,5,8}

Heart failure (HF) is a syndrome characterized by impaired pump performance, resulting in an inability to meet the metabolic demands of the body.

Types^{1,2,5,8,10}

Heart failure with reduced ejection fraction (HFrEF) or systolic heart failure: due to impaired cardiac contractility; ejection fraction (EF) $\leq 40\%$.

Heart failure with preserved ejection fraction (HFpEF) or diastolic heart failure: inability of the ventricles to relax; will have ejection fraction (EF) $> 40\%$ – 50% .

Causes^{1,2,3,4,5,7,8}

Multifactorial, not typically just one single cause.

- Hypertension and coronary artery disease
 - *Most common causes*
- Valvular heart disease (e.g., aortic stenosis, mitral regurgitation)
- Cardiomyopathies
 - Includes stress induced, alcohol induced, hypertrophic
- Chemotherapy-induced cardiotoxicity (e.g., anthracyclines, trastuzumab)
- Precipitants of *acute exacerbation* include:
 - Noncompliance to diet (e.g., excess sodium or fluid intake) and/or medications

- Myocardial ischemia or infarction
- Arrhythmias
 - Especially new-onset atrial fibrillation or flutter
- Severe infections (e.g., sepsis, pneumonia)
 - *Heart failure exacerbation occurs as a result of the inability to compensate from the increased demands.*
- Medications
 - Includes NSAIDs, thiazolidinediones, corticosteroids, minoxidil, calcium channel blockers (especially nondihydropyridine)
- Anemia
- Hyperthyroidism

Risk Factors^{2,4,5,7,8,9}

Risk factors coincide with the causes of heart failure.

- Age > 65 years
- African-American ancestry
- Overweight or obese
- Diabetes
- Sleep apnea
- Alcohol abuse
- Tobacco use

Signs & Symptoms^{1,2,3,4,5,8,9}

- Dyspnea (exertional or at rest)
- Orthopnea
- Paroxysmal nocturnal dyspnea (PND)
- Cough
- Impaired exercise tolerance
- Pedal edema
- Weight gain
- Crackles or rales
- Jugular venous distention
- Abnormal vital signs (e.g., tachycardia, tachypnea)
- Atypical presentation (e.g., fatigue, weight loss, confusion)

Cardiovascular

Table 3-1 New York Heart Association Functional Classification

Doctors usually classify patients' heart failure according to the severity of their symptoms. The table below describes the most commonly used classification system, the New York Heart Association (NYHA) Functional Classification.^a It places patients in one of four categories based on how much they are limited during physical activity.

Class	Patient Symptoms
I	No limitation of physical activity. Ordinary physical activity does not cause undue fatigue, palpitation, or dyspnea (shortness of breath).
II	Slight limitation of physical activity. Comfortable at rest. Ordinary physical activity results in fatigue, palpitation, or dyspnea (shortness of breath).
III	Marked limitation of physical activity. Comfortable at rest. Less than ordinary activity causes fatigue, palpitation, or dyspnea.
IV	Unable to carry on any physical activity without discomfort. Symptoms of heart failure at rest. If any physical activity is undertaken, discomfort increases.

Class	Objective Assessment
A	No objective evidence of cardiovascular disease. No symptoms and no limitation in ordinary physical activity.
B	Objective evidence of minimal cardiovascular disease. Mild symptoms and slight limitation during ordinary activity. Comfortable at rest.
C	Objective evidence of moderately severe cardiovascular disease. Marked limitation in activity due to symptoms, even during less-than-ordinary activity. Comfortable only at rest.
D	Objective evidence of severe cardiovascular disease. Severe limitations. Experiences symptoms even while at rest.

(continued)

Table 3-1 New York Heart Association Functional Classification (*Continued*)

For example:

- A patient with minimal or no symptoms but a large pressure gradient across the aortic valve or severe obstruction of the left main coronary artery is classified:
 - **Function Capacity I, Objective Assessment D**
- A patient with severe anginal syndrome but angiographically normal coronary arteries is classified:
 - **Functional Capacity IV, Objective Assessment A**

^a Adapted from Dolgin, M., The Criteria Committee of the New York Heart Association. (2014). *Nomenclature and Criteria for Diagnosis of Diseases of the Heart and Great Vessels* (9th ed.). Boston, MA: Lippincott Williams and Wilkins..

Original source: Criteria Committee of the New York Heart Association, Inc. (1964). *Diseases of the Heart and Blood Vessels. Nomenclature and Criteria for Diagnosis* (6th ed.). Boston, MA: Little, Brown and Co. (p. 114).

This content was last reviewed May 2017.

Tests^{1,2,3,4,5,8,10}

- Laboratory tests, reasonable to start with:
 - B-type natriuretic peptide (BNP) *most useful serum test*.
 - BNP (*affected by age and renal impairment*) supports the diagnosis and helps differentiate from other causes of dyspnea, such as from a pulmonary cause. Level < 100 unlikely to be heart failure.
 - Thyroid function, complete blood count (CBC), complete metabolic panel (CMP), magnesium, liver panel, urinalysis, fasting serum glucose.
 - Evaluate for hyperthyroidism, anemia, electrolytes (*due to medical management, such as diuretics*), and renal or liver impairment (*occurs from hypoperfusion*). Tests are indicated to rule out other comorbidities.
- Chest X-ray
 - Checks for other causes of dyspnea (e.g., pneumonia). Used to assess for pulmonary edema, cardiomegaly, and/or parenchymal edema (seen with moderate-severe heart failure).

- Electrocardiogram (EKG)
 - Checks for arrhythmias, left ventricular hypertrophy, and Q waves (*signifies prior myocardial infarction*).
- Echocardiography (transthoracic)
 - Estimates ejection fraction and is the preferred test for evaluating left ventricular function.
- Cardiac catheterization
 - Not done routinely; order if there's evidence of coronary disease and intervention would be warranted.

Treatment & Management^{1,3,4,5,8,9,11, 12}

- **Nonpharmacological and nursing interventions:**
 - Monitor body weight.
 - Encourage lifestyle modification (e.g., reducing sodium to < 2,000 mg in moderate-severe HF; fluid restrictions < 2 L/d with severe symptoms).
 - Promote physical activity.
 - Encourage diet and medication compliance.
 - Encourage alcohol and tobacco cessation.
- **Pharmacological and other interventions:**
 - Identify and treat the underlying (causes) of heart failure, such as:
 - Treat the hypertension.
 - Treat the dyslipidemia (*may prevent a future myocardial infarction*).
 - Aortic stenosis (consider aortic valve replacement).
 - Myocardial ischemia (consider coronary revascularization and/or antianginal agents).
 - ACE inhibitors (ACEIs) (e.g., Lisinopril [Prinivil, Zetril], captopril [Capoten], enalapril [Vasotec])
 - Example: Start enalapril 2.5–5 mg BID (max: 40 mg/day).
 - First-line therapy in individuals with systolic dysfunction. They prevent left ventricular remodeling. The significance of ACEIs and ARBs in those with diastolic heart failure is uncertain.

- Use an ARB, such as valsartan (Diovan) 20–40mg PO BID (max: 320 mg/day), if unable to tolerate an ACEI due to side effect, such as cough.
- Monitor for cough (*excluding ARBs*), renal impairment, angioedema (*rare with ARBs*), and hyperpotassemia.
- Beta blockers (e.g., metoprolol succinate [Toprol-XL], carvedilol [Coreg])
 - Example: Start carvedilol at 3.125 mg BID (max: 50 mg/day).
 - Reduces mortality and improves left ventricular function.
 - They may improve symptoms in those with diastolic heart failure.
 - Monitor closely for bradycardia, hypotension, and fatigue
- Diuretics, initially loops (e.g., furosemide [Lasix], bumetanide [Bumex])
 - Example: bumetanide 0.5–5 mg PO QD-BID (max: 10 mg/day).
 - Effective at relieving pulmonary congestion and edema in systolic and diastolic heart failure.
 - If high doses are not controlling the fluid overload, add an aldosterone antagonist (e.g., spironolactone [Aldactone]).
 - Example: Start spironolactone at 12.5–50 mg PO QD.
 - Recommended with NYHA class II–IV heart failure symptoms and $EF \leq 35\%$; reduces mortality in severe heart failure. May be beneficial in those with diastolic heart failure.
 - If pulmonary congestion or pedal edema is severe, add metolazone (Zaroxlyn) 2.5–10 mg PO QD.
 - Monitor renal function and electrolytes closely.
- Hydralazine and nitrate (isosorbide dinitrate) combination

- Example: Start hydralazine 12.5–25 mg TID-QID (max: 300 mg/day) and isosorbide dinitrate 10 mg TID-QID (max: 120 mg/day).
- Especially beneficial in blacks. Use this combo when unable to tolerate an ACEI or an ARB.
- Monitor for common symptoms: headache and dizziness.
- Digoxin (*fallen out of favor*)
 - Example: Dose of 125 mcg QD is typical; therapeutic target range between 0.5–0.9 ng/mL.
 - Increases the force of myocardial contraction, which improves HF symptoms with reduced ejection fraction. Not recommended in diastolic heart failure (unless used to improve rate with atrial fibrillation).
 - Monitor for GI disturbances (nausea/vomiting, abdominal pain) and bradycardia.
 - Used when patient is symptomatic despite taking other therapy. Not recommended as first line-therapy in HF.
- Not recommended to use calcium channel blockers with HfrEJ.
- For all the above medications:
 - Start at low doses and slowly titrate upward.
- Treat the depression and anxiety (often coexist with HF).
- Cardiology consultation/referral (when symptoms are refractory to medical therapy).
- Palliative care referral
 - To improve quality of life and provide relief of symptoms; as patient declines consider transition to hospice services.

Note: Beers listed items, as mentioned above, include digoxin and diuretics. Avoid routine prescribing of an ACEI with a potassium-sparing diuretic.

Differential Diagnosis^{4,6,10}

- Chronic obstructive pulmonary disease (COPD): Precipitants commonly include infection, allergies, or environmental triggers. Will have absence of paroxysmal nocturnal dyspnea and

low BNP, whereas HF will have paroxysmal nocturnal dyspnea and elevated BNP.

- Pneumonia: May have acute dyspnea, productive sputum, and/or fever. HF can be acute or chronic dyspnea, cough can be dry or productive, and absence of fever.

CLINICAL PEARLS^{3,4,8,9,10}

- Have discussions with the family and patient regarding end-of-life care (e.g., how aggressive to be with overall care/advanced directives) given the overall poor prognosis of patients with established heart failure, especially with NYHA class III or IV.
- Aggressive treatment of coronary artery disease and hypertension are essential in preventing heart failure from worsening, given these are the most common causes of heart failure in older adults.
- Although ACEIs, ARBs, mineralocorticoid antagonists, and beta blockers are not considered standard therapy in diastolic heart failure, it is reasonable to use these agents to improve symptoms.

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Hypertension

Definition^{1,2,5,6,13,14}

Hypertension (HTN) is a disease characterized by an elevation of systemic arterial blood pressure, often leading to cardiovascular disease (CVD)-related events or death.

Primary hypertension: Hypertension develops gradually with no known cause.

Secondary hypertension: Hypertension develops from an underlying cause.

Classification²

Normal: pressure < 120/80 mm Hg

Elevated: systolic 120–129 mm Hg *plus* diastolic < 80 mm Hg

Stage I hypertension: systolic 130–139 mm Hg *or* diastolic 80–89 mm Hg

Stage 2 hypertension: pressure ≥ 140/90 mm Hg

Hypertensive crisis: systolic > 180 mm Hg and/or diastolic > 120 mm Hg

Note: The above represents the new classification system from the 2017 American College of Cardiology/American Heart Association (ACC/AHA) guidelines.¹⁵

Older adults are typically classified based on their systolic results given isolated diastolic hypertension is uncommon.

Causes^{2,5,6,13}

- Primary (essential) hypertension
 - Cause unknown
- Secondary hypertension
 - Kidney disease (*most common*)
 - Medications (e.g., decongestants, corticosteroids, NSAIDs)
 - Sleep apnea
 - Hypo- or hyperthyroidism
 - Hypercalcemia (primary hyperparathyroidism)

Risk Factors^{2,5,6,11,13}

- Older age (> 60 years)
- African-American ancestry
- Family history of hypertension
- Overweight or obese
- Sedentary lifestyle
- Tobacco use
- Alcohol abuse
- Smoking
- Stress
- High sodium intake

Signs & Symptoms^{5,6,13}

There are usually no signs or symptoms associated with hypertension.

- Some may have blurry vision, chest pain, epistaxis, and/or headache.

Tests^{1,11,13,16}

- Screening tests: office blood pressure measurement, ambulatory and home blood pressure monitoring
- Office blood pressure measurement should be performed while the patient is sitting, using a manual or automated sphygmomanometer. The mean of two measurements is taken with an appropriately sized arm cuff with the arm at the level of the right atrium.
- Ambulatory and home blood pressure monitoring confirm the diagnosis of hypertension; ambulatory blood pressure monitoring is preferred for confirmation.
- Urine albumin, basic metabolic panel (BMP), fasting blood glucose, lipid panel, TSH
 - Ordered to evaluate for renal impairment; serum electrolytes ordered due to medication therapy monitoring (e.g., ACEI/ARB, diuretics), impaired glucose and dyslipidemia often seen with hypertension, and thyroid to evaluate for underlying thyroid disease.
- Electrocardiogram or echocardiography
 - Evaluate for cardiac abnormalities (e.g., left ventricular hypertrophy).
- Polysomnography
 - If suspected sleep apnea.

Treatment & Management^{1,2,3,4,5,6,7,8,9,10,11,13,14,16,18}

- **Nonpharmacological and nursing interventions:**
 - Educate on adverse effects of antihypertensives.
 - All antihypertensives associated with postural hypotension.
 - Educate importance of compliance with medications.
 - Uncontrolled hypertension leads to end organ damage (e.g., stroke, heart failure, myocardial infarction, renal insufficiency, retinopathy)
 - Stress the importance of blood pressure measurement techniques.

- Encourage lifestyle changes, such as:
 - Healthier eating practices; decrease intake of sodium (< 2,400 mg/day) and alcohol (< 1–2 drinks/day)
 - Smoking cessation
 - Stress management (e.g., yoga, meditating)
 - Increasing physical activity (e.g., walking 30 min/day)
- **Pharmacological and other interventions:**
 - Thiazide diuretics (e.g., hydrochlorothiazide [Microzide] or chlorthalidone)
 - Example: Start chlorthalidone 12.5–25 mg QD, which is the recommended agent in this class.
 - Thiazides can be used alone or in combo with other drug classes.
 - They are especially effective when combined with ACE inhibitor.
 - Can be used as monotherapy or in combo with a calcium channel blocker in blacks.
 - Monitor for electrolyte imbalance (e.g., hyponatremia, hypokalemia), urinary frequency, and hyperuricemia.
 - ACE inhibitor (ACEI) (e.g., lisinopril [Zestril, Prinivil] **or** angiotensin receptor blocker (ARB) (e.g., valsartan [Diovan])
 - Example: Start Lisinopril 5–10 mg QD (max: 80 mg/day due to HTN; max: 40 mg/day due to HF) or valsartan 80–160 mg QD (max: 320 mg/day).
 - They can be used alone or in combo with other drug classes.
 - Do not combine an ACE inhibitor with an ARB.
 - Use an ACE inhibitor or ARB with chronic kidney disease, heart failure, following myocardial infarction, coronary artery disease, and/or diabetes.
 - Monitor for cough, angioedema, hyperkalemia, and renal insufficiency.
 - Calcium channel blockers (CCB) include dihydropyridines (e.g., amlodipine [Norvasc]) or nondihydropyridines (e.g., diltiazem [Cardizem] or verapamil [Calan, Verelan])

Cardiovascular

- Example: Start amlodipine 2.5–5 mg QD (max: 10 mg/day).
- Can be used alone or in combo with other drug classes.
- Caution prescribing a nondihydropyridine with a beta blocker; combo increases risk of bradycardia.
- In systolic heart failure, they provide no mortality benefit; nondihydropyridines may worsen outcome by depressing cardiac function.
- Monitor for peripheral edema; caution use in patients with heart failure.
- Beta blockers (e.g., metoprolol tartrate [Lopressor], carvedilol [Coreg])
 - Example: Start metoprolol tartrate at 50 mg BID (max: 450 mg/day).
 - They are most often used in combo with other drug classes; used alone for hypertension without compelling indication is controversial.
 - Beta blockers are beneficial in patients with heart failure and following myocardial infarction.
 - Monitor for fatigue, dizziness, sexual dysfunction, and decreased pulse; avoid in severe COPD or asthma.
- Other options (not typically used as initial management): aldosterone antagonist (e.g., spironolactone [Aldactone]), loop diuretic (e.g., furosemide [Lasix]), hydralazine, peripheral alpha blocker (e.g., terazosin [Hytrin]), or central alpha agonist (clonidine [Catapres])
- For all the above medications:
 - Start at low dose and slowly titrate upward.
 - If not at target blood pressure goal, increase medication(s) to the max dose or add another medication.
- Consultation/referral to appropriate specialists (e.g., ophthalmology to evaluate for hypertensive retinopathy, nephrology with presence of kidney disease).

NOTE: Beers listed items, as mentioned above, include clonidine, peripheral alpha blockers, diuretics, and nondihydropyridine calcium channel blockers. Avoid routine prescribing of an ACEI with a potassium-sparing diuretic.

CLINICAL PEARLS^{2,13,14,15,16,17}

- Determining appropriate blood pressure goals in older individuals is controversial.
- Eighth Joint National Committee (JNC 8) guidelines recommend for adults \geq age 60 a target blood pressure goal of less than 150/90 mm Hg. If diabetes or chronic renal disease present, will need to maintain pressure goal of less than 140/90 mm Hg.
- The American College of Physicians (ACP) and American Academy of Family Physicians (AAFP) recommend treatment in adults age 60 years or above with blood pressures persistently at or above 150 mm Hg. In individuals with a history of stroke or transient ischemic attack, and/or increased cardiovascular risk, a systolic blood pressure goal of less than 140 mm Hg is reasonable.
- US Preventive Services Task Force (USPSTF) recommends a target blood pressure of 150/90 mm Hg in older adults age 60 years or older.
- The new guidelines issued by the American College of Cardiology/American Heart Association (ACC/AHA) aim for a target of under 130/80 mm Hg, suggesting older adults should have the same goal as younger adults.
 - This may not be realistic for some older adults when treated aggressively to the guidelines (due to poor vascular compliance).
- Deciding on which antihypertensive agent to prescribe is patient specific; consider comorbidities and simplicity of the medication (e.g., once daily dosing) to increase compliance.

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Peripheral Arterial Disease

Definition^{2,3,8,9}

Peripheral arterial disease (PAD) refers to atherosclerosis in the arteries that circulate the lower extremities.

Cause^{1,3,4,8,9}

- Atherosclerosis

Risk Factors^{1,2,3,4,8,9}

- Cigarette smoking
- Diabetes
- Advanced age
- Personal or family history of coronary heart disease (CHD)
- Dyslipidemia
- Hypertension
- Elevated homocysteine

Signs & Symptoms^{1,2,3,4,5,8,9}

- Asymptomatic
- Intermittent claudication (i.e., achy or painful leg exacerbated with walking, alleviated by rest).
- Decreased walking distance
- Thick, brittle nails
- Lower extremity cool to the touch
- Skin pallor or cyanosis
- Atrophic skin and hair loss
- Dependent rubor
- Erectile dysfunction
- Slow or nonhealing wounds (severe PAD)
- Absent or weak pedal pulses (severe PAD)
- Leg rest pain (severe PAD)
- Atypical complaints: impaired exercise tolerance, joint pain

Tests^{1,2,3,4,5,8,9}

- Lipid panel, fasting blood glucose or HbA1c
 - Assists in managing risk factors associated with PAD (e.g., dyslipidemia, diabetes).
- Doppler ultrasonography
 - Used when peripheral pulses aren't palpable.
- Ankle-brachial index (ABI)
 - Determines severity of circulation; abnormal is ≤ 0.9 , severe is ≤ 0.4 .
 - Factors that may cause inaccurate readings: older age, diabetes, and end stage renal disease.
- Toe-brachial index (TBI)
 - Order this test when ABI is inconclusive. Reading of < 0.7 is consistent with PAD.
- Arterial duplex ultrasound
 - Provides an overview of the location and severity of PAD.
- Exercise ABI testing
 - Reserved in individuals with symptoms consistent with PAD but with normal resting ABI.
- Computed tomography (CT) or magnetic resonance angiography (MRA)
 - Reserved in individuals who are planning for surgical or endovascular revascularization.

Treatment & Management^{1,2,3,5,6,7,8,9,10}

- **Nonpharmacological and nursing interventions:**
 - Encourage lifestyle changes.
 - Get involved in an exercise program (e.g., at least 3 walking sessions/week).
 - Healthy eating (low-fat diet).
 - Weight loss.
 - Advise smoking cessation (*nicotine is a vasoconstrictor*).

- Encourage daily foot inspections and provide foot care, especially diabetics.
 - Advise not to walk barefoot.
 - Important to stay clean to prevent infections.
- Reinforce measures to prevent pressure injury.
 - Look over bony prominences for ulcers; if not treated, can develop into gangrene, requiring amputation.
- Advise against using drugs that lead to vasoconstriction (e.g., pseudoephedrine).
- **Pharmacological and other interventions:**
 - Identify and treat reversible risk factors of PAD.
 - Treat the hypertension (*to improve tissue perfusion*), dyslipidemia, and diabetes (goal HgA1c of 7%).
 - Antiplatelet therapy (i.e., aspirin [Bayer, Bufferin, Ecotrin] or clopidogrel [Plavix])
 - Example: aspirin 81 mg PO daily (max: 325 mg/day).
 - If allergic to aspirin, use clopidogrel 75 mg daily.
 - These do not improve claudication symptoms, however they reduce cardiovascular and cerebrovascular events.
 - Monitor for upset stomach and bleeding.
 - Agents used for claudication relief (lifestyle limiting)
 - Cilostazol (Pletal) or pentoxifylline.
 - *Cilostazol is more effective than pentoxifylline.*
 - Example: cilostazol 100 mg PO BID. It can be combined safely with an antiplatelet.
 - Cilostazol improves walking distance in those with intermittent claudication.
 - Cilostazol may promote fluid retention and exacerbate heart failure.
 - Discontinue if no clinical improvement (i.e., walking distance) seen in about 3 months.
 - Statin therapy (e.g., atorvastatin [Lipitor], rosuvastatin [Crestor])
 - Example: Start atorvastatin 20-40 mg daily (max: 80 mg/day).

Cardiovascular

- These should be started on all patients with confirmed PAD.
- Reduce cardiovascular or cerebrovascular events, improve claudication symptoms, and slow the advancement of PAD.
- Musculoskeletal complaints can occur and are dose dependent; liver toxicity is uncommon.
- ACE inhibitors (ACEI) (e.g., captopril [Capoten], lisinopril [Zestril, Prinivil], ramipril [Altace])
 - Example: ramipril (Altace) 10 mg PO daily.
 - Provides some relief with claudication symptoms.
 - Monitor for hyperkalemia, dry cough, renal impairment.
- Beta blockers (e.g., atenolol [Tenormin], propranolol [Inderal])
 - These are used to reduce cardiovascular risk factors, especially in those with coronary artery disease or heart failure.
 - Avoid in severe PAD.
- Vascular consultation/referral
 - Refer patients with leg pain despite medical therapy and/or evidence of critical limb ischemia or gangrene (for consideration of surgical revascularization or amputation).
- Podiatry referral
 - Refer diabetic patients for routine nail care.

NOTE: Beers listed items, as mentioned above, include cilostazol and aspirin (if dose > 325 mg/day). Avoid routine prescribing of an ACEI with a potassium-sparing diuretic.

Differential Diagnosis^{1,9}

- Deep vein thrombosis: Unilateral leg will have swelling or tenderness; will have thromboembolic risk factors such as immobility, malignancy, recent major surgery.

- In comparison to PAD, most patients are asymptomatic; will not typically have leg swelling. Strong risk factors include diabetes and tobacco smoking.
- Peripheral neuropathy: Will have numbness or tingling sensation distally in an extremity. In comparison to PAD, patients will not typically have numbness or tingling sensation (most are asymptomatic).
- Musculoskeletal disorders (e.g., arthritic knees or hips): Achy pains will be noted with activity or exertion; ABI testing will be normal. In comparison to PAD, X-ray of affected joint would be negative. ABI testing would be abnormal ≤ 0.9 .

CLINICAL PEARLS^{1,3,8,9}

- Risk factor modification is key to slow the advancement of PAD and prevent future acute coronary syndrome or strokes.

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Venous Thromboembolism

Definition^{1,2,3,4,5,6,7}

Venous thromboembolism (VTE) is a thrombus that forms in the veins and includes two types: deep vein thrombosis (DVT) and pulmonary embolism (PE). DVT occurs when a thrombus arises in the deep veins, most commonly in the lower extremities. Thrombus in the lower extremity (*usually more proximal DVTs*) can dislodge and travel into the pulmonary arteries, which is a pulmonary embolus (PE).

Causes^{3,4,5,6,7}

- Virchow's triad
 - Vascular endothelial injury
 - Associated with some medications, surgery, trauma, smoking.
 - Venous stasis
 - Associated with prolonged immobility, heart failure.
 - Hypercoagulability
 - Associated with malignancies, smoking, volume depletion, sepsis.

Risk Factors^{1,2,3,4,5,6,7}

- Advanced age
- Recent hospitalization

Cardiovascular

- Major surgery (e.g., hip or knee arthroplasty)
- Immobility
- Trauma
- Malignancy
- Infection or sepsis
- Heart failure exacerbation
- Obesity
- Travel
- Prior VTE
- Presence of central venous catheter
- Some medications (e.g., hormone therapy, erythropoietin, tamoxifen,³ chemotherapy treatment)
- Inherited (e.g., factor V Leiden, protein C or S deficiency)
- Antiphospholipid antibodies
- Myeloproliferative disorders
- Smoking

Signs & Symptoms^{1,2,3,4,5,6,7}

Table 3-2 Comparing Signs & Symptoms of DVT and PE

Deep Vein Thrombosis (DVT)	Pulmonary Embolism (PE)
Many are asymptomatic	Many are asymptomatic
Extremity or calf pain	Confusion
Extremity edema	Pleuritic chest pain
Extremity erythema and warmth	Dyspnea
Homans sign (lacks sensitivity and specificity)	Cough (usually nonproductive, however may have hemoptysis)
	Palpitations
	Presyncope or syncope
	Abnormal vital signs (tachycardia, tachypnea, hypoxemia)

Tests^{1,2,3,5,6,7}

- No lab studies are specific enough to diagnose VTE.
 - Positive D-dimers aren't helpful; they are positive in older adults, infections, and recent surgery. A negative D-dimer ($< 0.4 \mu\text{g/mL}$) however excludes VTE.
- Duplex ultrasound, venous
 - Test of choice to diagnose a DVT. If test is negative and clinical suspicion still remains high, repeat test in about a week.
- Computed tomography pulmonary angiogram (CTPA)
 - Most commonly ordered to diagnose an acute PE. Although pulmonary angiography is the gold standard for diagnosis, CTPA is less invasive.
- Ventilation-perfusion (V/Q) lung scanning
 - Used to diagnose acute PE. Order this if CT contrast is contraindicated.
- Chest radiography
 - Most will be normal in acute PE; used to identify other causes of dyspnea, such as pneumonia.
- Calculate Wells criteria
 - Aids in assessing the possibility of DVT or PE presence.

Treatment & Management^{2,3,4,8,9,10,11,12,13,14}

- **Send patient to the hospital, if appropriate.**
 - Abnormal vital signs or presumed massive PE for workup and management (e.g., thrombolytic therapy, vasopressors, fluid resuscitation).
 - Most patients with VTE can be safely treated as outpatients, including those with low-risk PE.
- **Nonpharmacological and nursing interventions:**
 - Offer warm heat to the affected leg (DVT).
 - Relieves pain and inflammation.

Table 3-3 Model for Determining Clinical Suspicion of DVT
Model for Determining a Clinical Suspicion of Pulmonary Embolism (PE)

VARIABLES	POINTS*
Clinical signs and symptoms of deep vein thrombosis (minimum of leg swelling and pain with palpitation of the deep veins)	3.0
An alternative diagnosis is less likely than pulmonary embolism (PE)	3.0
Heart rate > 100 beats/min	1.5
Immobilization of surgery in the previous 4 wk	1.5
Previous deep vein thrombosis/pulmonary embolism	1.5
Hemoptysis	1.0
Malignancy (treatment ongoing or within previous 6 mo or palliative)	1.0
Total points	

*Total score ≤ 4 indicates PE unlikely; score > 4 indicates PE likely.

Johnson, S. A., & Rondina, M. T. (2017). Coagulation disorders. In *Hazzard's Geriatric Medicine and Gerontology (7th ed.)*. New York, NY: McGraw-Hill; Table 106-1.

- Encourage patient to not massage the calf region.
 - This helps to prevent thrombus from dislodging.
- Monitor for bleeding (effects of anticoagulation therapy).
- Encourage lifestyle changes, including:
 - Encourage smoking cessation (causes vasoconstriction, which promotes clotting).
 - Maintain healthy weight.
 - Maintain euvolemic status (dehydration is associated with hypercoagulability).
 - Encourage early ambulation given this is effective for postthrombotic syndrome (compression stockings have *not* been shown to prevent this).
- Educate patient on anticoagulation therapy.
 - Stress the importance of taking medications as prescribed.

Table 3-4 Model for Determining Clinical Suspicion of PE
Model for Determining Clinical Suspicion of Deep Vein Thrombosis

VARIABLES	POINTS*
Active cancer (treatment ongoing or within previous 6 mo or palliative)	1
Paralysis, paresis, or recent plaster immobilization of the lower extremities	1
Recently bedridden ≥ 3 days or major surgery within the past 4 wk	1
Localized tenderness along the distribution of the deep venous system	1
Entire leg swollen	1
Affected calf 3 cm greater than asymptomatic calf (measured 10 cm before tibial tuberosity)	1
Pitting edema confined to the symptomatic leg	1
Dilated superficial veins (nonvaricose)	1
Previous deep vein thrombosis (DVT)/pulmonary embolism	1
Alternative diagnosis is at least as likely as that of deep vein thrombosis	-2
Total points	

*Total score 2-4 indicates DVT unlikely; score ≥ 5 indicates DVT likely.

Johnson, S. A., & Rondina, M. T. (2017). Coagulation disorders. In *Hazzard's Geriatric Medicine and Gerontology* (7th ed.). New York, NY: McGraw-Hill; Table 106-2.

- Explain the importance of having routine INRs checked, while on warfarin. Provide education on vitamin K-rich foods while taking warfarin.
- Educate patients to monitor for complications, such as bleeding.
- **Pharmacological and other interventions:**
 - Direct-acting oral anticoagulant (DOAC) (e.g., apixaban [Eliquis], edoxaban [Savaysa], rivaroxaban [Xarelto], dabigatran [Pradaxa])

- Example: apixaban 10 mg PO BID for a week, then 5 mg PO BID.
 - Dose is changed to 2.5 mg PO BID, if age is > 80 years, weight is < 132 lbs. or serum creatinine > 1.5.
- These are recommended over warfarin in acute VTE *without* cancer.
- Compared to warfarin, these agents require no regular monitoring, no dietary restrictions, have fewer drug interactions, and cause less bleeding.
- Adjustment of dose may be required due to renal impairment. They are also more expensive.
- Warfarin (Coumadin, Jantoven)
 - Example: warfarin 5 mg PO daily.
 - Can be used in VTE not associated with cancer, although the DOACs are preferred.
 - Monitor INR closely (goal of 2.0–3.0); bleeding risk increases with certain drugs such as antibiotics, antifungals, and NSAIDs. Consumption of foods with vitamin K should be kept consistent.
- Low-molecular-weight heparin (LMWH) (e.g., dalteparin [Fragmin], enoxaparin [Lovenox]).
 - Example: enoxaparin 1 mg/kg subQ q12 hrs
 - Adjust dose if CrCl < 30/min (bleeding risk)
 - LMWH is preferred over warfarin and DOACs in the setting of cancer-related VTE.
 - These are added to the regimen for **5** days if initially using warfarin, dabigatran, or edoxaban.
 - Will need to be added with warfarin until INR has been therapeutic (> 2.0) for 24 hrs.
 - If unable to use a LMWH, switch to unfractionated heparin, which is preferred in the setting of severe renal impairment.
 - In patients with recurrent VTE who are already on an oral anticoagulant (i.e., warfarin or DOAC), LMWH should be used instead. If another VTE occurs while on LMWH, increase the dose by at least 25%.

- Anticoagulation duration.
 - Therapy is individualized (while also considering bleeding risk); in circumstances such as cancer, long-term anticoagulation is appropriate.
 - Lifelong treatment recommended if VTEs are unprovoked and/or if VTEs return for a second time.
 - Three months is recommended for VTEs that are provoked.
- Inferior vena cava filter.
 - Used when patient cannot tolerate anticoagulation (such as bleeding risk). Not to be used while taking an anticoagulant.
- **Patient scenarios:**
 - Distal DVT: Treated *only* if symptomatic. If no symptoms are present, monitor and repeat imaging in 2 weeks. Treat for 3 months (DOACs preferred), if repeat imaging shows DVT extension or with severe symptoms.
 - Superficial venous thrombosis: 4–6 weeks of fondaparinux (preferred) or LWMH should be considered, especially if is above the knee (close to the greater saphenous vein)
 - Subsegmental pulmonary embolism: No anticoagulation needed if recurrence unlikely and absence of a DVT. These patients should instead be closely monitored
 - Arm DVT: If caused by central venous catheter, do not remove patent catheter if needed for further use. Continue anticoagulation until three months after catheter discontinued.

NOTE: Beers listed items, as mentioned above, include enoxaparin and oral anticoagulants. If taking warfarin plus amiodarone or an NSAID, monitor INRs closely.

Differential Diagnosis^{1,3,5,6}

- Baker cyst: Pain will be acute in the calf region and ultrasound will confirm cyst. Compared to a DVT, many will be asymptomatic and ultrasound would have different findings.

- Cellulitis: Fever and/or leukocytosis may be present. Compared to a DVT, clinical leg findings (e.g., swelling) are more pronounced in DVT and not typical to have infectious findings.
- Pneumonia: May have productive sputum with fever; will have a positive sputum culture and leukocytosis. Compared to a PE, cough is common, however usually nonproductive. White blood count (WBC) is not typically elevated.

CLINICAL PEARLS^{2,3,8,9,11}

- Anticoagulation duration is individualized; consider the risk of bleeding, risk of falls, cost of medication, life expectancy, risk of VTE recurrence, and patient adherence to medication.
- Factors that increase the risk of bleeding while taking anticoagulation therapy: frequent falls, impaired liver or renal function, history of bleeding, concomitant use of an NSAID or antiplatelet, and age > 65–75 years.
- Periodically (at least annually) reassess the risks versus benefits of anticoagulation. If anticoagulation is stopped, low-dose aspirin can be used for treatment of recurrent VTE (although not as effective).

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