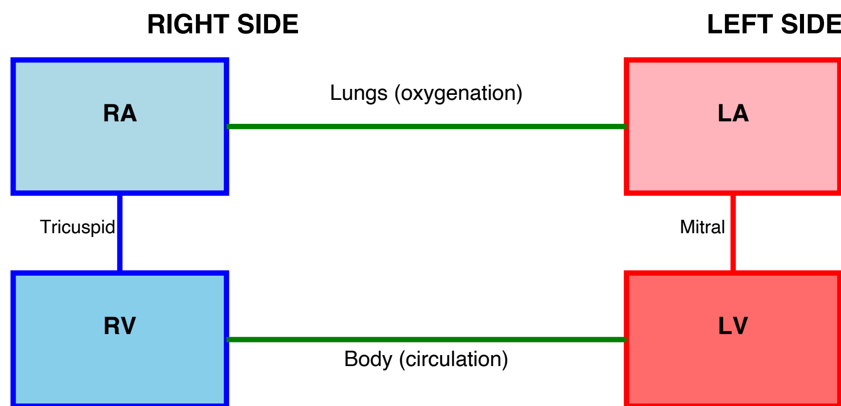
CHAPTER 2: CARDIOVASCULAR

Heart Anatomy and Physiology

Heart Structure and Function



Coronary Artery Disease (CAD) and Angina

- Narrowing of coronary arteries from atherosclerotic plaque reducing blood flow to heart muscle
- Stable angina: predictable chest pain with exertion, relieved by rest or nitroglycerin
- Unstable angina: chest pain at rest or with minimal exertion, indicates plaque rupture and clot formation
- Myocardial infarction (MI): complete vessel occlusion with myocardial necrosis
- NSTEMI (non-ST elevation MI): partial vessel occlusion, elevated troponin, ST depression/T wave changes
- STEMI (ST-elevation MI): complete vessel occlusion, ST elevation on EKG, requires urgent revascularization

CLINICAL PEARL

CHEST PAIN RED FLAGS: STEMI, NSTEMI, unstable angina, aortic dissection, pulmonary embolism, tension pneumothorax, pericarditis. Always obtain EKG within 10 minutes.

Acute Coronary Syndrome (ACS) Management

- Immediate: aspirin 325 mg, nitroglycerin (if SBP >90), oxygen if hypoxic, IV access
- EKG: STEMI → urgent PCI (percutaneous coronary intervention) or fibrinolysis
- NSTEMI/unstable angina: dual antiplatelet (aspirin + P2Y12 inhibitor: clopidogrel, ticagrelor, prasugrel), anticoagulation (heparin, enoxaparin)
- Long-term post-MI: aspirin, P2Y12 inhibitor (12 months), beta-blocker, ACE inhibitor, statin

Hypertension

Blood Pressure Classification

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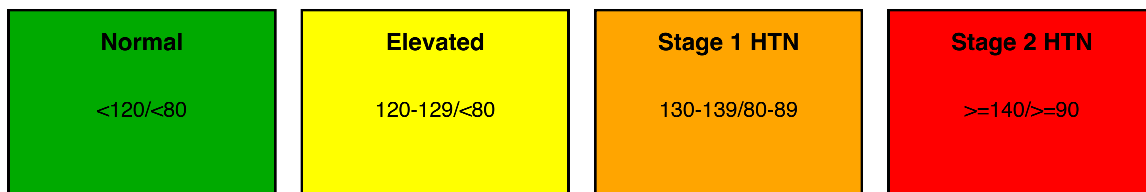


Systolic/Diastolic mmHg

- Normal: <120/<80 mmHg
- Elevated: 120-129/<80 mmHg
- Stage 1 HTN: 130-139/80-89 mmHg
- Stage 2 HTN: >=140/>=90 mmHg
- Hypertensive crisis: >=180/>=120 with symptoms or organ damage

Hypertension Treatment

MNEMONIC: First-Line Antihypertensives: ACEB

ACE inhibitors (lisinopril, enalapril) | Calcium channel blockers (amlodipine, diltiazem) | Estrogen avoidance (OCPs/HRT can raise BP) | Blockers - beta-blockers (metoprolol, atenolol), alpha-blockers (doxazosin) | Bonus: Thiazide diuretics (HCTZ, chlorthalidone)

- Lifestyle: weight loss, DASH diet, reduce sodium (<2300 mg/day), limit alcohol, exercise
- Pharmacotherapy: start one agent, titrate to goal, add second if needed

CLINICAL PEARL

ACE inhibitors and ARBs provide cardiac protection in diabetics and heart failure patients - preferred choices. Thiazide diuretics effective but worsen glucose control and lipids.

Heart Failure

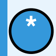
Heart Failure Pathophysiology and Classification

- Systolic HF (reduced ejection fraction, HFrEF, EF <40%): impaired LV contraction from MI, hypertension, cardiomyopathy
- Diastolic HF (preserved EF, HFpEF, EF >50%): LV stiff, cannot relax/fill properly, often from chronic HTN, obesity
- Forward failure: inadequate cardiac output leading to fatigue, hypotension
- Backward failure: fluid backup causing congestion - pulmonary (shortness of breath) or systemic (edema)

Acute Decompensated Heart Failure

- Presentation: shortness of breath, orthopnea (breathing difficulty when lying flat), PND (paroxysmal nocturnal dyspnea), peripheral edema, weight gain
- Diagnosis: BNP or NT-proBNP elevated, chest X-ray shows pulmonary edema, echocardiogram assesses EF
- Treatment: diuretics (furosemide IV for acute), vasodilators (nitroglycerin), inotropes if cardiogenic shock

Chronic Heart Failure Management



MNEMONIC: HF Medications - ACEI & ARB & Beta & Diuretics

ACE inhibitor (lisinopril) or ARB (losartan) - foundational | Add Beta-blocker (carvedilol, metoprolol) | Add Diuretic (furosemide, torsemide) | Aldosterone antagonist (spironolactone) if reduced EF | ARNI (sacubitril/valsartan) replacing ACE-I

- Devices: pacemakers for bradycardia, ICDs (implantable cardioverter-defibrillators) for arrhythmia/sudden death prevention
- Referral to cardiology if EF <40%, difficult to manage, or considering device therapy

Arrhythmias

Atrial Fibrillation (AFib)

- Chaotic atrial electrical activity causing irregular ventricular response
- Presentation: palpitations, dyspnea, chest discomfort, may be asymptomatic
- Major complication: stroke risk from atrial clot formation (5x higher than sinus rhythm)
- CHA2DS2-VASc score: predicts stroke risk, guides anticoagulation decision

- Treatment: rate control (beta-blocker, calcium channel blocker, digoxin) vs rhythm control (antiarrhythmics, cardioversion)
- Anticoagulation: warfarin or DOAC (dabigatran, rivaroxaban, apixaban, edoxaban) if CHA2DS2-VASc >= 1 (or 2+ in females)

Ventricular Arrhythmias

- Premature ventricular contractions (PVCs): early beats from ventricle, usually benign if infrequent
- Ventricular tachycardia (VT): rapid ventricular rate, can degenerate to ventricular fibrillation (VF)
- Ventricular fibrillation: complete disorganization of ventricular electrical activity, no cardiac output = cardiac arrest

> **WARNING**
> VT/VF = MEDICAL EMERGENCY. ACLS protocol: CPR, defibrillation, epinephrine, antiarrhythmics (amiodarone)

Supraventricular Tachycardia (SVT)

- Rapid regular heart rate originating above ventricles (atrial or AV nodal)
- Treatment acute: vagal maneuvers (Valsalva), adenosine IV (causes transient AV block), calcium channel blockers
- Chronic: beta-blockers, calcium channel blockers, ablation for refractory cases

Heart Murmurs and Valvular Disease

Murmur Characteristics and Types

> **MNEMONIC: APE To MAN - From APE to MAN Heart Sound Evolution**
> Aortic stenosis (APE-harsh crescendo-decrescendo) | Pulmonic stenosis (similar harsh ejection) | Ejection click (pop before whoosh) | Tricuspid regurgitation (holosystolic) | Mitral regurgitation (holosystolic blowing - MAN sound) | Aortic regurgitation (diastolic decrescendo) | Note: Systolic = APE, Diastolic/Regurg = MAN

- Systolic murmurs: occurring during ventricular contraction
- Diastolic murmurs: occurring during ventricular relaxation/filling
- Continuous murmurs: throughout systole and diastole

Mitral Stenosis

- Narrowed mitral valve orifice reducing LV filling from mitral leaflet fibrosis/calcification
- Often from rheumatic heart disease (following untreated strep throat)
- Presentation: dyspnea, orthopnea, AFib, pulmonary edema
- Diagnosis: echocardiogram shows reduced mitral valve area

- Treatment: diuretics, beta-blockers for rate control, anticoagulation if AFib present, surgical valve repair/replacement if severe

Mitral Regurgitation

- Incompetent mitral valve allowing blood backflow into left atrium during systole
- Acute MR: post-MI papillary muscle rupture causing sudden cardiogenic shock
- Chronic MR: progressive LV dilation and dysfunction
- Treatment: afterload reduction (vasodilators, ACE-I), diuretics, surgical repair/replacement if severe

Aortic Stenosis

- Narrowed aortic valve orifice obstructing LV outflow
- Most common valvular lesion in developed countries, often from calcific degeneration in elderly
- Classic triad: angina, syncope (fainting from inadequate cerebral perfusion), dyspnea
- Diagnosis: echocardiogram shows reduced valve area, high gradients

WARNING

CRITICAL: Avoid vasodilators in AS - can cause sudden hemodynamic collapse. Surgical valve replacement indicated for symptomatic severe AS. TAVR (transcatheter aortic valve replacement) option for some patients.

Aortic Regurgitation

- Incompetent aortic valve allowing diastolic backflow into left ventricle
- Acute AR: aortic dissection, infective endocarditis - hemodynamically unstable
- Chronic AR: LV eccentric hypertrophy and progressive dilation
- Treatment: afterload reduction essential (ACE-I, ARBs), surgical repair/replacement if severe

Stage 1 hypertension is defined as BP ___/___ to ___/___.

Answer: 130/80 to 139/89

PRACTICE QUESTION

A 55-year-old man with diabetes and BP 145/92. What is most appropriate first-line?

A) Metoprolol
B) Lisinopril
C) Amlodipine
D) Hydrochlorothiazide

Answer: B

PRACTICE QUESTION

Which heart murmur is harsh crescendo-decrescendo at right upper sternal border?

A) Mitral regurgitation

B) Aortic stenosis

C) Mitral stenosis

D) Aortic regurgitation

Answer: B