CARDIOVASCULAR DISEASE

STUDENT HANDOUT

2022

- Atherosclerosis:
  - Begins as soft deposits of fat that harden with age
  - Referred to as “hardening of arteries”
  - Atheromas (fatty deposits) prefer coronary arteries

Coronary Artery Disease:
Etiology and Pathophysiology

- Atherosclerosis is major cause of CAD
  - Characterized by lipid deposits within the intima of arteries
  - Endothelial injury and inflammation play major role in development
- Chronic Endothelial Injury:
  - HTN
  - Tobacco use
  - HLD
  - Hyperhomocysteinemia
  - DM
  - Infections
  - Toxins

- C-reactive Protein (CRP)
  - Protein produced by liver
  - Nonspecific marker of inflammation
  - Increased in patients with CAD
  - Chronic exposure to CRP linked with unstable plaques and oxidation of LDL cholesterol
  - Further contributes to atherosclerosis

Developmental Stages of CAD

- **Fatty Streak**
  - Earliest lesion of atherosclerosis
  - Lipids accumulate and migrate into smooth muscle cells
  - Can be seen in coronary arteries by age _____and increase in size as person ages
  - Tx that lowers LDL can help reverse this.
- **Fibrous Plaque**
  - Beginning of progressive changes in the endothelium of arterial walls
  - Appears in coronary arteries by age _____
  - Collagen covers the fatty streak
  - Vessel lumen is narrowed
  - Blood flow reduced
  - Fissures can develop
- **Complicated Lesion**
  - Final and most dangerous stage of development of atherosclerosis
  - Fibrous plaque grows and continued inflammation results in plaque instability
  - Plaque _____
  - Platelet thrombus formation
  - Further narrowing or total occlusion of blood vessel

Collateral Circulation

- Arterial anastomoses (connections) within coronary circulation
- Increased with _____
- May be inadequate with rapid onset CAD

Risk Factors For CAD

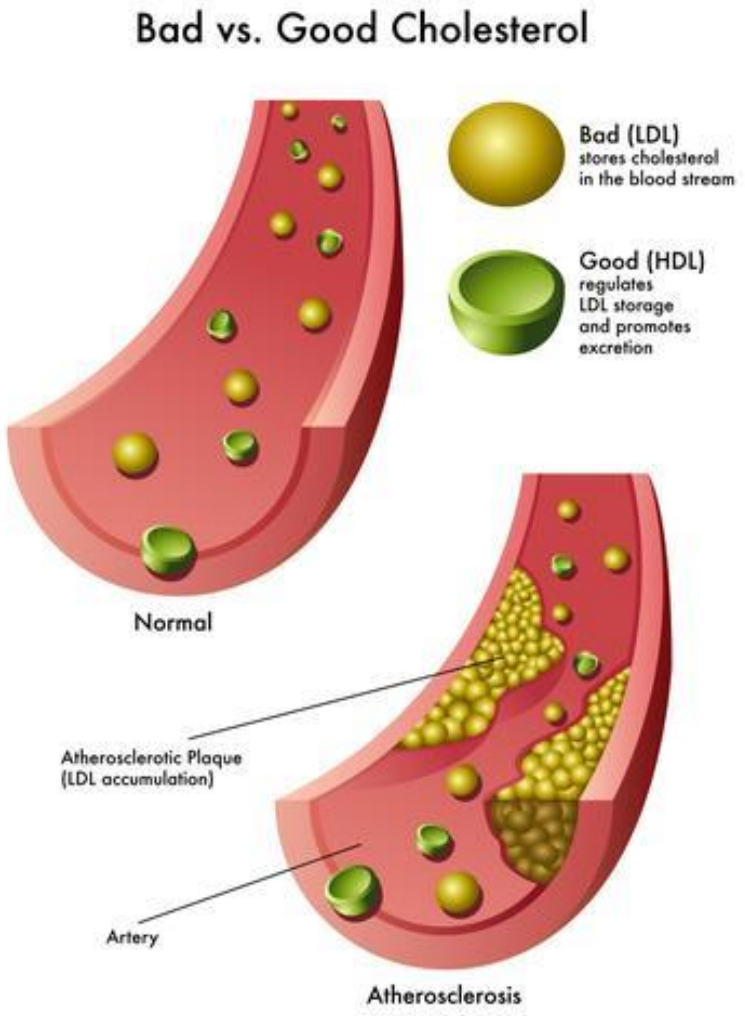
Nonmodifiable risk factors

- Age
- Gender
- Ethnicity
- Family History
- Genetic Predisposition

Risk Factors For CAD

Major modifiable risk factors

- Elevated serum lipids
  - Cholesterol >200mg/dL
  - Triglycerides >150mg/dL
  - HDL
  - LDL



Risk Factors For CAD

Major modifiable risk factors

- Hypertension
  - >_____mmHg
  - Goal for > age 60 is <150/90 mmHg
  - Begin lifestyle changes for prehypertension
  - Treat hypertension with drugs

Risk Factors For CAD
Major modifiable risk factors

- Tobacco Use
  - Increased catecholamine release
  - Increases LDL, Decreases HDL, Increases oxygen radicals
  - Increases Carbon monoxide
- Second-Hand Smoke

Risk Factors For CAD
Major modifiable risk factors

- Physical Inactivity
- Obesity

- Diabetes Mellitus
- Metabolic Syndrome
- Psychologic States
- Homocysteine level
- Substance abuse

Nursing and Interprofessional Care: Health promotion

Identification of High-Risk Clients

- Health history
- Family history
- Presence of CV symptoms
- Environmental patterns- diet, activity
- Psychosocial history- ETOH, tobacco, drugs, stressful events, exposure to pollutants or toxins
- Values and beliefs about health and illness- may affect how disease is treated or compliance to treatment

Nursing and Interprofessional Care: Health promotion

- Manage high-risk clients by controlling modifiable risk factors
- Encourage lifestyle changes
  - Education
  - Clarify personal values
  - Set REALISTIC goals
- Physical Fitness
  - FITT formula- 30 minutes most days plus weight training 2 days a week
  - Regular physical activity contributes to:
    - Weight reduction
    - Reduction of >10% in systolic BP
    - Increase HDL cholesterol

Nursing and Interprofessional Care: Health promotion

- Nutritional Therapy
  - Decrease saturated fats and cholesterol
    - Lower fat milks, milk alternatives
  - Increase complex carbohydrates and _____
    - Whole grains, whole fruits and vegetables
  - Decrease red meat, egg yolks, and whole milk
  - Increase Omega-3 fatty acids

Nursing and Interprofessional Care: Health promotion

- Lipid-lowering drug therapy
  - Drug therapy started if diet and exercise are ineffective
  - Drugs that restrict lipoprotein production
    - Statins (atorvastatin, simvastatin, pravastatin)
      - Inhibit cholesterol synthesis, decrease LDL, increase HDL
      - Monitor for liver damage and myopathy
- Niacin (Niaspan)
  - Water soluble B vitamin
  - Highly effective in lowering LDL and triglyceride levels by inhibiting synthesis
  - Increases HDL
  - SE: flushing, purities, GI side effects, orthostatic hypotension
- Fibric Acid Derivatives (Lopid)
  - Works by removal of VLDLs and increasing production of apolipoproteins.
  - Decreases triglycerides and increases HDL
  - SE: GI irritability

Nursing and Interprofessional Care: Health promotion

- Drugs that increase lipoprotein removal
  - Bile acid sequestrants
    - Increase conversion of cholesterol to bile acids
    - GI side effects
    - Can bind to other drugs and decrease absorption and effectiveness
      - Warfarin, thiazides, thyroid hormones, beta-adrenergic blockers
      - Separate the time of administration of these drugs

- Drugs that decrease cholesterol absorption
  - Ezetimibe (Zetia)
    - Decrease absorption of dietary and biliary cholesterol

Nursing and Interprofessional Care: Health promotion

- Antiplatelet therapy
  - Aspirin
    - Used unless contraindicated
    - Recommendation for men and women 45+
  - Clopidogrel (Plavix)
    - Used in women when ASA is contraindicated or poorly tolerated
    - Women 65+
    - Benefit for MI prevention outweighs risk of GI bleed or hemorrhagic stroke

Gerontologic Considerations: CAD

- Increased incidence and mortality associated with CAD in older adults
- Strategies to reduce risk and treat CAD are effective
- Treat HTN and high lipids
- Smoking cessation
- Modifications for physical activity
  - Longer warm up
  - Longer periods of low-intensity activity
  - Longer rest periods
  - Avoid extremes in temperature
  - 30 min minimum most days as able
- Most likely to change previous habits when hospitalized or symptomatic.

Clinical Manifestations of CAD: Angina

- Chronic and progressive disease
- O2 demand > O2 supply → myocardial ischemia
- Angina= clinical manifestation (symptom)
  - Occurs when arteries are _____blocked
  - 50% or more for left main coronary artery

- Intermittent chest pain
- Occurs over long period of time
- Same pattern of onset, duration, and intensity of symptoms
- Few minutes in duration
- ST segment depression and/or T wave inversion on 12-lead EKG
- Controlled with drugs
  - Calcium channel blockers decrease the spasms of the coronary arteries

Silent Ischemia	Prinzmetal's (variant) Angina	Microvascular Angina
• Occurs in absence of subjective symptoms • Associated with diabetic neuropathy • Confirmed EKG changes	• Rare • Occurs at rest, not increased with physical demand • Seen in clients with h/o migraine headaches, Raynaud's phenomenon, and heavy smoking (all things that cause vasoconstriction/vasospasms) • Spasm of a major coronary artery- result of increased intracellular calcium • CAD may or may not be present	• Occurs in the absence of significant CAD or coronary spasm of a major coronary artery • CP is r/t myocardial ischemia associated with atherosclerosis or spasm of small distal branch vessels (microvasculature of coronary arteries) • Prevention and treatment follows CAD recommendations

Chronic Stable Angina: Types of angina

Chronic stable angina:
Interprofessional care

Goal: decrease _____and/or increase _____

Short-acting nitrates

- Dilate peripheral and coronary blood vessels
- Give sublingually or by spray
- If no relief in 5 min- get to comfortable position, apply O2, call EMS
- If some relief- repeat q5 min for max of _____
- Patient teaching
- Can use prophylactically

Long-acting nitrates

- To reduce angina incidence
- Main SE: headache, orthostatic hypotension
- Methods of administration:
  - Oral
  - NTG (2%) ointment
  - Transdermal controlled-release NTG

Chronic stable angina:
Interprofessional Care

- Angiotensin Converting Enzyme inhibitors (ACE)
  - Lisinopril (-PRIL family)
- Angiotensin Receptor Blockers (ARBs)
  - Losartan (-SARTAN family)
- Beta-Blockers
  - Carvedilol, metoprolol, bisoprolol (-OLOL family)
- Calcium Channel Blockers
  - Amlodipine, nicardipine, nifedipine (-IPINE family)
  - Diltiazem and Verapamil (outliers of -IPINe family)
- Lipid-lowering drugs
  - Sodium current inhibitor
    - Ranolazine (Ranexa)

Chronic stable angina: diagnostic studies

- Chest X-Ray
- 12-lead EKG
- Laboratory Studies
- Echocardiogram
- Exercise Stress Test
- Electron Beam Computed Tomography
- Coronary Computer Tomography Angiography

Chronic Stable Angina:
Treatment

Cardiac Catheterization/ Coronary Angiography

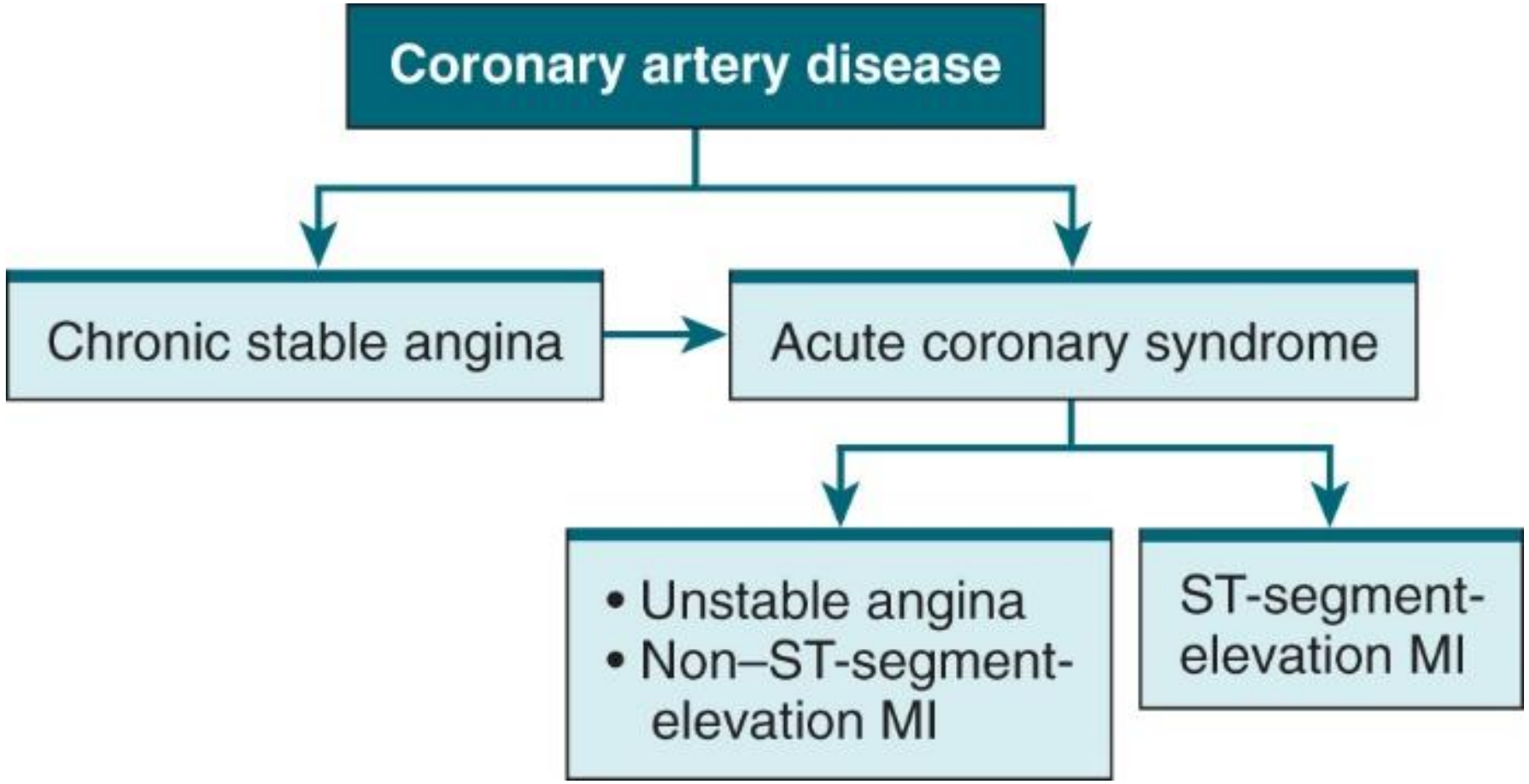
- Visualize blockages (diagnostic)
- Open blockages (interventional)
  - Percutaneous Coronary Intervention (PCI)
  - Balloon Angioplasty
  - Stent

Chronic Stable Angina: Treatment

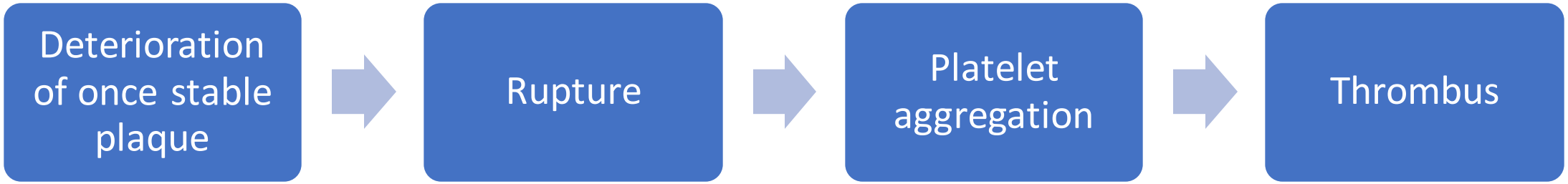
Alternative Therapies

- Enhanced External Counterpulsation (EECP)
  - Inflatable cuffs placed around legs
  - Increase venous return
  - Augment DBP
- Spinal Cord Stimulation

Acute Coronary Syndrome



Acute Coronary Syndrome:
Etiology and pathophysiology



- Result
  - Partial occlusion of coronary artery: UA or NSTEMI
  - Total occlusion of coronary artery: STEMI

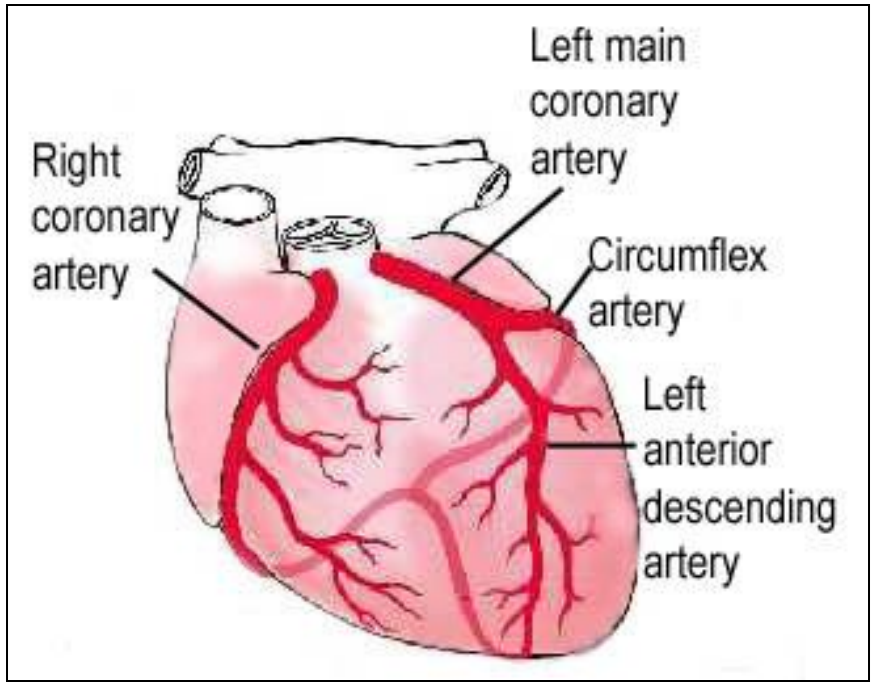
Clinical manifestations of ACS: unstable angina

- New onset
- Occurs at rest
- Increase in frequency, duration, or with less effort
- Pain lasting >/= 10 minutes
- Needs immediate treatment
- Symptoms in women often under-recognized

- 2 types:
  - ST-elevation and non-ST-elevation
  - Result of abrupt stoppage of blood flow through a coronary artery, causing irreversible myocardial cell death (necrosis)
    - Preexisting CAD
    - STEMI- occlusive thrombus
    - NSTEMI- non-occlusive thrombus

Area of MI in relation to coronary artery

Associated Coronary Artery	Left Ventricle Involvement
Left anterior descending	Septal wall
Left anterior descending	Anterior wall
Left anterior descending or circumflex	Lateral wall, low
Circumflex	Lateral wall high
Right coronary artery	Inferior wall



Clinical manifestations of Acs: myocardial infarction

Pain:

- Severe chest pain not relieved by rest, position change, or nitrate administration
  - Heaviness, pressure, tightness, burning, constriction, crushing
  - Substernal or epigastric
  - May radiate to neck, lower jaw, arms, back
- Often occurs early morning
- Atypical sites of pain in women and elderly
- No pain if cardiac neuropathy (diabetes)

Clinical Manifestations of ACS: Myocardial Infarction(MI)

Catecholamine Release and Stimulation of SNS

- Release of glycogen
- Diaphoresis
- Increased _____&_____
- _____ of peripheral blood vessels
- Skin: ashen, clammy, and/or cool to touch

Clinical manifestations of acs: myocardial infarction

Cardiovascular	GI	Immune

• Initially, increased HR and BP, then decreased BP (secondary to decrease in cardiac output)
• Crackles
• JVD
• Abnormal heart sounds
  • S3 or S4
  • New murmur
	• Nausea and Vomiting
	  • Reflex stimulation of the vomiting center by severe pain
	  • Vasovagal reflex
	  • Initiated from the area of infarct heart muscle
		• Fever
		  • Up to 100.4 F in first 24-48 hours
		  • May stay elevated for 4-5 days
		  • Systemic inflammatory process caused by heart cell death

Myocardial infarction: healing process

- Within 24 hours, leukocytes infiltrate the area of cell death
- Proteolytic enzymes of neutrophils and macrophages begin to remove necrotic tissue (by 4^{th} day= thin wall)
- Necrotic zone identifiable by EKG changes
  - Lowering of ST segments, T-wave inversion, pathologic Q wave
- Collagen matrix laid down
  - To form scar tissue

Myocardial infarction: healing process

- 10-14 days after MI, scar tissue is still weak
- Heart muscle vulnerable to stress
- Monitor client carefully as activity level increases

- By 6 weeks after MI, scar tissue has replaced necrotic tissue
  - Area is said to be healed, but less compliant
- Ventricular remodeling
  - Normal myocardium will hypertrophy and dilate in attempt to compensate for infarcted muscle
  - Can lead to development of late HF
    - ACE inhibitors given to limit remodeling

Complications of MI

Dysrhythmias

- _____complications
- Present in 80-90% of all MI patients
- Can be caused by ischemia, electrolyte imbalance, or SNS stimulation
- _____and _____are most common cause of death in the prehospitalization period

Heart failure

- Occurs when pumping power of heart has diminished
- Left-Sided HF
  - Mild dyspnea, restlessness, agitation, slight tachycardia initially
- Right-Sided HF
  - JVD, hepatic congestion, lower extremity edema

Complications of MI

Cardiogenic shock

- Occurs because of:
  - Severe LV failure, papillary muscle rupture, ventricular septal rupture, LV free wall rupture, RV infarction
- Requires aggressive management
  - High death rate

Papillary muscle dysfunction or rupture

- Causes mitral valve regurgitation
- Aggravates an already compromised LV leading to rapid clinical deterioration

Complications of MI

Left ventricular aneurysm

- Myocardial wall becomes thinned and bulges out during contraction
- Leads to HF, dysrhythmias, and angina

Ventricular septal wall rupture and left ventricular free wall rupture

- New, loud systolic murmur
- HF and Cardiogenic Shock
- Emergency repair
- Rare condition associated with high death rate

Complications of MI

Acute pericarditis

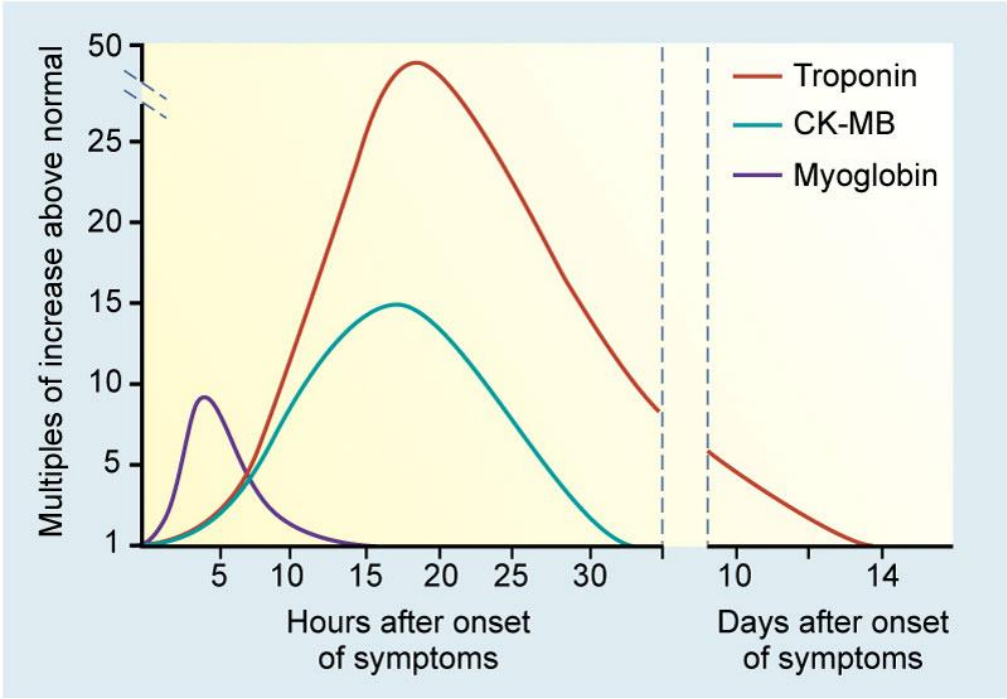
- Inflammation of visceral and/or parietal pericardium
- Mild to severe chest pain
  - Increases with inspiration, coughing, movement of upper body
  - Relieved by sitting in forward position
- Pericardial friction rub
- EKG changes

Dressler syndrome

- Pericarditis and fever that develops 1-8 weeks after MI
- Chest pain, fever, malaise, pericardial friction rub, arthralgia
- High dose ASA is tx of choice

Unstable angina and MI: diagnostic studies

- Detailed Health History
- 12-Lead EKG
  - Compare to previous EKGs
  - Changes in QRS complex, ST segment, and T wave
  - Distinguish between STEMI and NSTEMI
  - Serial EKGs reflect evolution of MI
- Serum Cardiac Biomarkers
  - Troponin T, Troponin I, Creatine Kinase, Myoglobin
  - Serial levels to see trend and differentiate between UA (all normal) and NSTEMI (abnormal)
- Coronary Angiography
  - STEMI only
- Pharmacologic Testing
  - Abnormal but non-diagnostic EKG and negative biomarkers



Interprofessional care: Acute coronary syndrome

Initial interventions:

- 12-Lead EKG
- Upright position
- Continuous oxygen- keep O2 sat _____%
- IV access
- Nitroglycerin (SL)
- ASA (chewable)
- High dose statin (atorvastatin if not already taking before)
- Morphine for _____

Interprofessional care: acute coronary syndrome

- Ongoing monitoring
  - Treat dysrhythmias
  - Frequent VS monitoring
  - Bedrest/limited activity for 12-24 hrs
- UA or NSTEMI
  - Dual antiplatelet therapy and heparin
  - Cardiac cath with PCI once stable
- STEMI
  - Reperfusion therapy (Emergent PCI)
    - Treatment of choice for confirmed STEMI
    - Goal: 90 minutes from door to cath lab
    - Balloon angiography and stent(s)
    - Many advantages over CABG

Interprofessional care:
acute coronary syndrome

- Thrombolytic Therapy:
  - Only for STEMI
    - Agencies that do not have cardiac cath resources
  - Given IV within 30 minutes of arrival to ED
  - Patient selection critical

- IV heparin to prevent re-occlusion

- Draw blood and start 2-3 IV sites
- Complete any invasive procedures prior
- Administer according to protocol
- Monitor closely for signs of bleeding
- Assess for signs of reperfusion
  - Return of ST segment to baseline is best sign

Interprofessional care:
acute coronary syndrome

Coronary Surgical Revascularization

- Indicated for the following patients
  - Failed medical management
  - Have left coronary artery or three-vessel disease
  - Are not candidates for PCI
  - Have failed PCI and continue to have chest pain
  - History of DM, LV dysfunction, CKD
- CABG and PCI are considered palliative tx for CAD, not a cure

Interprofessional care:
acute coronary syndrome

Traditional Coronary Artery Bypass Graft (CABG) Surgery

- Requires sternotomy and cardiopulmonary bypass
- Uses arteries and veins for grafts
  - Internal mammary artery is most commonly used as graft
  - May also use saphenous vein, radial artery, gastroepiploic artery and/or inferior epigastric artery

Nursing Management:
complications related to CPB

- Bleeding and anemia from damage to RBCs and platelets
- Fluid and electrolyte imbalances
- Hypothermia as blood is cooled as it passes through bypass machine
- Infections

Interprofessional care:
acute coronary syndrome

Minimally Invasive Direct Coronary Artery Bypass (MIDCAB)

- Indicated for the following patients:
  - Diseased LAD or RCA
- Does not involve sternotomy and CPB

Interprofessional care:
acute coronary syndrome

Off-Pump Coronary Artery Bypass (OPCAB)	Totally Endoscopic Coronary Artery Bypass (TECAB)	Transmyocardial Laser Revascularization
• Sternotomy but no CPB • Less blood loss • Less renal dysfunction • Less postop A-Fib • Fewer neurologic complications	• Uses robot to perform CABG • Done with or without CPB • If CPB used it is with femoral access • Used for limited bypass grafting • Increased precision • Smaller incisions • Decreased blood loss and pain • Shorter recovery time	• Indirect revascularization procedure • For patients who are not candidates for traditional surgery but need CABG • High energy laser is used to create channels in heart muscle to allow blood flow to ischemic areas • Can be done using left thoracotomy approach or in combination with CABG

Interprofessional care:
acute coronary syndrome

Drug Therapy

- IV Nitroglycerin
- Morphine
- Beta-Adrenergic Blockers
- ACE Inhibitors
- Antidysrhythmic Drugs
- Lipid-Lowering Agents
- Stool Softeners

Interprofessional care:
acute coronary syndrome

Nutritional Therapy

- Initially NPO
- Progress to:
  - Low salt
  - Low saturated fat
  - Low cholesterol

Nursing assessment:

Subjective Data

- Health History
  - CAD/ chest pain/ angina/ MI
  - Valve disease
  - HF/ cardiomyopathy
  - HTN, DM, anemia, lung disease, HLD
- Drugs
  - Antiplatelets/anticoagulants, nitrates, ACEs, Beta-blockers, CCBs, antiHTN drugs, lipid-lowering drugs, OTC and Herbals
- HPI
  - Events related to current illness, including tx and response
- Family history
- Indigestion/heart burn; N/V
- Urinary urgency or frequency
- Straining at stool
- Palpitations, dyspnea, dizziness, weakness
- Chest pain
- Stress, depression, anger, anxiety

Objective data

- Anxious, fearful, restless, distressed
- Cool, clammy, pale skin
- Tachycardia or bradycardia
- Pulsus alternans
- Pulse deficit
- Dysrhythmias
- S3, S4, high or low BP, murmur

Nursing management:
chronic stable angina and ACS

- Nursing Diagnoses:
  - Decreased cardiac output
  - Acute pain
  - Anxiety
  - Activity intolerance
  - Ineffective health management

- Overall goals
  - Relief of pain (ALWAYS 0/10 pain!)
  - Preservation of heart muscle
  - Immediate and appropriate treatment
  - Effective coping with illness-associated anxiety and initial denial of illness
  - Participation in rehabilitation plan
  - Reduction of risk factors

Nursing Management: chronic Stable Angina

Acute intervention

- Upright position
- Supplemental O2
- Assess VS
- 12-lead EKG
- NTG followed by opioid if needed
- Assess heart and breath sounds
  - Before and after getting out of bed
  - Most likely anxious with cool/clammy skin

Ambulatory care

- Provide reassurance
- Patient teaching
  - CAD and angina
  - Precipitating factors for angina
  - Risk factor reduction
  - Medication regimen

Nursing management:
acute coronary syndrome

Acute Care

- Pain: NTG, morphine, O2
- Continuous monitoring
  - ECG (telemetry)
  - ST segment
  - Heart and breath sounds
  - VS, SpO2, I&O
- Rest and Comfort
  - Balance rest and activity
  - Begin cardiac rehabilitation
- Anxiety reduction
  - ID source and alleviate
  - Patient teaching important
- Emotional and Behavioral reaction
  - Maximize social support systems
  - Consider open visitation

Nursing Management:
Coronary Revascularization: PCI

- Monitor for recurrent angina
- Frequent VS, including cardiac rhythm
- Monitor catheter insertion site for bleeding
- Neurovascular assessment of involved extremity
- Bed rest per institutional policy

Nursing Management:
Coronary Revascularization: CABG

- ICU for first 24-36 hours
- Pulmonary artery catheter
- Intraarterial line
- Pleural/mediastinal chest tubes
- Continuous ECG
- ET tube with mechanical ventilation
- Epicardial pacing wires
- Urinary catheter
- NG tube

Post-Op nursing care

- Assess for bleeding
- Monitor hemodynamic status
- Assess fluid status
- Replace blood and electrolytes PRN
- Restore temperature
- Monitor for A-fib (very common)
- Surgical site care
  - Artery/vein harvest site
  - Leg incisions
  - Chest incision
- Pain management
- DVT prevention
- Pulmonary hygiene
- Cognitive dysfunction

Nursing management: ambulatory care

- Cardiac rehabilitation
- Patient and caregiver teaching
- Physical activity
  - METs scale
  - Monitor heart rate
  - Low-level stress test before d/c
  - Isometric vs isotonic activities
  - Avoid outdoor activities in extremes of hot or cold
- Resumption of sexual activity
  - Teach when to discuss other physical activity
  - ED drugs are contraindicated with nitrates
  - Prophylactic _____ before sexual activity
  - When to avoid sex
  - Typically, 7-10 days post MI or when patient can _____

Nursing Management
Evaluation

Overall Expected Outcomes are that the patient with ACS:

1. Reports relief of pain _____
2. Maintains stable VS
3. Reports decreased anxiety and increased sense of self control
4. Achieves a realistic program of activity that balances physical activity with energy conserving activities
5. Describes the disease process, measures to reduce risk factors, and rehabilitation activities necessary to manage the therapeutic regimen

Sudden cardiac death

- Unexpected death from cardiac causes
  - Almost 400,000 annually
- Abrupt disruption in cardiac function resulting in loss of CO and cerebral blood flow
- Most commonly caused by:
  - Ventricular dysrhythmias
  - Structural heart disease
  - Conduction disturbances
- No warning signs or symptoms of MI
- Prodromal symptoms if associated with MI
  - CP, palpitations, dyspnea
  - Death usually within 1 hour of onset of acute symptoms

Sudden cardiac death: nursing/interprofessional care

- Diagnostic workup to r/o or confirm MI
  - Cardiac biomarkers
  - ECGs
  - Treat accordingly
- Cardiac cath
- PCI or CABG
- 24-hour Holter monitoring
- Exercise stress test
- Signal averaged ECG
- Electrophysiologic study
- Implantable cardioverter-defibrillator (ICD)
- Antidysrhythmic drugs
- LifeVest
- Patient teaching
- Psychosocial adaptation
  - "brush with death"
  - "Time Bomb" mentality
  - Additional issues
    - Driving restrictions
    - Role reversal
    - Change in occupation