**INTRODUCTION**

- **Calcium scores**: how much calcification a person has in arteries; this helps determine pt's predisposition to atherosclerosis.

- **Chronic inflammation** can increase chances of damage to endothelium (esp in coronary arteries).

- **Dyslipidemia** is a strong risk factor for CAD
  - Could also mean low levels HDL
  - Very low-density lipoprotein (VLDL) is made in liver → LDL and HDL
  - LDL carries cholesterol to tissues and may cause plaque in arteries
  - HDL carries cholesterol to liver for elimination

- **Nitroglycerin** is given to relieve pain for angina
  - Can cause hypotension

**Progression of CAD**

1. Asymptomatic CAD
2. Stable angina
   - No cardiac cell death

**Acute Coronary Syndrome**

- **Def**: chest pain caused by inadequate O2 supply to myocardium, leads to **ischemia**
- **CAD** is the most common cause but can be due to other issues like hypotension
- Triggered by any events that increase heart’s O2 demand such as HTN, smoking, etc.
  - HTN increases afterload → heart has to work harder to pump blood out
- Angina will cause activation of SNS
  - Forces the heart to work even harder when it’s already weak

**Types of Angina**

- **Stable**
  - Consistent pattern of onset, duration, and s/s
  - Usually worsened by physical or emotional stress or exertion

- **Variant angina (Prinzmetal’s)**
  - Rare and can be associated with Raynaud’s disease or history of migraines
  - Often occurs during rest
  - Caused by coronary artery spasms → vasoconstriction of heart → ischemia of heart
  - Treatment: calcium channel blockers for vasodilation

- **Unstable angina**
  - Unpredictable
  - Long lasting
  - EMERGENCY!

**Exacerbating Factors of Angina**

- Exertion
- Stress
• Temperature extremes
  o Vasoconstriction due to coldness → higher BP → increased workload for heart
• Tobacco use
• Heavy meals
  o Heart has to send more blood to GI system
• Stimulants (cocaine, caffeine, amphetamines)
• Circadian rhythms (more common is morning)
  o “stress hormones” are usually released in the morning into blood → makes heart beat faster

Clinical Manifestation
• Chest pain
  o Usually pain goes up to left jaw → left arm
  → This is more often in men than women
  o Can vary a lot for different pts
• Different pain characteristics for women
  o SOB
  o Epigastric pain
  o Tight chest and squeezing
  o Cold sweat
  o Dizziness
  o Nausea
  o Others
• Different pain characteristics for diabetic pts
  o Due to neuropathy, can be asymptomatic
• SNS activation
  o Pt feels impending doom
  o n/v, pallor, tachycardia, tachypnea, vasoconstriction
  o Restlessness, anxiety
• Pt may be either hypotensive or hypertensive
  o Hypotensive b/c if the heart is too weak → can’t pump blood out → low BP
• Dysrhythmias due to AV heart block (if AV nodes or SA nodes are damaged)
• Projectile vomiting is common for STEMI
• Heart failure and pulmonary edema
  o Manifests as coarse crackles in lungs (do not get confused with fine crackles which is usually atelectasis)
  o Most common reason for this is CAD
  o Mechanism: blood backup in lung b/c ventricle is too weak

DIAGNOSTICS
• 12 lead ECG (most important) – we need to get this ASAP
• Cardiac enzymes
• Stress test/exercise test
• Echocardiogram
• Cardiac catheterization – putting a catheter into heart to visualize the coronary artery using contrast dye
• Other blood tests
  o CRP: a molecule the liver makes in response to inflammation; ppl with high CRP → higher risk for CAD
  o Plasma ceramindes: high levels found in pts with chronic inflammation; fairly new

ECG Changes in MI
1) ST-segment depression
  o Seen with unstable angina and non-transmural MI (NSTEMI)
  → Non-transmural MI: not a full myocardium thickness damage
2) ST-segment elevation
  o Seen in transmural MI
  → Full thickness of myocardium damaged
  o Diagnosis requires 2 contiguous leads
3) T-wave inversion
  o Means ischemia or angina; NSTEMI
4) Pathologic Q waves
   - Develops as MI evolves
   - More permanent
   - May be an indication that person had a previous MI
   - Necrosis has already occurred

Cardiac Biomarkers

<table>
<thead>
<tr>
<th>Cardiac enzyme</th>
<th>Normal levels</th>
<th>Starts to rise</th>
<th>Returns to normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>CK-MB</td>
<td>0%</td>
<td>4 hours (peaks at 18hrs)</td>
<td>2 days</td>
</tr>
<tr>
<td>Troponin T</td>
<td>Less than 0.2ng/L</td>
<td>4-6 hrs (peaks at 10-24 hrs)</td>
<td>10 days</td>
</tr>
<tr>
<td>Troponin I</td>
<td>Less than 0.03ng/L</td>
<td>4-6hrs</td>
<td>4 days</td>
</tr>
<tr>
<td>Myoglobin</td>
<td>Less than 90mcg/L</td>
<td>3 hrs</td>
<td>24 hrs</td>
</tr>
</tbody>
</table>

- CK-MB is best if pt previously had an MI and we want to check if he/she had another one since CK-MB goes back to normal within 2 days unlike troponin T
- Troponin is most accurate for cardiac issues b/c they only exist in heart cells
- Myoglobin is not very specific to heart, but is the fastest one to show up

Checking Labs Before Cardiac Therapies

- **Make sure to check pt's labs before** for any precautions that may be needed
  - Ex: you may want to tell HCP that pt is at-risk for bleeding if platelet levels are too low
- We may not treat a a little high BG levels due to risk of hypoglycemia if we administer hypoglycemia med
- Keep a close eye on creatinine since we may do a procedure needing contrast dye
- High BNP values may indicate HF due to ventricular stretching

EMERGENCY MANAGEMENT

- Most important is to ensure airway by administering O2
- 12-lead ECG – do this before giving any meds in order to figure out that the cardiac issue is
- 2 IV access
- Pain assessment (PQRSTU)
- Baseline labs
- CXR
- Prep for possible PCI or fibrinolytic therapy
- Manage pain – pain may actually cause heart to work harder
- Meds
- Others

Medication (OHBATMAN)

1. Oxygen
2. Heparin (decrease clot growth or new clots)
3. Beta blockers
4. Aspirin
5. Thrombolytics
6. Morphine
7. Ace-inhibitors
8. Nitroglycerin
- You may consider stool softeners b/c pain meds can cause constipation and “bearing down” can stress heart
STEMI Treatment
• Main meds: aspirin, beta-blockers, heparin
  o Meds can change ECG pattern, so make sure to get ECG first!
  o Always ask pt for consuming Viagra b/c it drops BP (vasodilation) and if you mix it with nitroglycerin → severe hypotension risk
• Supportive med: O2, nitrates, morphine
• You need to do immediate reperfusion b/c time is important; can do:
  o PCI with stent – should be done in less than 90 mins
  o Fibrinolytics – should be done in less than 30 mins of s/s; not done much
  o CABG (surgery)

Anticoagulants in MI

<table>
<thead>
<tr>
<th>Antiplatelet meds</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Aspirin</td>
<td>Heparin</td>
</tr>
<tr>
<td>Clopidogrel</td>
<td>LMWHs</td>
</tr>
<tr>
<td>Glycoprotein IIb/IIa inhibitors</td>
<td>Coumadin (vit K antagonist)</td>
</tr>
<tr>
<td></td>
<td>Direct thrombin inhibitors</td>
</tr>
</tbody>
</table>

• Make sure to assess skin and check for ecchymosis, scars with bleeding, hematoma, hematuria, etc. for bleeding precautions
  o Do neuro assessment for brain bleed

REPERFUSION THERAPY
• Goal: restore BF to affected areas
• 3 main ones:
  1. PCI
  2. Thrombolytic therapy
  3. CABG

Percutaneous Coronary Intervention (PCI)
• Can be done in femoral or radial artery
• Performed in cath lab
• 2 types:
  o Balloon angioplasty: increases vessel diameter
  o Stent placement: stent may be drug eluting and requires anticoagulation and antiplatelet treatment

1) Pre-PCI management
  o Keep pt NPO 8–12 hrs before
  o Assess for allergies
  o Ensure IV access
  o Baseline labs
  o Others
2) Post-PCI management
  o Monitor site for bleeding or hematoma
  o Assess pulse, color, temp, capillary refill, and sensation frequently
  o Monitor v/s trends
  o Monitor pain
    → Chest pain is a high sign for re-occlusion
  o Monitor ECG changes constantly
    → Sometimes a little bit of dysrhythmias okay since it can be due to re-perfusion
    → Look out for A-fib, V-fib, or V-tach
  o Lab tests (esp creatinine)
    → Creatinine and urine output is important since this procedure may use contrast dye
  o Reinforce bedrest for 2–6 hrs due to risk of bleeding
  o Instruct pt to keep legs straight, bed should not be elevated more than 30 degrees (for femoral PCI) to maintain hemostasis
Fibrinolytic Therapy
- **Def:** "clot busting" meds given
- Very high risk for bleeding
  - Make sure to scan pt for contraindications like:
    - **NSTEMIs** (b/c those clots are different from STEMI clots)
    - Recent hemorrhagic stroke
    - Active bleeding like ulcer or colitis
    - Intracranial neoplasm (brain tumor)
    - Pregnancy
    - Recent trauma or surgery
- **Time is critical**
  - Should be given **within 3–6 hrs** of s/s
    - Ideal is **30min to 1hr**
    - After 6 hrs, bleeding risk is higher due to necrosis tissue being more prone to bleeding
- **IV administration**
- This is **not a final treatment** (due to high chance of re-occlusion); needs follow up PCI or CABG

Coronary Artery Bypass Graft (CABG)
- **Def:** creation of alternate route for blood to supply heart
- This may **last longer** than other procedures
- Access to thoracic cavity via sternotomy
- Place on **cardiopulmonary bypass (CPB)** – mechanically circulating and oxygenating blood for body while bypassing the heart and lungs
  - Allows surgeon to complete surgery in bloodless field: sometimes not done
CONSEQUENCES OF MI

- Contractility of affected area disrupted
  - Affected area can no longer pump or transmit electrical impulses
- Outcome depends on the degree and location of damage
  - Majority of infarctions involve left ventricle
- Highest mortality MI is ventricular fibrillation

Complications

Rehabilitation

1) Hospital for post MI activity levels
2) Early recovery
   - 2–12 weeks outpatient programs; may be longer for STEMI
   - Monitored continuously with increased activity
3) Late recovery
   - Long term maintenance
   - Permanent lifestyle changes may be needed
   - Medication supervision
- Education pt on nitroglycerin
  - Pill must be dissolved under tongue
  - Protect from light, extreme temp, moisture, and air
  - Prophylactic use (antibiotic) for activities causing increased heart work
  - Dose: 1 tablet every 5 mins, up to 3 doses; call 911 if s/s doesn’t resolve after 1 tablet

Side effects

- Headache, hypotension, reflex tachycardia, flushing (not serious)