Acute Coronary Syndromes
Dr. S. MacLachlan, R. A. Seyon MN, NP, CCN(C) & Dr. R.G. Williams

I. Definition:
   o “constellation of symptoms manifesting as a result of acute myocardial ischemia”
   o Includes:
     o Unstable Angina (UA)
     o Non ST Elevation Myocardial Infarction (NSTEMI)
     o ST Elevation Myocardial Infarction (STEMI)

II. Epidemiology:
   o Among the leading causes of death and hospitalizations world wide
   o In Canada
     ▪ 80,000 AMI/year
     ▪ 20,000 deaths/year
     ▪ 140,000 UA hospitalized
     ▪ death or nonfatal AMI within one year of 10,000 discharged
     ▪ 500,000 Emergency Department visits for evaluation of chest pain and associated symptoms
       • >12% confirm myocardial injury

III. Etiology:
   o Atherosclerotic plaque rupture
     ▪ Inflammation
     ▪ Thrombosis
   o Vasospasm
   o Dissection
   o Decreased oxygen delivery (i.e., anemia, hypotension)
   o Increased oxygen consumption (i.e., sepsis, thyrotoxicosis)

IV. Pathophysiology:
   o Atheromatous plaque
   o Contained within coronary intima by thin cap
   o Within the core, lipid laden “foam cells” produce the procoagulant, tissue factor (TF)
   o Rupture occurs at the shoulder
   o TF + VIIIa, generates Xa = thrombin production
   o Platelets are activated by exposure to:
     ▪ Collagen
     ▪ von Willebrand factor
     ▪ thrombin
   o Further activation and induction of vasospasm with:
     ▪ adenosine diphosphate
     ▪ thromboxane A2
• **prostacyclins**
  o Activated platelets cross link **fibrinogen**
  o Results in **Occlusive Thrombus**

V. **Clinical Features:**
  o **History:**
    ▪ Symptom onset, duration, exacerbators, palliators, cocaine use
  o **Physical Examination:**
    ▪ *vital signs*
    ▪ *inspection* distress, work of breathing, pulsations *palpation*
      ▪ edema, peripheral pulses, thrill/bruits, PMI, JVP
    ▪ *auscultation*
      ▪ heart sounds, murmurs, bruits
      ▪ pulmonary adventitia
  o **ACS associated symptoms:**
    ▪ Diaphoresis
    ▪ Nausea and vomiting
    ▪ Dyspnea
    ▪ Lightheadedness/Syncope
    ▪ Palpitations
  o **Anginal Equivalents:**
    ▪ *Angina* = visceral sensation that is poorly defined and localized
    ▪ Dyspnea
    ▪ Diaphoresis
    ▪ Discomfort in areas of radiation (jaw, shoulder, arm)
    ▪ GI complaints (inferior AMI)
    ▪ Dizziness, weakness, presyncope
  o **Atypical Presentations:**
    ▪ Up to 30%
    ▪ Female, Elderly, Diabetic patients

VI. **The Spectrum of ACS:**
  o **Stable Angina**
    ▪ Does not predict acute events
    ▪ Marker of established coronary artery disease (CAD)
      ▪ Fixed lesion/partially occluded vessel
      ▪ Mismatch in oxygen supply and demand
    ▪ Precipitants:
      ▪ Exercise
      ▪ Cold
      ▪ Stress
    ▪ Duration:
      ▪ $\leq$ 15 to 20 minutes
    ▪ Relief:
      ▪ Rest
- Nitroglycerine
  - **Unstable Angina**
    - New Onset Angina
      - CCS III or IV
      - Within past 1-2 months
    - Crescendo Angina
      - Previous stable angina which has become more frequent, severe, prolonged, easily induced or less responsive to nitroglycerine
    - Rest Angina
      - Angina occurring at rest and lasting more than 15-20 minutes

VII. **CCS Classification of Angina:**
- **Class I**
  - No limitation with ordinary physical activity. Angina with strenuous rapid or prolonged exertion.
- **Class II**
  - Slight limitation of ordinary physical activity. Angina occurs with walking or climbing stairs rapidly, walking uphill, walking or stair climbing after meals, in cold, in wind, or when under emotional stress, or only during the few hours after awakening.
- **Class III**
  - Marked limitation of ordinary physical activity
  - Angina occurs with walking < 1-2 blocks or climbing <1 flight of stairs in normal conditions.
- **Class IV**
  - **IVa** - Inability to carry out physical activity without discomfort: angina may be present at rest.
  - **IVb** - Angina requires oral therapy with improvement, but reoccurs with minimal provocation.
  - **IVc** - Symptoms persisting, not manageable with oral therapy, may be hemodynamically unstable, requires coronary care monitoring and parental medication.

VIII. **UA/NSTEMI:**
- Patent culprit artery, ulcerated plaque and associated thrombus
- Significant risk of thrombotic reocclusion
- Heterogeneous population
  - Atypical presentation
  - Variable age
  - Variable medical burden
- **Unstable Angina** = ACS *without* abnormal levels of serum biomarkers for myocardial necrosis (*Troponin I, Troponin T, CK-MB*)
IX. ST Elevation Myocardial Infarction:
   - Complete thrombotic occlusion of a major epicardial artery
   - 12 lead EKG is **cornerstone** of initial evaluation
     - done **within 10 minutes** of presentation
     - Compare to previous EKG tracings
     - Serial EKG’s are essential
   - ST Elevation and associated territory
     - **II, III, AVF**: Inferior
     - **V1 - V4**: Anteroseptal
     - **I, aVL, V5-V6**: Lateral
     - **V1-V2 tall R, ST depression**: True posterior
   - Presentation Characteristic
     - Symptoms of cardiac ischemia
     - Elevation of serum markers for cardiac injury
     - More prolonged and severe symptoms
     - Little response to nitroglycerine
     - Specific EKG changes on serial EKGs
     - Elevation of serum markers for cardiac injury

X. Troponin I:
   - High sensitivity and specificity
   - Appears within **6 hours** of injury
   - Requires up to **14 days** for clearance
   - Not useful with reinfarction (If reinfarction suspected → assess CK-MB)
   - Spectrum
     - Higher the troponin, the greater the risk
   - False positive:
     - CHF, pericarditis, myocarditis, contusion, cardiomyopathy
     - Shock
     - Renal insufficiency
     - Pulmonary emboli

XI. Ischemia:
   - Mismatch between perfusion and oxygen demand
   - Goal: **Reduce oxygen demands** and/or **Increase perfusion**
   - EKG Changes:
     - ST and T wave changes
     - ST segment depression
     - T waves flattened, inverted, tall and peaked, symmetrical

XII. Injury:
   - Prolonged ischemia (minutes)
   - Can “salvage” with reperfusion
   - EKG changes:
     - ST segment elevation
- >1 mm in 2 or more anatomically contiguous leads
- New left bundle branch block (LBBB)
- True posterior change

XIII. **Infarction:**
- Myocardial cell necrosis
- *Leaking of intracellular components*
- EKG Changes:
  - Abnormal Q waves
  - >2 hours after symptoms
  - >1 mm wide
  - Height > 25% R wave

XIV. **Wellens’ Syndrome:**
- First described in 1982 by HJJ Wellens
- Characteristic EKG pattern of T waves associated with critical stenosis in left anterior descending artery
- Simplified criteria:
  - History of chest pain
  - Inverted or biphasic T waves in V2 and V3
  - T wave changes may also be present in V1, V4-6
  - Changes appear when pain free
  - Little or no ST-segment elevation
  - No loss of precordial R waves, no pathological Q waves
  - No enzymatic evidence of infarction
XV. Risk Stratification and Prognosis:
   o Clinical risk algorithms → Thrombolysis In Myocardial Infarction Risk Score
   o Retrospectively derived/Prospectively validated

TIMI RISK SCORE FOR UA/NSTEMI

<table>
<thead>
<tr>
<th>HISTORICAL</th>
<th>POINTS</th>
<th>Risk Score</th>
<th>Event Rate%*</th>
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<tbody>
<tr>
<td>age &gt;/= 65 y</td>
<td>1</td>
<td>0/1</td>
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<tr>
<td>&gt;/= 3 CAD risk factors</td>
<td>1</td>
<td>2</td>
<td>8.3</td>
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<tr>
<td>known CAD (stenosis &gt;/= 50%)</td>
<td>1</td>
<td>3</td>
<td>13.2</td>
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<tr>
<td>ASA use in past 7 days</td>
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<td>4</td>
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<td>5</td>
<td>26.2</td>
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PRESENTATION

<table>
<thead>
<tr>
<th>Event</th>
<th>Rate%*</th>
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<tbody>
<tr>
<td>&gt;/= 2 anginal episodes &lt;/= 24 hours</td>
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<tr>
<td>elevated cardiac markers</td>
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<tr>
<td>ST deviation &gt;/= 0.5 mm</td>
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**RISK SCORE:** /7

* - All-cause mortality, new or recurrent MI, or severe ischemia requiring revascularization at 14 days

TIMI RISK SCORE FOR STEMI

<table>
<thead>
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<th>HISTORICAL</th>
<th>POINTS</th>
<th>Risk Score</th>
<th>Event Rate%*</th>
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<tr>
<td>age &gt;/= 75 y or 65-74 y</td>
<td>3 or 2</td>
<td>0</td>
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<tr>
<td>DM, HTN, Angina</td>
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<td>1</td>
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<tr>
<td>EXAM</td>
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<td>2</td>
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<tr>
<td>SBP &lt; 100 mmHg</td>
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<td>4.4</td>
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<tr>
<td>HR &gt; 100</td>
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<td>4</td>
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<td>weight &lt; 67 kg (150lbs)</td>
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<td>PRESENTATION</td>
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<td>7</td>
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<tr>
<td>anterior ST elevation or LBBB</td>
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<tr>
<td>time to Rx &gt; 4 hours</td>
<td>1</td>
<td>&gt;8</td>
<td>35.9</td>
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**RISK SCORE:** /14

* - 30 mortality, 1 year mortality in those surviving the first 30 days ranges from 1 – 17%

References