Arrhythmic Complications of MI

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Arrhythmic Complications of MI

- 90% of patients develop some form of arrhythmia
  - during or immediately after the event
- 25% of patients manifest within the first 24 hours
- First Hour
  - Risk of serious arrhythmias, such as VF or VT
  - The risk declines thereafter
- Higher with an STEMI
- Most peri-infarct arrhythmias are benign and self-limited
- But the arrhythmias that result in hypotension
  - Increase myocardial oxygen requirements
  - Predispose the patient to develop additional malignant ventricular arrhythmias
Pathophysiology of arrhythmic complications

- MI results:
  - Generalized autonomic dysfunction
  - Enhanced automaticity of the myocardium and conduction system

- Electrolyte imbalances:
  - Hypokalemia and Hypomagnesemia

- Hypoxia

- The damaged myocardium acts as substrate
  - Re-entrant circuits
  - Changes in tissue refractoriness

- Enhanced efferent sympathetic activity
  - Increased catecholamines
  - Local release of catecholamines from nerve endings in the heart muscle

- Transmural infarction
  - Interrupt afferent and efferent limbs of the sympathetic nervous system
  - Autonomic imbalance is the promotion of arrhythmias
## Arrhythmias in Acute MI

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinus Bradycardia</td>
<td>- ↑Vagal tone</td>
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<tr>
<td></td>
<td>- ↓SA nodal artery perfusion</td>
</tr>
<tr>
<td>Sinus Tachycardia</td>
<td>- CHF</td>
</tr>
<tr>
<td></td>
<td>- Volume depletion</td>
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<tr>
<td></td>
<td>- Pericarditis</td>
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<tr>
<td></td>
<td>- Chronotrophic drugs (e.g. Dopamine)</td>
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<tr>
<td>APB’s, atrial fib, VPB’s, VT, VF</td>
<td>- CHF</td>
</tr>
<tr>
<td></td>
<td>- Atrial Ischemia</td>
</tr>
<tr>
<td></td>
<td>- Ventricular ischemia</td>
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<tr>
<td></td>
<td>- CHF</td>
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<tr>
<td>AV block (1°, 2°, 3°)</td>
<td>- IMI: ↑Vagal tone and ↓AV nodal artery flow</td>
</tr>
<tr>
<td></td>
<td>- AMI: Destruction of conduction tissue</td>
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</tbody>
</table>
Classification of peri-infarction arrhythmias

• Supraventricular Tachyarrhythmias
  – Sinus tachycardia
  – Premature atrial contractions
  – Paroxysmal SVT
  – Atrial flutter
  – Atrial fibrillation

• Accelerated Junctional Rhythms

• Bradyarrhythmias
  – Sinus bradycardia
  – junctional bradycardia
  – Atrioventricular (AV) blocks
  – First-degree AV block
  – Second-degree AV block
  – Third-degree AV block

• Intraventricular Blocks
  – Left anterior fascicular block (LAFB)
  – Right bundle branch block (RBBB)
  – Left bundle branch block (LBBB)

• Ventricular Arrhythmias
  – Premature ventricular contractions (PVCs)
  – Accelerated Idioventricular Rhythm
  – Ventricular tachycardia
  – Ventricular fibrillation

• Reperfusion Arrhythmias
Arrhythmic Complications:
Supraventricular Tachyarrhythmias

• **Tachycardia:**
  – Increases myocardial oxygen demand
  – Decreased length of diastole compromises coronary flow
  – Worsening myocardial ischemia

• **Sinus tachycardia:**
  – Pain, Anxiety, Heart failure, Hypovolemia, Hypoxia, Anemia, Pericarditis, Pulmonary embolism

• **Premature atrial contractions (PAC):**
  – Often occur before the development of PSVT, atrial flutter, or atrial fibrillation
  – The usual cause—Atrial distention due to increased LV diastolic pressure or inflammation associated with pericarditis

• **Paroxysmal supraventricular tachycardia (PSVT):**
  – The incidence of a PSVT in AMI is less than 10%
  – Adenosine can be used when hypotension is not present
  – Intravenous diltiazem or beta-blocker- if not heart failure
  – Hemodynamic compromise- DCCV
Arrhythmic Complications: Supraventricular Tachyarrhythmias

• **Atrial fibrillation**
  – 10-15% among patients who have MIs
  – Due to LV failure, ischemic injury to the atria, or RV infarction
  – Pericarditis
  – Associated with an increased risk of mortality and stroke, particularly in AMI

• **Treatment Strategies:**
  – DCCV if unstable
  – Stable condition- Rate or rhythm control
  – IV amiodarone or IV digoxin (in patients with LV dysfunction or heart failure)
  – IV beta blockers and or diltiazem -- in pt without moderate-severe heart failure
  – If new-onset conversion to sinus rhythm should be considered
  – Anticoagulation
  – Duration of anticoagulation unclear for new transient onset of afib.

• **Atrial flutter**
  – < 5% of patients with AMI
  – Usually transient and results from sympathetic overstimulation

• **Treatment strategies:**
  – Similar to those for atrial fibrillation
  – Rate control is difficult
  – DCCV may be needed
Arrhythmic Complications:
Accelerated Junctional Rhythm

• Results from increased automaticity of the junctional tissue
  – Heart rate of 70-110 bpm
• Most common in IMI
• Treatment is directed at correcting the underlying ischemia
ST/LBBB/AWMI
AF/Afl – NSRcAPCs – AF/Afl
Typical Atrial Flutter breaks to NSR
AVNRT
NSR with ‘Incessant’ Atypical AVNRT

Stem: A 74-year-old woman seen in the emergency room for weakness and dyspnea.
IWMI/JuncRhy/EctAtRhy c Capture
Conduction System: detail
Blood supply of the septum

Blood Supply of the IV Septum

## Blood Supply in the Conduction System

<table>
<thead>
<tr>
<th>Conduction Pathway</th>
<th>Primary Arterial Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>• SA node</td>
<td>- RCA (70% of patients)</td>
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<tr>
<td>• AV node</td>
<td>- RCA (85% of patients)</td>
</tr>
<tr>
<td>• Bundle of His</td>
<td>- LAD (septal branches)</td>
</tr>
<tr>
<td>• RBB</td>
<td>- Proximal portion by LAD</td>
</tr>
<tr>
<td></td>
<td>- Distal portion by RCA</td>
</tr>
<tr>
<td>• LBB</td>
<td></td>
</tr>
<tr>
<td>Left anterior fascicle</td>
<td>- LAD</td>
</tr>
<tr>
<td>Left posterior fascicle</td>
<td>- LAD and PDA</td>
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</table>
Think Anatomically

LAD supplies most of the conduction system **below** the A-V node
  (i.e. the His-Purkinje system)
RCA supplies most of the conduction system **at or above** the A-V node
  (i.e. the A-V node and, usually, the S-A node)
Arrhythmic Complications: Bradyarrhythmias

• **Sinus bradycardia**
  – Common IMI, upto 40%
  – Observed in the first 1-2 hours after IMI
  – Results from Cholinergic stimulation of heart from vagus nerve damage
  – Maybe protective- reduce Oxygen demand
  – Clinically significant bradycardia that decreases cardiac output and hypotension may result in ventricular arrhythmias

• Usually not associated with an increase in the acute mortality risk

• If symptomatic and or hypotensive: (sinus rate of < 40 bpm with hypotension)
  – Atropine
  – If atropine is ineffective transcutaneous or transvenous pacing is indicated
  – Inotropes --dopamine, epinephrine and/or dobutamine

• **Junctional bradycardia**
  – Protective AV junctional escape rhythm --35-60 bpm in patients with IMI
  – Not usually associated with hemodynamic compromise
  – Treatment is typically not required
## Arrhythmic Complications: AV and Intraventricular Blocks

### First-degree AV block
- ~15%, most commonly in IMI
- Usually its above His Bundle
- No specific therapy is indicated

### Second-degree AV block
- **Mobitz type I** -- 10%
  - Common with IMI
  - It does not affect the patient's overall prognosis
  - A Mobitz type I block does not necessarily require treatment

- **A Mobitz type II AV block**
  - accounts < 1%
  - Usually wide QRS complex
  - Almost always associated with AMI
  - Often progresses suddenly to a complete heart block.
  - Mobitz type II AV blocks are associated with a poor prognosis
  - Mortality rate associated with their progression to a complete heart block is approximately 80%

- Transcutaneous pacing or atropine
- Possibly a permanent pacemaker
Acute I(WMI with Mobitz I
CHB with Junctional Escape Rhythm
CHB with Fasc Escape
LBBB with 2:1 Mobitz II Block
LBBB with 3:2 Mobitz 2 Block
LBBB to CHB
Arrhythmic Complications: AV and Intraventricular Blocks

- A third-degree AV block
- Occurs in ~5-15% of MI
  - May occur with anterior or inferior infarctions
Arrhythmic Complications: AV and Intraventricular Blocks

**Inferior MI**
- Gradually progress from first degree
- Level of block is upranodal or intranodal
- Escape rhythm is usually stable with a narrow QRS and rates exceeding 40 bpm.
- In 30% of patients, the block is below the His bundle
- Usually responds to atropine
- In most patients, it resolves within a few days
- The mortality rate ~15%, high if RV infarction is present
- Symptomatic patients whose condition is unresponsive to atropine- temp pacing
- Permanent pacing should be considered if persists after revascularization

**Anterior MI**
- Intraventricular block or a Mobitz type II AV block usually precedes a third-degree AV block
- Occurs suddenly
- Associated with a high mortality rate
- Unstable escape rhythms with wide QRS complexes and at rates of less than 40 bpm
- Immediate pacing required
- Often receive a permanent pacemaker
Arrhythmic Complications: Intraventricular Blocks

- **Intraventricular blocks**
- ~15% of patients with MI
- Isolated LAFB occurs in 3-5% of patients with MI
- Isolated LPFB occurs in 1-2% of patients who have an MI
- RBB receives its dominant blood supply from the LAD artery
- New RBBB, ~2% of patients with AMI, suggests a large infarct territory
  - Progression to complete heart block is uncommon
  - Anterior MI and a new RBBB, the substantial risk for death is mostly from cardiogenic shock, due to the large size of the myocardial infarct
- RBBB with an LAFB is commonly occurs with occlusion of the proximal LAD coronary artery
  - Higher risk of developing complete AV block is heightened
  - Mortality is mostly related to the amount of muscle loss
  - In 40% of patients, a trifascicular block progresses to a complete heart block-rate of progression unknown
**Arrhythmic Complications:**

**Ventricular Arrhythmias**

- **Premature ventricular contractions (PVC)**
  - Warning for ? Other malignant arrhythmias

- **Accelerated idioventricular rhythm (AIVR)**
  - AIVR is seen in as many as 20% of patients who have an MI
  - Wide QRS complex escape rate faster than the atrial rate, but less than 100 bpm
  - The mechanism might involve:
    - Structural damage to Sinoatrial node or the AV node
    - Abnormal ectopic focus in the ventricle

- AIVR no associated with increased mortality
- Reperfusion arrhythmia
- No need to treat
- Suppression with AAD can lead to asystole
Arrhythmic Complications:
Ventricular Arrhythmias

- **Nonsustained ventricular tachycardia (NSVT)**
  - Within 48 hours of MI not associated with an increased mortality risk
  - If occurs >48 hours after MI with depressed LVEF-- may represent increased mortality
  - EPS maybe needed for risk assessment
  - Multiple episodes NSVT require intensified monitoring
  - Serum K+ >4.5 mEq/L, and serum Mag >2.0 mEq/L
  - Ongoing ischemia should aggressively be sought and corrected if found

- **Sustained ventricular tachycardia**
  - Monomorphic VT - myocardial scar
  - Polymorphic VT - ischemia
  - Sustained polymorphic VT after an AMI is associated with a hospital mortality rate of 20%
  - If sustained and HD compromise → DCCV

- ?ICD vs EPS guided ICD vs Life vest
Arrhythmic Complications: Ventricular Arrhythmias

• Greatest in the first hour ~(4.5%)
  – ~80% occur within 12 hours
• Secondary or late VF >48 hours after an MI
  – Associated with pump failure and cardiogenic shock
  – Risk factors: Large infarct, BBB and AMI
  – In-hospital mortality rate of 40-60%

• Each minute of uncorrected VF is associated a 10% decrease in the likelihood of survival

• Intravenous amiodarone and lidocaine
• If not in cardiogenic shock- Beta Blockers- reduce VF and mortality
Arrhythmic Complications: Reperfusion Arrhythmias

• In the past, the sudden onset of rhythm disturbances after thrombolytic therapy in patients with AMI was believed to be a marker of successful coronary reperfusion.

• However, a high incidence of identical rhythm disturbances is observed in patients with AMI in whom coronary reperfusion is unsuccessful.

• Therefore, these so-called reperfusion arrhythmias are neither sensitive nor specific for reperfusion.
Sustained VT
Sustained VT
Polymorphic VT c Coronary Spasm
Left Posterior Fascicular Tachycardia
Sustained VT
Baseline EKG p DCCV
LBBB and AMI
Sustained VT
Spontaneous Termination of VT
RBBB/LAHB/IWMI/AWMI/ProlongedQTc
Prolonged QT with Torsades
Baseline – AF/LBBB
Baseline – AWMI/RBBB/LAHB
Left Posterior Fascicular Tachycardia
AF with Type A WPW
Isorhythmic AIVR