Non-ST-Segment Elevation Acute Coronary Syndrome (NSTE-ACS)

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Pathology, Pathophysiology, and Epidemiology

Pathology, Pathophysiology, and Epidemiology

The Vulnerable Plaque

Ruptured Plaque with Occlusive Thrombus Formation


Characteristics of Unstable and Stable Plaque

Unstable
- Inflammatory cells
- Few SMCs
- Eroded endothelium
- Activated macrophages

Stable
- Lack of inflammatory cells
- More SMCs
- Intact endothelium
- Foam cells

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Atherothrombosis: Thrombus Superimposed on Atherosclerotic Plaque


Systemic and Focal Plaque Rupture by IVUS in ACS Patients Undergoing PCI

Analysis of 72 Arteries (n=24 TnI-positive ACS Patients)

- Plaque rupture at site of culprit lesion: 79.0%
- Plaque rupture elsewhere than site of culprit lesion: 70.8%
- Plaque rupture in different artery than culprit lesion: 37.5%


Plaque rupture at site of culprit lesion
Plaque rupture elsewhere than site of culprit lesion
Plaque rupture in different artery than culprit lesion

% Plaque rupture

0 25 50 75 100
Frequency of Multiple “Active” Plaques in Patients With ACS

80% of Patients With ≥2 Plaques

Frequency of multiple active plaque ruptures beyond the culprit lesion.

N=24

Atherothrombosis* is the Leading Cause of Death Worldwide¹

<table>
<thead>
<tr>
<th>Causes of Mortality (%)</th>
<th>Pulmonary Disease</th>
<th>Injuries</th>
<th>AIDS</th>
<th>Cancer</th>
<th>Infectious Disease</th>
<th>Atherothrombosis*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>6.3</td>
<td>9</td>
<td>9.7</td>
<td>12.6</td>
<td>19.3</td>
<td>22.3</td>
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<tr>
<td>5</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>10</td>
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<tr>
<td>15</td>
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<td>20</td>
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<td>30</td>
<td></td>
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</tr>
</tbody>
</table>

* Atherothrombosis defined as ischemic heart disease and cerebrovascular disease.

Thrombus Formation and ACS

Old Terminology:
- UA
- Non-ST-Segment Elevation Acute Coronary Syndrome (ACS)

New Terminology:
- Thrombus Formation
- Non-ST-Segment Elevation Acute Coronary Syndrome (ACS)

Epidemiology of ACS in the United States

- Single largest cause of death
  - 515,204 US deaths in 2000
  - 1 in every 5 US deaths

- Incidence
  - 1,100,000 Americans will have a new or recurrent coronary attack each year and about 45% will die*  
  - 550,000 new cases of angina per year

- Prevalence
  - 12,900,000 with a history of MI, angina, or both

* Based on data from the ASCC study of the National Heart, Lung, and Blood Institute, 1997-1998. Includes Americans hospitalized with definite or probable MI or fatal CHD, not including silent MI. ACS indicates acute coronary syndrome; MI, myocardial infarction; ARIC, Atherosclerotic Risk in Communities; and CHD, coronary heart disease. From American Heart Association. Heart Disease and Stroke Statistics—2003 Update.  
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Risk and Risk Stratification

GUSTO IIb: Correlation of 6-Month Mortality With Baseline ECG Findings in Patients With ACS

Braunwald Classification of Risk for Patients with Unstable Angina

<table>
<thead>
<tr>
<th>Feature</th>
<th>High Risk</th>
<th>Intermediate Risk</th>
<th>Low Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>History</td>
<td>Accelerating tempo of angina, &gt;48 hrs preceding 48 hrs</td>
<td>Prior MI, peripheral or cerebral vascular disease, CAD, or prior aspirin use</td>
<td>No high-risk feature but may have any of the following features</td>
</tr>
<tr>
<td>Character of Pain</td>
<td>Mangled angina (&gt;48 hrs), recent pain</td>
<td>Mangled (ST) with new angina, now resolved, with evidence of high likelihood of CAD</td>
<td>New onset of progressive CCS Class III or IV angina the past 2 weeks</td>
</tr>
<tr>
<td>Clinical Findings</td>
<td>Hypertension, diabetes, or CHF, &gt;70 yrs</td>
<td>Age &gt;75 yrs.</td>
<td>Age &gt;70 yrs</td>
</tr>
<tr>
<td>ECG</td>
<td>Abnormal at rest with transient ST-segment changes &gt;0.05 mV</td>
<td>Elevated ST-deviation peaks &gt;0.2 ml</td>
<td>Normal or unchanged ECG during an episode of chest discomfort</td>
</tr>
<tr>
<td>Cardiac Markers</td>
<td>Elevated (TnT or TnI) &gt;0.1 ng/mL</td>
<td>Slightly elevated (TnT or TnI) &lt;0.1 ng/mL</td>
<td>Normal</td>
</tr>
</tbody>
</table>

TIMI Risk Score

- Age ≥65 years
- >3 CAD Risk Factors
- Prior Coronary Stenosis >50%
- ST deviation
- >2 Anginal events <24 hours
- ASA in last 7 days
- Elevated Cardiac Markers (CK-MB or troponin)
The TIMI Risk Score and Incidence of Adverse Ischemic Events in Patients with NSTE-ACS

Prognostic Value of Troponin T or I in ACS: A Meta-Analysis

Troponin I Levels and Mortality in Patients with NSTE-ACS

Initial Therapies and Management
ACC/AHA Class I Recommendations for Initial Management and Anti-Ischemic Therapy

- Bed rest
- Continuous ECG Monitoring
- Supplemental O₂ to maintain SaO₂ >90%
- NTG (IV or PO as dictated clinically)
- Beta-blockers (PO and/or IV)
- IV Morphine prn pain, anxiety, and/or CHF
- IABP for hemodynamic instability
- ACEI for persistent hypertension in patients with LV systolic dysfunction or CHF

Pathogenesis of Acute Coronary Syndromes: The integral role of platelets

Platelets and Anti-Platelet Therapies

The Role of Platelets in Atherothrombosis
Platelet Inhibition With GP IIb/IIIa Inhibitors

The Primary Composite End Point in the CURE Trial

Treatment of Unstable Angina
Results of a study from the Montreal Heart Institute
CURE: Primary End Point in Subgroups

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>Placebo</th>
<th>Plavix</th>
<th>RR</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST Changes</td>
<td>14.3%</td>
<td>11.5%</td>
<td>0.79</td>
</tr>
<tr>
<td>No ST Changes</td>
<td>8.7%</td>
<td>7.0%</td>
<td>0.80</td>
</tr>
<tr>
<td>Enzyme Elevation</td>
<td>13.1%</td>
<td>10.7%</td>
<td>0.81</td>
</tr>
<tr>
<td>No Enzyme Elevation</td>
<td>10.9%</td>
<td>8.8%</td>
<td>0.79</td>
</tr>
<tr>
<td>Post-Randomization Revascularization</td>
<td>13.9%</td>
<td>11.4%</td>
<td>0.81</td>
</tr>
<tr>
<td>No Post-Random Revascularization</td>
<td>10.1%</td>
<td>8.1%</td>
<td>0.79</td>
</tr>
</tbody>
</table>

CURE Secondary End Points

<table>
<thead>
<tr>
<th>Endpoint</th>
<th>Placebo</th>
<th>Plavix</th>
<th>RR</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CV Death/ MI/CVA</td>
<td>11.7%</td>
<td>9.28%</td>
<td>0.80</td>
<td>0.000005</td>
</tr>
<tr>
<td>CV Death/MI CVA/Ref Ischemia</td>
<td>19.02%</td>
<td>16.68%</td>
<td>0.88</td>
<td>0.0004</td>
</tr>
<tr>
<td>CV Death</td>
<td>5.4%</td>
<td>5.06%</td>
<td>0.92</td>
<td>NA</td>
</tr>
<tr>
<td>MI</td>
<td>6.68%</td>
<td>5.19%</td>
<td>0.77</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Stroke</td>
<td>1.4%</td>
<td>1.2%</td>
<td>0.85</td>
<td>NA</td>
</tr>
<tr>
<td>Refract Ischemia</td>
<td>9.4%</td>
<td>8.8%</td>
<td>0.93</td>
<td>NA</td>
</tr>
<tr>
<td>Major Bleeding</td>
<td>2.7%</td>
<td>3.6%</td>
<td>1.34</td>
<td>0.03</td>
</tr>
</tbody>
</table>

PURSUIT Primary End Point

P=0.03 by the log-rank test

PURSUIT Primary Composite End Point

P=0.04
### Meta-Analysis of IV GP IIb/IIIa Inhibitors in NSTE-ACS: Death or MI at 30 Days

<table>
<thead>
<tr>
<th>Study</th>
<th>Placebo</th>
<th>IV Gp IIb/IIIa</th>
<th>Odds Ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRISM</td>
<td>7.1%</td>
<td>5.8%*</td>
<td>0.80</td>
<td>0.65-1.06</td>
</tr>
<tr>
<td>PRISM-PLUS</td>
<td>12.0%</td>
<td>8.7%</td>
<td>0.70</td>
<td>0.55-0.90</td>
</tr>
<tr>
<td>PARAGON-A</td>
<td>11.7%</td>
<td>13.6%*</td>
<td>1.17</td>
<td>0.80-1.70</td>
</tr>
<tr>
<td>PARAGON-B</td>
<td>11.4%</td>
<td>10.8%</td>
<td>0.92</td>
<td>0.71-1.20</td>
</tr>
<tr>
<td>PURSUIT</td>
<td>15.7%</td>
<td>13.4%</td>
<td>0.83</td>
<td>0.70-0.99</td>
</tr>
<tr>
<td>GUSTO-IV</td>
<td>13.6%*</td>
<td>14.2%</td>
<td>0.89</td>
<td>0.79-1.00</td>
</tr>
<tr>
<td>Overall</td>
<td>11.8%</td>
<td>10.8%*</td>
<td>0.91</td>
<td>0.85-0.98</td>
</tr>
</tbody>
</table>

* Without heparin. † With/without heparin. (l), Low dose; (h), High-dose.


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### GP IIb/IIIa Therapy and Mortality (30 day) in Diabetics with NSTE-ACS

- **Pursuit**: Odds Ratio 0.83 CI 0.93-0.95
- **PRISM**: Odds Ratio 1.00 CI 1.00-1.00
- **PRISM-PLUS**: Odds Ratio 0.74 CI 0.68-0.81
- **GUSTO-IV**: Odds Ratio 0.88 CI 0.75-1.03
- **PARAGON A**: Odds Ratio 0.88 CI 0.72-1.09
- **PARAGON B**: Odds Ratio 0.88 CI 0.72-1.09
- **Pooled**: Odds Ratio 0.91 CI 0.79-1.05

Mortality: 6.2% vs. 4.6%
OR=0.74
CI=0.59-0.92
P=0.007


### GP IIb/IIIa Inhibitor NSTE-ACS Studies Analysis Risk-Adjusted Mortality at 30 Days

<table>
<thead>
<tr>
<th>Study</th>
<th>Placebo</th>
<th>IV Gp IIb/IIIa</th>
<th>Odds Ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRMI^1</td>
<td>0.88</td>
<td>0.79-0.97</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boersma^2</td>
<td>0.91</td>
<td>0.83-1.01</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

GP IIb/IIIa Inhibitor Favored (aspirin + heparin)
Control Arm Favored (aspirin + heparin)


### Antithrombotic and Antiplatelet Therapy in ACS

Milestones in ACS Management

ACC/AHA Recommendations for Antiplatelet Therapy in Patients with NSTE-ACS

• Class I
  ✓ ASA
  ✓ Clopidogrel if ASA-allergic or intolerant
  ✓ Clopidogrel in addition to ASA if early invasive approach not planned
  ✓ Clopidogrel should be withheld for 5-7 days if CABG planned
  ✓ GP IIb/IIIa inhibitor if cardiac cath and PCI planned

Contraindications to GP IIb/IIIa Rx

• Active or recent bleeding (4-6 weeks)
• Severe hypertension (SBP >180-200 mm Hg; DBP >110 mm Hg)
• Any hemorrhagic CVA (+/- intracranial neoplasm, AVM, or aneurysm)
• Any CVA within 30 days–2 years
• Major surgery or trauma within 4-6 weeks
• Thrombocytopenia ( <100,000/mm³ )
• Bleeding diathesis/warfarin with elevated INR
• (Doses must be avoided with renal insufficiency or failure)
Antithrombin Therapy Studies and Recommendations

Comparison of Heparin + ASA vs ASA Alone

ESSENCE Results

TIMI 11B: Enoxaparin vs. Heparin in NSTE-ACS
Guidelines for the Use of Enoxaparin in Patients with NSTE-ACS

- 1 mg/kg SQ q12 hours (actual body weight)
  - An initial 30 mg IV dose can be considered
  - Adjust dosing if CrCl <30 cc/min
    - 1 mg/kg SQ q24 hours
  - Do not follow PTT; do not adjust based on PTT
  - Stop if platelets ↓ by 50% or below 100,000/mm³
  - If patient to undergo PCI:
    - 0-8 hours since last SQ dose: no additional antithrombin therapy
    - 8-12 hours since last SQ dose: 0.3 mg/kg IV immediately prior to PCI

ACC/AHA Recommendations for Antithrombin Therapy in Patients with NSTE-ACS

- Class I
  - Anticoagulation with subcutaneous LMWH or intravenous UFH should be added to antiplatelet therapy
  - Dose of UFH 60-70 U/kg (max 5000) IV followed by infusion of 12-15 U/kg/hr (initial max 1000 U/hr) titrated to aPTT 1.5-2.5 times control
  - Dose of enoxaparin 1 mg/kg subcutaneously q12 hr; the first dose may be preceded by a 30-mg IV bolus

- Class IIa
  - Enoxaparin is preferable to UFH as an anticoagulant unless CABG is planned within 24 hours

Early Invasive Strategy Studies and Recommendations in Patients with NSTE-ACS

 ACC/AHA Recommendations for Antithrombin Therapy in Patients with NSTE-ACS

- Class I
  - Anticoagulation with subcutaneous LMWH or intravenous UFH should be added to antiplatelet therapy
  - Dose of UFH 60-70 U/kg (max 5000) IV followed by infusion of 12-15 U/kg/hr (initial max 1000 U/hr) titrated to aPTT 1.5-2.5 times control
  - Dose of enoxaparin 1 mg/kg subcutaneously q12 hr; the first dose may be preceded by a 30-mg IV bolus

- Class IIa
  - Enoxaparin is preferable to UFH as an anticoagulant unless CABG is planned within 24 hours

Available at: www.acc.org/clinical/guidelines/unstable/unstable.pdf
TACTICS Trial Results Based on Troponin

<table>
<thead>
<tr>
<th>Troponin Status</th>
<th>Initial Medical Rx</th>
<th>Early Cath + PTCA</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>15%</td>
<td>10%</td>
<td>P=NS</td>
</tr>
<tr>
<td>Positive</td>
<td>20%</td>
<td>25%</td>
<td>P&lt;0.001</td>
</tr>
</tbody>
</table>

(TnT indicates troponin T; and ST, ST segment.


The Primary Composite Ischemic End Point in RITA-3

Meta-Analysis of Trials of Early Cardiac Cath and Revascularization Versus Initial Medical Therapy Alone in Patients with NSTE-ACS
Invasive vs Conservative Strategy for UA/NSTEMI

Conservative

Invasive

VANQWISH
MATE
TACTICS-TIMI 18
TIMI IIIB
FRISC II

ISAR-COOL
RITA-3
VINO
TRUCS

UA indicates unstable angina; NSTEMI, non-ST-segment myocardial infarction; ISAR, Intracoronary Stenting and Antithrombic Regimen Trial; RITA, Randomized Intervention Treatment of Angina; VANQWISH, Veterans Affairs Non-Q-Wave Infarction Strategies in Hospital study; MATE, Medicine vs Angioplasty for Thrombolytic Exclusions trial; TACTICS-TIMI 18, Treat Angina with Aggrastat® and Determine Cost of Therapy with Invasive or Conservative Strategy; and FRISC, Fragmin during InStability in Coronary Artery Disease.

Conclusions—Recent ACS Trials

- OASIS 5—Fondaparinux has less bleeding than enoxaparin, non-inferior clinical outcomes at 9 days, and less death and death/MI at 6 months; UFH is probably required in the cath lab—dose unknown.

- ACUITY—Bivalirudin with provisional GPI has less bleeding than UFH/LMWH + GPI, comparable ischemic outcomes, and superior net clinical benefit. Bivalirudin + GPI is comparable to UFH/LMWH + GPI

Conclusions—Recent ACS Trials

- ICTUS—In troponin (+) patients, a selective invasive management strategy may be an option, but there was a high use of angiography and revascularization in the selective arm.

- ISAR REACT 2—Clopidogrel loading alone is not sufficient in ACS patients; Troponin (+) patients derive significant benefit with GP IIb/IIIa antagonists

- SYNERGY—Enoxaparin is an alternative in invasively managed patients, but may have slightly higher bleeding, especially when UFH is indiscriminately added in the cath lab

Conclusions—ACS Management

- NSTE-ACS is common and associated with high morbidity and mortality

- Early invasive strategy is preferred in higher-risk individuals

- Early initiation of appropriate antiplatelet and antithrombin therapy is important for reduction of ischemic events

- Balancing the risk of ischemic and bleeding complications is essential to maximize clinical benefit in individual patients

- The evidence base and strategies for optimal management of NSTE-ACS continue to evolve
ACC/AHA Class I Recommendations for Invasive and Medical Strategies in Patients with NSTE-ACS

- Class I
  - An early invasive strategy in patients with any high-risk indicators:
    - Recurrent angina/ischemia at rest or with low-level activities
    - Elevated troponin
    - New or presumed new ST-segment depression
    - Recurrent angina/ischemia with CHF Sx and S3 gallop, pulmonary edema, worsening rales, or new or worsening MR
    - High-risk findings on noninvasive stress testing
    - Depressed LVEF (<40%)
    - Hemodynamic instability
    - Sustained ventricular tachycardia
    - PCI with 6 months or prior CABG

- In the absence of any of the above high-risk indicators, either an early conservative or an early invasive strategy

Available at www.acc.org/clinical/guidelines/unstable/unstable.pdf.

ST Elevation Acute Myocardial Infarction (STEMI)

Quinn Capers, IV, MD, FACC, FSCAI
Assistant Professor
Director, Peripheral Vascular Interventions,
OSU Ross Heart Hospital
Director, Cath Lab, University Hospital East
EKG: Acute anterior STEMI

Artery Opened Emergently

Cardiac Cath Lab

Before stent, artery closed, no blood flow to heart
After stent, artery open, blood flow to heart restored
Combination of blood clot and “plaque” removed from artery

**S-T segment Elevation acute Myocardial Infarction (STEMI)**

- **Definition:** acute myocardial infarction that occurs when coronary artery is completely occluded
- **Differs from non-ST elevation MI in,** which coronary artery is often not completely occluded
- **Coronary artery is clogged with combination of “plaque” and thrombus**

**STEMI: Vascular Biology**

<table>
<thead>
<tr>
<th>Normal coronary artery</th>
<th>Atherosclerotic plaque</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lined with endothelial cells</td>
<td>Lined with endothelial cells</td>
</tr>
<tr>
<td>No resident inflammatory cells (monocytes/macrophages/lymphocytes)</td>
<td>Monocytes/macrophages infiltrate vascular wall and “destabilize” plaque</td>
</tr>
<tr>
<td>Vasodilatory&gt;Vasoconstriction</td>
<td>Vasoconstriction&gt;Vasodilatory</td>
</tr>
<tr>
<td>Antithrombotic</td>
<td>Prothrombotic</td>
</tr>
</tbody>
</table>

**Features of the stable plaque:**

- Thick fibrous cap separating sub-intima from flowing blood
- High ratio of connective tissue: lipids
- Low density of inflammatory cells
- Low enzymatic activity within plaque: “cold”
- Less prone to rupture
**STEMI: Vascular Biology**

- Features of the unstable or “vulnerable” plaque:
  - Thin fibrous cap separating sub-intima from flowing blood
  - High ratio of lipids to connective tissue
  - High density of inflammatory cells, especially at “shoulders”
  - High enzymatic activity within plaque: warm
  - More prone to rupture

**STEMI: Pathophysiology**

Unstable or “vulnerable” plaque:
- Unstable angina, acute MI (Non-STEMI or STEMI)
- High systemic inflammatory state (CRP, ESR, IL1)
- “Acute coronary syndromes”

**STEMI: Vascular Biology**

- Changing the vulnerable plaque to a quiescent, stable plaque is major focus of treatment of CAD patients
  - Statins (lipid lowering drugs)
  - BP control
  - Inhibition of renin angiotensin system
  - Tobacco avoidance
STEMI: Pathophysiology

- Plaque rupture (70%) or endothelial erosion (30%)
- Results in flowing blood coming in contact with plaque contents
- Plaque contents are highly thrombogenic
- Plaque + overlying thrombus impairs blood flow to myocardium

STEMI: Clinical Presentation

- ST segment elevation MI (STEMI)
  - Severe angina, shortness of breath, or both
  - Physical exam can separate high from low risk pt
    - Rales on lung auscultation, gallops on cardiac auscultation, tachycardia, low BP
  - EKG: ST segment elevation in at least two contiguous leads

Coronary Thrombosis: Clot begets Clot

- Ruptured plaque promotes thrombin formation and recruits platelets to site
- Thrombin stimulates platelet activation
- Activated platelets accelerate thrombin formation

STEMI: Clinical Presentation

- To Diagnose Acute MI, 2 of these 3 must be present:
  - Discomfort suspicious for cardiac ischemia (usually “deep seated” chest, arm, neck, or back discomfort)
  - EKG abnormalities consistent with ischemia or infarction (ST segment depression or elevation or T wave inversion)
  - Elevated markers of myocardial necrosis in the bloodstream (CPK, CPK-MB, troponin I, troponin T, myoglobin)
### Acute Coronary Syndromes: Treatment Principles

- Restore normal coronary blood flow as soon as possible (“Time is muscle”)
  - Address coronary thrombosis, interrupt cycle
  - Increase diameter of coronary artery to allow perfusion
  - Main principle: do not delay immediate reperfusion

### STEMI: Specifics of Treatment

- Antiplatelet therapy
  - ASA, Clopidogrel
- Antithrombin therapy
  - Heparin, LMWH, other antithrombins
- Beta blocker

### Acute Coronary Syndromes: Treatment Principles

- Decrease myocardial oxygen demand
  - Decrease HR, BP
  - Interrupt sympathetic nervous system/catecholamine stimulation of heart

### STEMI: Specifics of Treatment

- Nitroglycerin
- Supplemental Oxygen
- Anxiolytic
**STEMI: Specifics of Treatment**

- Reperfuse without delay!
- Reperfuse without delay!
- Reperfuse without delay!

**STEMI: Reperfusion Therapy**

- Thrombolytic therapy
- Emergent cardiac cath/angioplasty/stent
- Emergent CABG

---

**STEMI: Specifics of Treatment**

- Benefits of immediate reperfusion:
  - Improves chances of survival
  - Minimizes myocardial damage

**STEMI: Reperfusion Therapy**

- Thrombolytic therapy
  - Medications that enhance endogenous clot dissolving substances
  - Examples: tPA, rPA, streptokinase
  - Given IV, dissolve coronary thrombus
  - Leaves behind ruptured plaque
  - Success rate: 65-75%
STEMI: Reperfusion Therapy

- Emergent cardiac cath/angioplasty/stent
  - Fastest way to open coronary artery
  - Most “complete” method of reperfusion
  - Allows risk stratification by visualizing other coronary arteries and assessing LV function and pressure
- Success rate: 95%+

Thrombolytic Therapy vs Emergent Stent Placement

- In multiple head-to-head studies, percutaneous intervention in STEMI pts proved superior to fibrinolytic drug therapy (better survival, better myocardial salvage, lower complication rates)
- Often used together (STEMI pt in small hospital placed on fibrinolytic drug, transported emergently to larger center for emergent cath)
- The point is: whether using fibrinolytic therapy or emergent coronary intervention, get the artery open as soon as possible!!! It can mean the difference between a relatively normal life, life with severe heart disease, and death.

Thrombolytic Therapy vs Emergent Stent Placement

<table>
<thead>
<tr>
<th>Fibrinolytic drug tx</th>
<th>Percutaneous intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Improves survival in STEMI pts</td>
<td>- Improves survival in STEMI pts</td>
</tr>
<tr>
<td>- Works within 90 min of initiation of tx</td>
<td>- Works within 30 min of initiating cath</td>
</tr>
<tr>
<td>- Initial success in 65-75% of pts</td>
<td>- Initial success in &gt;95% of pts</td>
</tr>
<tr>
<td>- 20-30% reocclude artery</td>
<td>- &lt;1% reocclude artery</td>
</tr>
<tr>
<td>- Intracranial bleed in approx 1%</td>
<td>- Intracranial bleed risk &lt;0.1%</td>
</tr>
<tr>
<td>- Artery left with severe stenosis</td>
<td>- Artery left with 0% residual stenosis</td>
</tr>
<tr>
<td>- Available in most, if not all hospitals</td>
<td>- Available in &lt;1/3 of hospitals</td>
</tr>
</tbody>
</table>

Acute Coronary Syndromes: Treatment: STEMI

- Delays are a major problem, with delays at several steps:
  - Patient delays seeking medical help (denial, poor access, social issues)
  - Delay in ER staff performing EKG
  - Delay in EKG being presented to MD for interpretation
  - Delay in drugs being mixed in pharmacy and administered to pt
  - Delay in transporting pt from ER to cath lab or from one hospital to another
  - Delay in cath lab staff coming in from home
STEMI: The Aftermath

- Therapies to start before hospital discharge:
  - ACE inhibitors (prevent post-MI cardiac enlargement or “remodeling”, and sudden death)
  - Statins (decrease lipids and change vulnerable, rupture-prone plaques to stable plaques)
  - Aldosterone receptor antagonists (improve survival in pts with severe LV dysfunction post-MI)
  - (These are all in addition to ASA, clopidogrel, beta-blocker)

STEMI: Summary

- Coronary thrombosis is a hallmark of acute coronary syndromes
- Much of the therapy for STEMI is directed at interrupting the vicious cycle of thrombosis (e.g., ASA, clopidogrel, heparin, IIb/IIIa blockers)
- In STEMI, emergent reperfusion can be life-saving, the sooner the better
- We must continue efforts to decrease delays in opening the occluded artery in STEMI pts

STEMI: Summary

- Unstable or “vulnerable” plaques are lipid-filled, tense, metabolically active, and prone to rupture, causing acute coronary syndromes
- A main focus of treating CAD pts is transforming vulnerable plaques to stable plaques. Statins are the drugs with the most evidence supporting this.