

Chest Pain: the Anginal Syndromes



Howard J. Sachs, MD
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Chest Pain - How do we know it's an anginal syndrome?

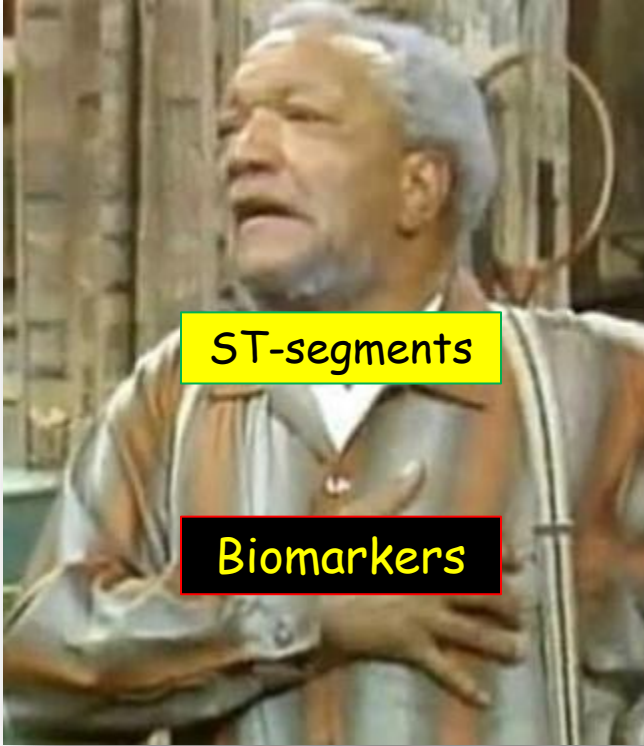


Chest Pain - How do we know it's an anginal syndrome?

Angina



Test	Result
Troponin I, Quantitative	< 0.01 ng/mL



ST-segments

Biomarkers

The Big One



Test	Result
Troponin I, Quantitative	12.75 ng/mL

Chest Pain - How do we know
it's an anginal syndrome?

"Rule in" Typical Angina

Typical Chest Pain
(tightness, squeezing, pressure)



Three Anginal Syndromes:

- Chronic **Stable**: Exertional, **relieved with rest**
- **Unstable** (ACS): Not relieved with rest and/or Non-exertional
- **Vasospastic** (Variant, Prinzmetal): Non-exertional

Chest Pain - How do we know
it's an anginal syndrome?

MI, discussed in a separate video, is **characterized** by:

- Anginal Chest pain **PLUS**
- EKG Abnormality, and/or
- Elevation of Biomarkers

The **NBME** will use the **MI** presentation to query
a completely separate set of derivatives.

- Vasospastic: Non-exertional

Chest Pain - How do we know it's an anginal syndrome?



MI, disc

erized by:

- An
- EK
- Elevation of biomarkers

Test	Result
Troponin I, Quantitative	12.75 ng/mL

The NE

to query ives.

Vasospastic: Non-exertional

"Rule

Typ (tightness

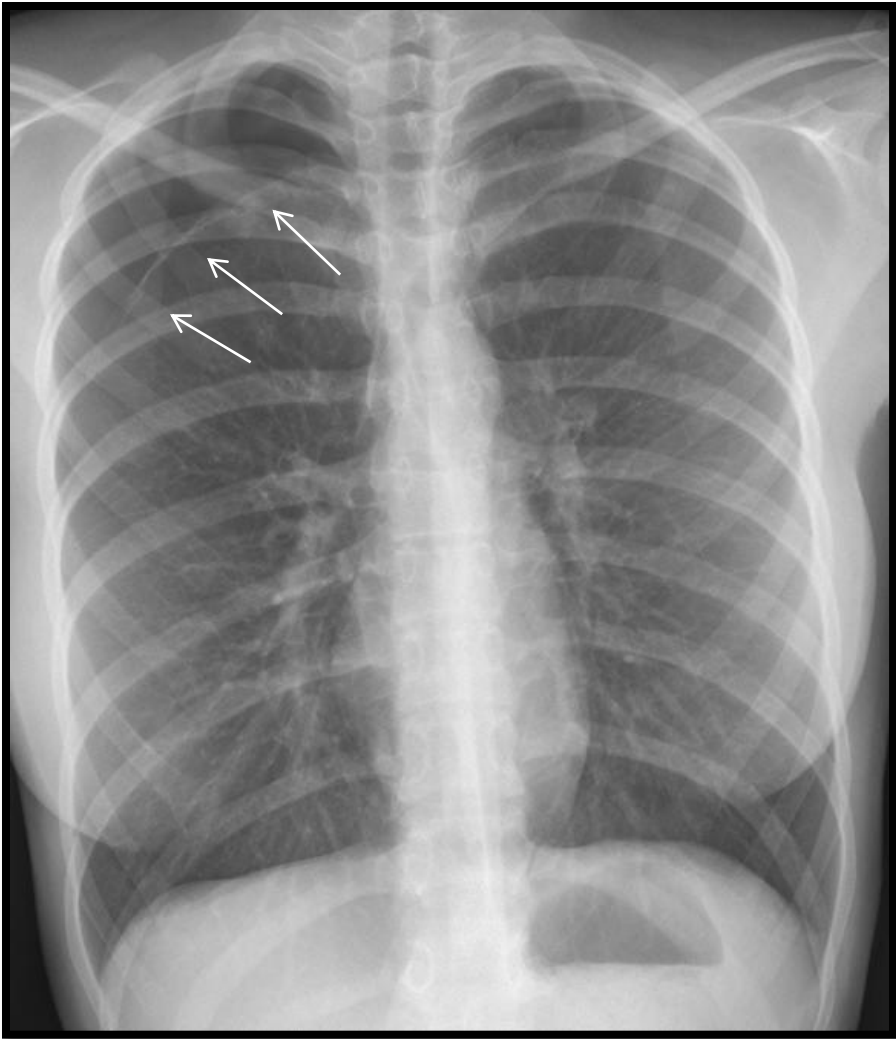
Chest Pain - How do we know it's an anginal syndrome?

"Rule in" Typical Angina

Typical Chest Pain
(tightness, squeezing, pressure)

"Rule out" **Non-Anginal CP**

Pericardial: Sharp, Positional (Pericarditis)
Pulmonary: Pleuritic (PE), PTX
Aortic: Ripping, Tearing (Dissection)
MVP: Young woman with click



- How do we know
if it's a non-anginal syndrome?

↓
"Rule out" **Non-Anginal CP**

Pericardial: Sharp, Positional (Pericarditis)
Pulmonary: Pleuritic (PE), PTX
Aortic: Ripping, Tearing (Dissection)
MI: Young woman with click

Height	5 ft 6.7 in
Weight	112 lb
BMI Calculated	17.7kg/m ²

Chest Pain - How do we know it's an anginal syndrome?

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(tightness, squeezing, pressure)

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Chest Pain - How do we know
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"Rule out" Non-Anginal CP

Pericardial: Sharp, Positional (Pericarditis)
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Aortic: Ripping, Tearing (Dissection)
MVP: Young woman with click

When they present these modifiers, they are specifically
telling you the patient does **NOT** have CAD as etiology

Chest Pain - How do we know it's an anginal syndrome?

"Rule in" Typical Angina

Typical Chest Pain
(tightness, squeezing, pressure)

"Rule out" Non-Anginal CP

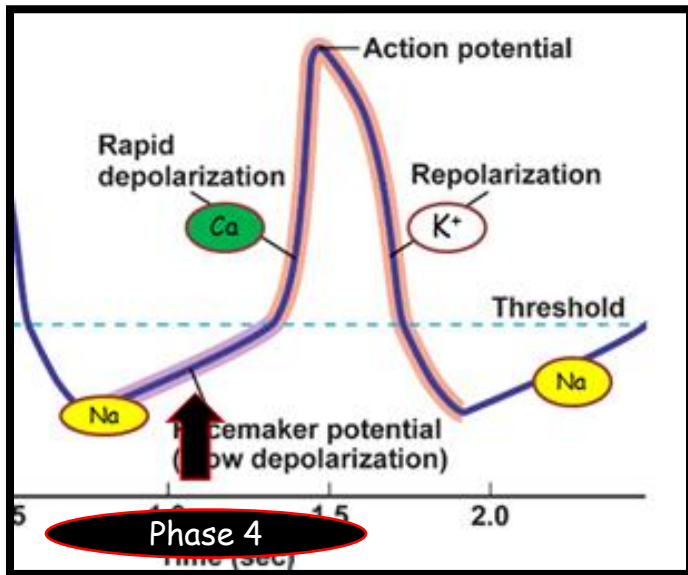
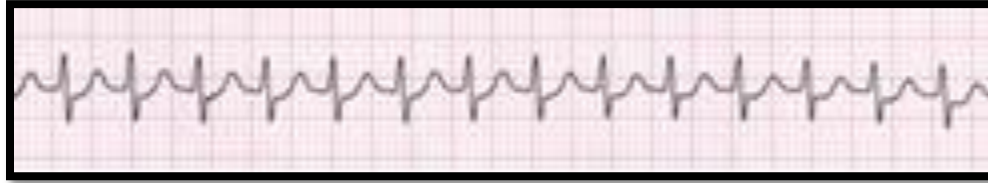
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Pulmonary: Pleuritic (PE), PTX
Aortic: Ripping, Tearing (Dissection)
MVP: Young woman with click

Hardly Worth Mentioning

Asthma, MSK, Zoster, Esophagus, Hepatobiliary, Pancreas

Aortic stenosis, Tachyarrhythmia, Adenosine

Aortic stenosis, Tachyarrhythmia, Adenosine



Affects phase 4 of the action potential reducing the rate of spontaneous depolarization

(opens K channels which hyperpolarizes cells of the AV node; decreases slope of phase 4)

Adverse Effect: Chest pain and flushing

the Anginal Syndromes: *the Language*

Stable Angina

Unstable Angina

Vasospasm

History

Relieved with rest

Not relieved w/ rest
Non-exertional

Non-exertional

No Relief With Rest OR
Non-exertional onset

the Anginal Syndromes

Stable Angina

Unstable Angina

Vasospasm

History

Relieved with rest

Not relieved w/ rest
Non-Exertional

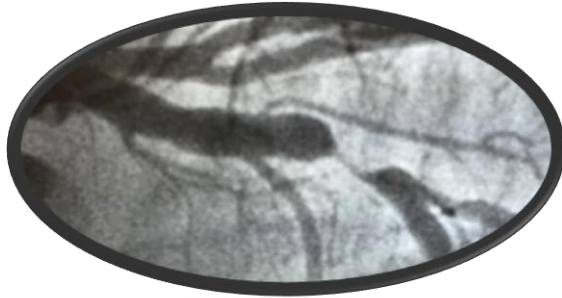
Non-Exertional

Data

Obstructive Disease
>70-80%

Obstructive plus
(partial) **Thrombus**

Non-Obstructive
plus **Spasm**



the Anginal Syndromes

Stable Angina

Unstable Angina

Vasospasm

History

Relieved with rest

Not relieved w/ rest
Non-Exertional

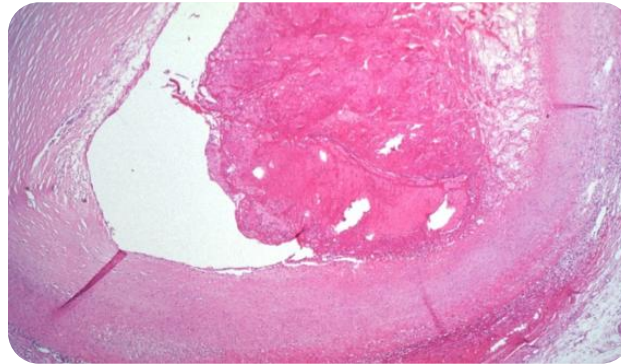
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the Anginal Syndromes

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Unstable Angina

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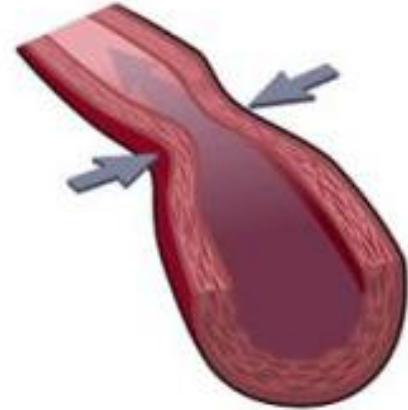
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the Anginal Syndromes

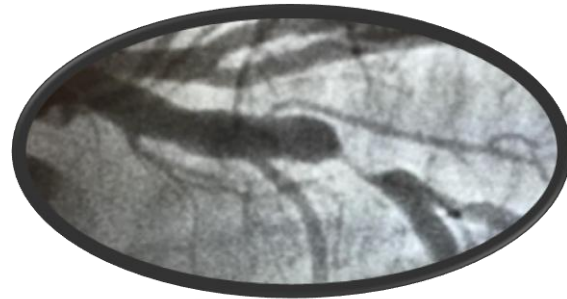
	Stable Angina	Unstable Angina	Vasospasm
History	Relieved with rest	Not relieved w/ rest Non-Exertional	Non-Exertional
Data	Obstructive Disease >70-80%	Obstructive plus Thrombus	Non-Obstructive plus Spasm

Pathophysiology

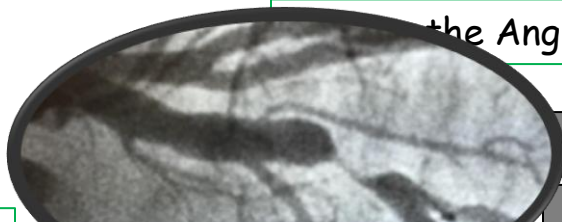
Flow-limiting during period of
increased oxygen demand

No Plaque Rupture
No Thrombus

Key Point:
Subendocardial Hypoperfusion



the Anginal Syndromes



Unstable Angina

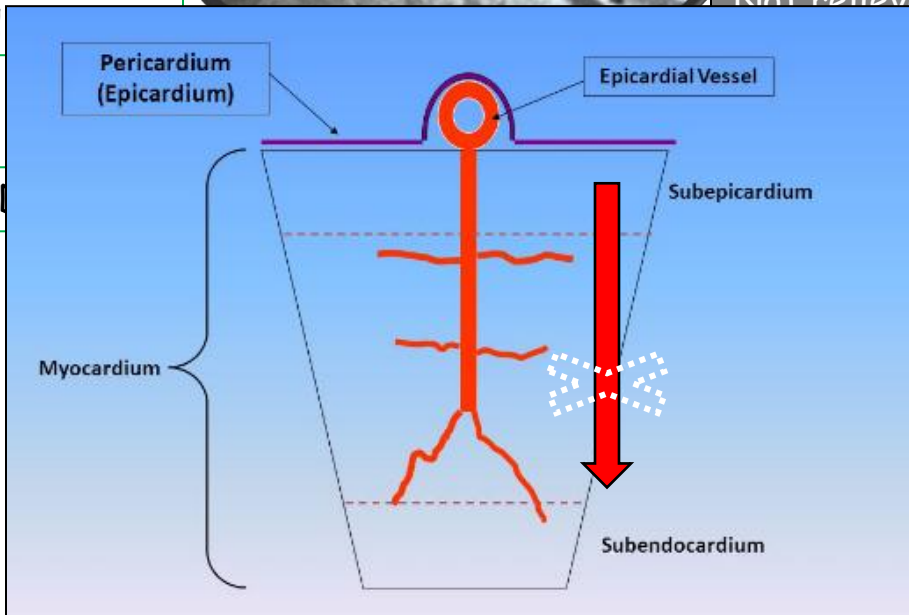
Not relieved w/ rest
Exertional

Vasospasm

Non-Exertional

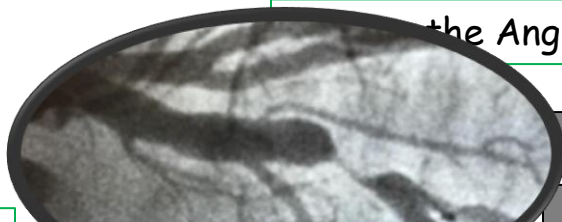
Stenotic plus
Thrombus

Non-Obstructive
plus Spasm



Key Point:
Subendocardial Hypoperfusion

the Anginal Syndromes



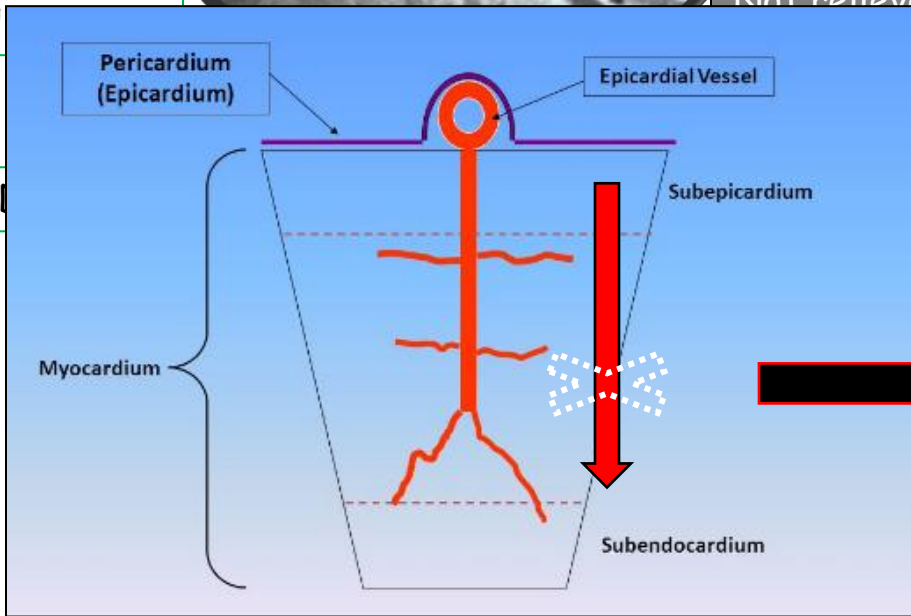
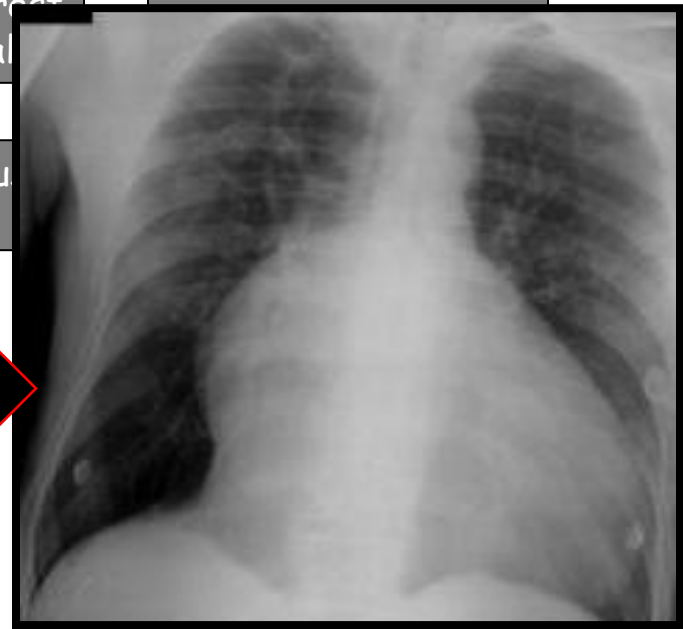
Unstable Angina

Vasospasm

Not relieved w/ rest

Intermittent

Refractory to nitroglycerin



Key Point:
Subendocardial Hypoperfusion

the Anginal Syndromes

Stable Angina

Unstable Angina

History

Relieved with rest

Not relieved w/ rest
Non-Exertional

Data

Obstructive Disease
>70-80%

Obstructive plus
Thrombus

Pathophysiology

Key Derivatives:

Subendocardial Hypoperfusion → Hibernating Myocardium



Hibernating: impaired LV function due to **CHRONICALLY** reduced coronary blood flow. May be reversed with restoration of blood flow (i.e. revascularization)

the Anginal Syndromes

	Stable Angina	Unstable Angina	Vasospasm
History	Relieved with rest	Not relieved w/ rest Non-Exertional	Non-Exertional
Data	Obstructive Disease >70-80%	Obstructive plus Thrombus	Non-Obstructive plus Spasm
	Pathophysiology		

Key Derivatives:

Subendocardial Hypoperfusion → Hibernating Myocardium

Hibernating and **Stunned** Myocardium - both characterized by:
1) reduced coronary blood flow and 2) transient (reversible) impairment of LV function.

Hibernating: impaired function due to **CHRONICALLY** reduced coronary blood flow. May be reversed with restoration of blood flow (i.e. revascularization)

Stunned: impaired function due to **ACUTE** vessel occlusion (but prior to myocardial cell death)

the Anginal Syndromes

Stable Angina

Unstable Angina

Vasospasm

History

Relieved with rest

Not relieved w/ rest
Non-Exertional

Non-Exertional

Data

Obstructive Disease
70-80%

Obstructive plus
Thrombus

Non-Obstructive
plus Spasm

Pathophysiology

Plaque rupture → Thrombus → Partial Occlusion

the Anginal Syndromes

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Unstable Angina

Vasospasm

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Relieved with rest

Not relieved w/ rest
Non-Exertional

Non-Exertional

Data

Obstructive Disease
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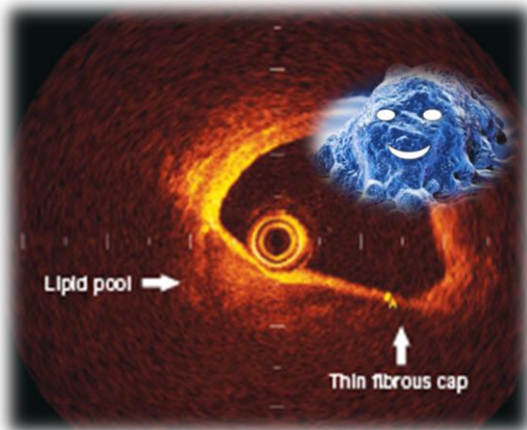
Obstructive plus
Thrombus

Non-Obstructive
plus Spasm

Pathophysiology

Plaque rupture → Thrombus → Partial Occlusion

What causes plaque rupture?: Metalloproteinases



the Anginal Syndromes

Stable Angina

Unstable Angina

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Non-Exertional

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Obstructive Disease
70-80%

Obstructive plus
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Pathophysiology

Plaque rupture → Thrombus → Partial Occlusion

What causes plaque rupture?: Metalloproteinases



Test	Result
Troponin I, Quantitative	< 0.01 ng/mL

How do we identify **partial occlusion**?:
ST segment depression with **negative biomarkers**.

the Anginal Syndromes

Stable Angina

Unstable Angina

Vasospasm

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Relieved with rest

Not relieved w/ rest
Non-Exertional

Non-Exertional

Data

Obstructive Disease
70-80%

Obstructive plus
Thrombus

Non-Obstructive
plus Spasm

Pathophysiology

Vascular smooth mm hyperreactivity
Potential mediators?: TXA₂, endothelin

Reversible myocardial hypoperfusion/injury:
ST segments may ↑; negative biomarkers

the Anginal Syndromes

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Unstable Angina

Vasospasm

History

Relieved with rest

Not relieved w/ rest
Non-Exertional

Non-Exertional

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Obstructive Disease
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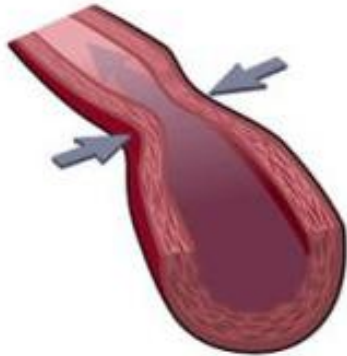
Obstructive plus
Thrombus

Non-Obstructive
plus Spasm

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Potential mediators?: TXA₂, endothelin

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the Anginal Syndromes

Stable Angina

Unstable Angina

Vasospasm

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Obstructive Disease
70-80%

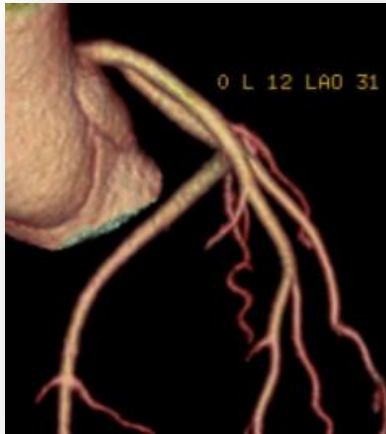
Obstructive plus
Thrombus

Non-Obstructive
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Potential mediators?: TXA₂, endothelin

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the Anginal Syndromes

Stable Angina

Unstable Angina

Vasospasm

History

Relieved with rest

Not relieved w/ rest
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Non-Exertional

Data

Obstructive Disease
70-80%

Obstructive plus
Thrombus

Non-Obstructive
plus Spasm

Modifiers

Stress Test
Angiography

EKG
Biomarkers (-)

Stress Test, Angiography
Provocation: **Ergonovine**

the Anginal Syndromes

	Stable Angina	Unstable Angina	Vasospasm
History	Relieved with rest	Not relieved w/ rest Non-Exertional	Non-Exertional
Data	Obstructive Disease 70-80%	Obstructive plus Thrombus	Non-Obstructive plus Spasm
Modifiers	Stress Test Angiography	EKG Biomarkers (-)	Stress Test, Angiography Provocation: Ergonovine

Ergonovine:

- α -agonist used diagnostically
- Elicits vasospasm in **reactive segments** of coronary vessels

the Anginal Syndromes

Stable Angina

Unstable Angina

Vasospasm

History

Relieved with rest

Not relieved w/ rest
Non-Exertional

Non-Exertional

Data

Obstructive Disease
70-80%

Obstructive plus
Thrombus

Non-Obstructive
plus Spasm

Modifiers

Stress Test
Angiography

EKG
Biomarkers (-)

Stress Test, Angiography
Provocation: Ergonovine

the Anginal Syndromes

Stable Angina

Unstable Angina

Vasospasm

History

Relieved with rest

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Non-Exertional

Non-Exertional

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Obstructive Disease
70-80%

Obstructive plus
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plus Spasm

Modifiers

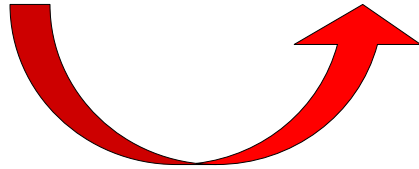
Stress Test
Angiography

EKG
Biomarkers (-)

Stress Test, Angiography
Provocation: Ergonovine

the Anginal Syndromes

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History	Relieved with rest	Not relieved w/ rest Non-Exertional	Non-Exertional
Data	Obstructive Disease 70-80%	Obstructive plus Thrombus	Non-Obstructive plus Spasm
Modifiers	Stress Test Angiography	EKG Biomarkers (-)	Stress Test, Angiography Provocation: Ergonovine



Note: a patient with chronic stable angina may progress to unstable angina (i.e. they rupture a plaque and now have rest pain).

the Anginal Syndromes

Stable Angina

History

Relieved with rest

Data

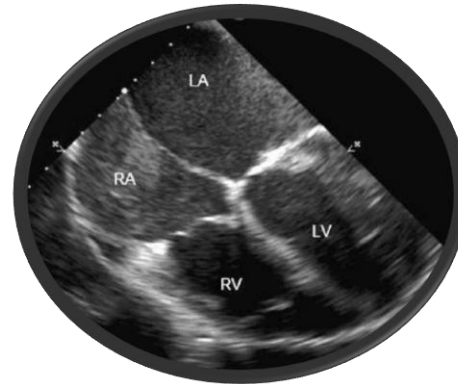
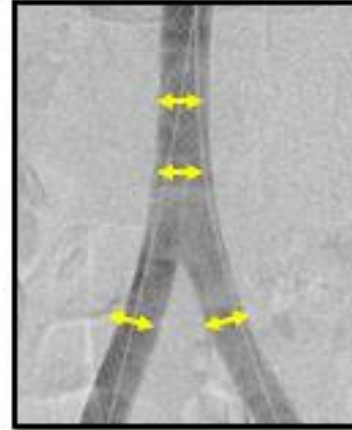
Obstructive Disease
70-80%

Modifiers

Stress Test
Angiography

Pharmacology
Derivatives

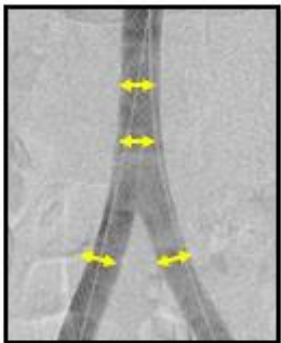
β -blockers
Nitrates



Venodilation



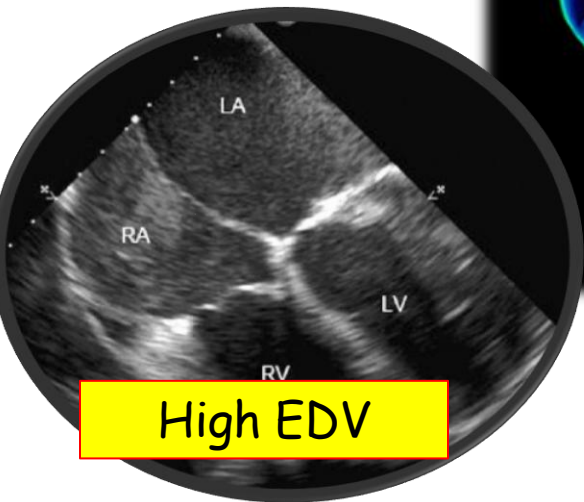
↓ Preload
(↓ EDV)



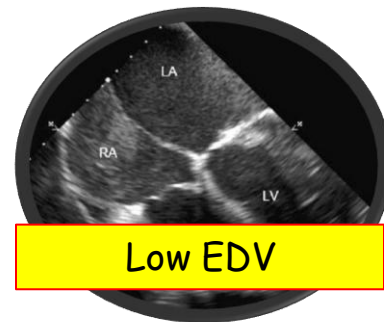
Veins on Angina



Veins on NTG



High EDV



Low EDV

the Anginal Syndromes

Stable Angina

Unstable Angina

Vasospasm

History

Relieved with rest

Not relieved w/ rest
Non-Exertional

Non-Exertional

Data

Obstructive Disease
70-80%

Obstructive plus
Thrombus

Non-Obstructive
plus Spasm

Modifiers

Stress Test
Angiography

EKG
Biomarkers (-)

Stress Test, Angiography
Provocation: Ergonovine

Pharmacology
Derivatives

β -blockers
Nitrates

Calcium Channel Blockers
Nitrates

the Anginal Syndromes

	Stable Angina	Unstable Angina	Vasospasm
History	Relieved with rest	Not relieved w/ rest Non-Exertional	Non-Exertional
Data	Obstructive Disease >70-80%	Obstructive plus Thrombus	Non-Obstructive plus Spasm

Typical Questions:

Patient with exertional chest pain relieved with rest.

- Which of the following are most likely to be noted on coronary angiogram? Which of the following are most likely hypoperfused?
- Patient noted with a decreased ejection fraction that improves following revascularization. Which of the following best explains this finding? (Hibernation or Stunning)
- Patient with chest pain during an activity which increases oxygen demand. The pain is relieved with a pill taken sublingually. What is the MOA or mechanism of symptom relief?

the Anginal Syndromes

	Stable Angina	Unstable Angina	Vasospasm
History	Relieved with rest	Not relieved w/ rest Non-Exertional	Non-Exertional
Data	Obstructive Disease >70-80%	Obstructive plus Thrombus	Non-Obstructive plus Spasm

Typical Questions with Answers:

Patient with exertional chest pain relieved with rest.

- Which of the following are most likely to be noted on coronary angiogram (>70% occlusion)? Which of the following are most likely hypoperfused (Subendocardium)?
- Patient noted with a decreased ejection fraction that improves following revascularization. Which of the following best explains this finding? (Hibernation or Stunning)
- What is the MOA (\uparrow cGMP \rightarrow \downarrow IC Calcium) or mechanism of symptom relief (Venodilation/ \downarrow EDV)?

the Anginal Syndromes

	Stable Angina	Unstable Angina	Vasospasm
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Data	Obstructive Disease 70-80%	Obstructive plus Thrombus	Non-Obstructive plus Spasm

Typical Question:

Patient with history of exertional chest pain relieved with rest now experiences pain at rest. EKG during episode shows transient ST segment depressions. Troponin is not detected in serum.

- Which best characterizes his presentation? (Stable, Unstable, Vasospasm, NSTEMI)
- Which of the following was precipitating event? (Progressive obstruction, Thrombus with complete obstruction, Thrombus with partial obstruction)

the Anginal Syndromes

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the Anginal Syndromes

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History	Relieved with rest	Not relieved w/ rest Non-Exertional	Non-Exertional
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Typical Question:

Patient with nocturnal chest pain. EKG reveals ST segment elevation. Troponin 1.0 ng/mL. Stress test (or angiogram) fails to reveal occlusive disease.

- What is his most likely diagnosis? (Stable, Unstable, STEMI, Prinzmetal's)
- He receives an agent (name the agent) during angiogram that induces vasospasm (MOA of that agent)?
- Best treatment option of this patient?

the Anginal Syndromes

	Stable Angina	Unstable Angina	Vasospasm
History	Relieved with rest	Not relieved w/ rest Non-Exertional	Non-Exertional
Data	Obstructive Disease 70-80%	Obstructive plus Thrombus	Non-Obstructive plus Spasm

Typical Questions with Answers:

Patient with nocturnal chest pain. EKG reveals ST segment elevation.
Troponin 1.0 ng/mL. Stress test (or angiogram) fails to reveal occlusive disease.

- What is his most likely diagnosis? (Stable, Unstable, STEMI, **Prinzmetal's**)
- He receives an agent (**ergonovine**) during angiogram that induces vasospasm (**α -agonist**)?
- Best **treatment** option of this patient: calcium channel blocker (amlodipine, diltiazem, verapamil) +/- nitrate preparation.

the Index Cards

Me: Take Less Notes, Not More...

Student: What is the material I need to know???

Chronic Stable Angina

- History:
 - Exertional, relieved with rest
- Pathophysiology
 - Fixed obstructive lesion $>70\%$ → flow limitation
 - Provoked by increased myocardial oxygen demand
 - Characterized by hypoperfusion of the subendocardium
- Data:
 - Angiographically detected lesion
 - No evidence of thrombus
 - Stress testing may detect ST-segment changes that resolve in recovery phase
- Derivatives
 - Myocardial hibernation: LV dysfunction due to chronic hypoperfusion that may be reversible with revascularization
 - Treatment may include β -blockers and/or nitrates

Unstable Angina (ACS)

- History:
 - Not provoked by exertion (or exertional and not relieved by rest)
- Pathophysiology
 - Precipitated by **rupture** of 'vulnerable **plaque**' with associated **partially-occluding thrombus**
 - Plaque instability mediated, in part, by $M\Phi$ metalloproteinases
- Data
 - ST-segment Δ (usually depression) with possible T-wave abnormality (inversions)
 - Distinguished from NSTEMI by **negative biomarkers**

Vasospastic Angina

- History:
 - Non-exertional (not provoked by increase in myocardial oxygen demand); **Nocturnal**
- Pathophysiology
 - Vascular smooth muscle **hyperreactivity**
 - **Vasospasm** in reactive segments **provoked** by **ergonovine** (α -agonist)
- Data
 - ST segment elevation (during episode)
 - May be detected during ambulatory EKG monitoring
 - **No evidence of occlusive coronary disease**
 - May have non-occlusive lesions as substrate for vasoreactivity
 - Occlusive disease is excluded (on USMLE) by any negative test for ischemia including stress testing or angiogram
- Derivative
 - Treatment may include nitrates and/or **calcium channel blockers**

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