Creighton EMS Refresher 2012

ACS-STEMI

Introduction

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Goals and Protocols

Introduction

- 12 Lead is Standard of Care

- State recognizes need for all EMS to acquire
  - EMT application and transmission
  - Grant for equipment

Acute Myocardial Infarction (AMI)

- *Definition:*

Death of Heart Tissue

due to

Obstruction of Blood Flow

AMI - Critical Concept

- AMI is not a single event
- It is a rapidly evolving process

The Goal:

Identify, Intervene, and

STOP HEART MUSCLE DEATH

Prehospital Issues

- 1.2 million Americans experience AMI annually
- 400,000 die in the field (ER)
- Most deaths are arrhythmic
- EMS must act with urgency

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Deaths from coronary heart disease

"People live with their own idiosyncrasies and die of their own illnesses."
Vietnamese proverb

Civilization kills. Since 1990, more people have died from coronary heart disease than from any other cause. Unlike stroke, coronary heart disease is a comparative newcomer on the world stage. Variations in death rates are marked: they are lower in populations with short life expectancy.

Heart disease mortality rates are also affected by differences between countries in the major risk factors, especially blood pressure, blood cholesterol, smoking, physical activity and diet. While genetic factors play a part, 80% to 90% of people dying from coronary heart disease have one or more major risk factors that are influenced by lifestyle.

Death rates from coronary heart disease have decreased in North America and many western European countries. This decline has been due to improved prevention, diagnosis, and treatment, in particular reduced cigarette smoking among adults, and lower average levels of blood pressure and blood cholesterol. It is expected that 82% of the future increase in coronary heart disease mortality will occur in developing countries.

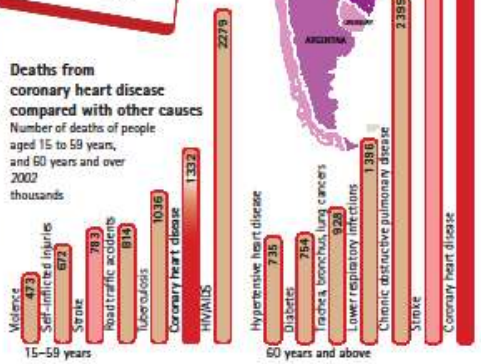
Of all coronary heart disease patients who die within 28 days after the onset of symptoms, about two-thirds die before reaching hospital. This highlights not only the need for early recognition of the warning signs of a heart attack, but also the need for prevention.

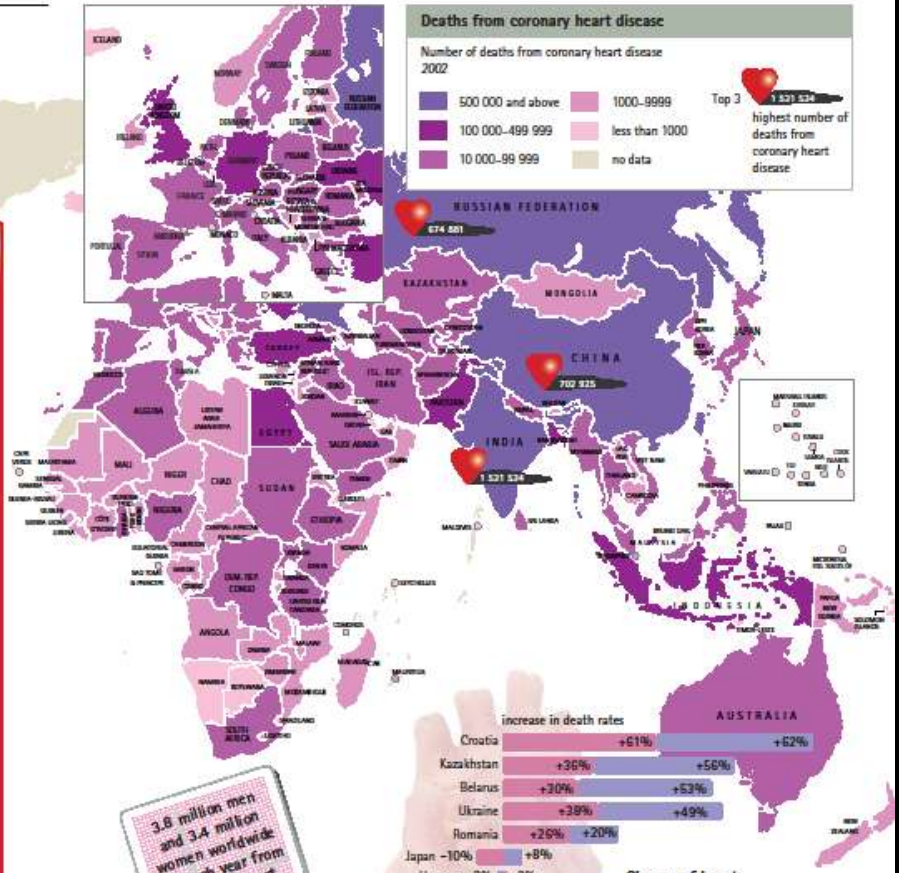
Despite improvements in survival rates, in the USA 1 in 4 men and 1 in 3 women still die within a year of a recognized first heart attack.

Coronary heart disease is now the leading cause of death worldwide. It is on the rise and has become a true pandemic that respects no borders.

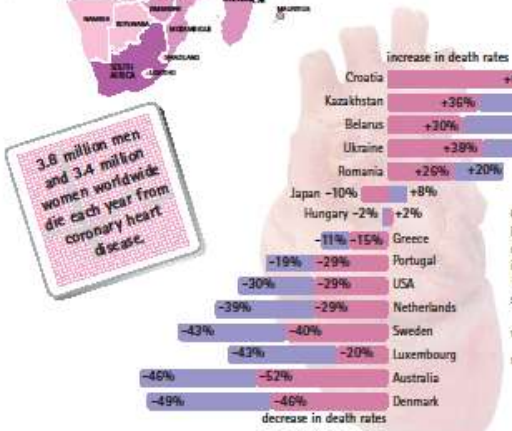
Deaths from coronary heart disease compared with other causes

Number of deaths of people aged 15 to 59 years, and 60 years and over
2002
thousands





3.8 million men and 3.4 million women worldwide die each year from coronary heart disease.



Change of heart

Percentage change in coronary heart disease death rates, in people aged 35 to 74 years
1988–1998
selected countries

women
men

1 Types of cardiovascular disease

"All the knowledge I possess everyone else can acquire, but my heart is all my own."
Johann Wolfgang von Goethe
The Sorrows of Young Werther 1774

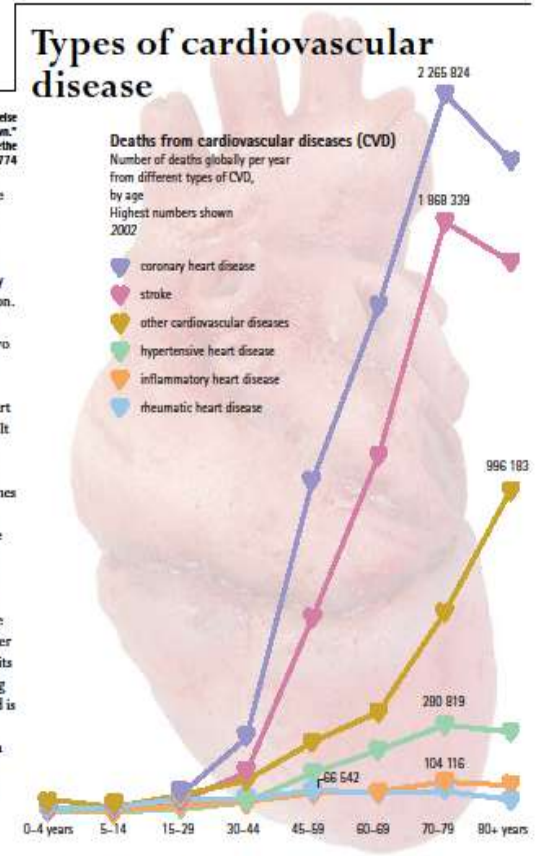
The human heart is only the size of a fist, but it is the strongest muscle in the human body.

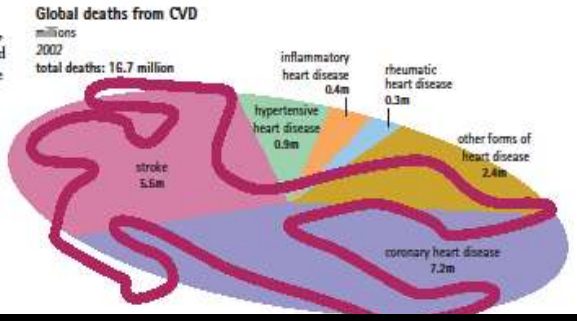
The heart starts to beat in the uterus long before birth, usually by 21 to 28 days after conception. The average heart beats about 100 000 times daily or about two and a half billion times over a 70 year lifetime.

With every heartbeat, the heart pumps blood around the body. It beats approximately 70 times a minute, although this rate can double during exercise or at times of extreme emotion.

Blood is pumped out from the left chambers of the heart. It is transported through arteries of ever-decreasing size, finally reaching the capillaries in all the tissues, such as the skin and other body organs. Having delivered its oxygen and nutrients and having collected waste products, blood is brought back to the right chambers of the heart through a system of ever-enlarging veins. During the circulation through the liver, waste products are removed.

This remarkable system is vulnerable to breakdown and assault from a variety of factors, many of which can be prevented and treated. Risk factors will be explored on pages 24–43.





Stroke

Strokes are caused by disruption of the blood supply to the brain. This may result from either blockage (ischaemic stroke) or rupture of a blood vessel (haemorrhagic stroke).
Risk factors High blood pressure, atrial fibrillation (a heart rhythm disorder), high blood cholesterol, tobacco use, unhealthy diet, physical inactivity, diabetes, and advancing age.

Coronary heart disease kills more than 7 million people each year, and strokes kill nearly 6 million. Most of these deaths are in developing countries.

Coronary heart disease

Disease of the blood vessels supplying the heart muscle.
Major risk factors High blood pressure, high blood cholesterol, tobacco use, unhealthy diet, physical inactivity, diabetes, advancing age, inherited (genetic) disposition.
Other risk factors Poverty, low educational status, poor mental health (depression), inflammation and blood clotting disorders.

Rheumatic heart disease

Damage to the heart muscle and heart valves from rheumatic fever, caused by streptococcal bacteria.

Congenital heart disease

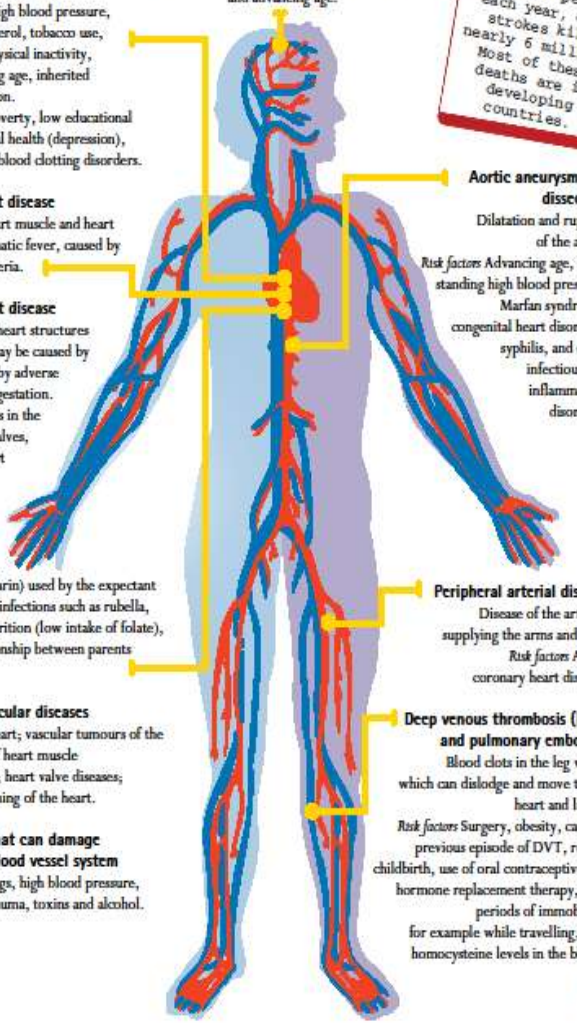
Malformations of heart structures existing at birth may be caused by genetic factors or by adverse exposures during gestation. Examples are holes in the heart, abnormal valves, and abnormal heart chambers.
Risk factors Maternal alcohol use, medicines (for example thalidomide, warfarin) used by the expectant mother, maternal infections such as rubella, poor maternal nutrition (low intake of folate), close blood relationship between parents (consanguinity).

Other cardiovascular diseases

Tumours of the heart; vascular tumours of the brain; disorders of heart muscle (cardiomyopathy); heart valve diseases; disorders of the lining of the heart.

Other factors that can damage the heart and blood vessel system

Inflammation, drugs, high blood pressure, unhealthy diet, trauma, toxins and alcohol.



Aortic aneurysm and dissection

Dilatation and rupture of the aorta.
Risk factors Advancing age, long-standing high blood pressure, Marfan syndrome, congenital heart disorders, syphilis, and other infectious and inflammatory disorders.

Peripheral arterial disease

Disease of the arteries supplying the arms and legs.
Risk factors As for coronary heart disease.

Deep venous thrombosis (DVT) and pulmonary embolism

Blood clots in the leg veins, which can dislodge and move to the heart and lungs.
Risk factors Surgery, obesity, cancer, previous episode of DVT, recent childbirth, use of oral contraceptive and hormone replacement therapy, long periods of immobility, for example while travelling, high homocysteine levels in the blood.

Acute Myocardial Infarction (AMI)

Prehospital Standard of Care -

- **Patient Assessment**
- **12 Lead ECG Screening**
- **PCI/Fibrinolysis Screening**

Standard of Care Rationale

- **Leading cause of death:** **Coronary Disease**
- **Cause of most AMIs:** **Thrombus**
- **Reduce time to Rx:** **Prehospital ECG**
- **Early Rx: (PCI/Fibrinolysis)** **Saves Lives**

“TIME IS MUSCLE”

The Prehospital ECG in AMI

Although adds Prehospital time:

- **Shortens in-hospital treatment time**
- **Patient's more likely to receive Fibrinolytics or percutaneous coronary intervention (PCI)**
- **Significantly reduces patient mortality**

Areas of Delay - National Heart Attack Alert Program

- **Patient**
- **Prehospital**
- **Hospital**

GOAL: 30 - 90 Minutes to Treatment

Cardiac Checklist - Key Components

- Focused History
- 12 Lead ECG
- Physical Examination
- Fibrinolytic Criteria

Cardiac Event Protocol

- *EMS SYSTEM APPROACH THAT SHOULD ADDRESS:*

- Oxygen - IV - cardiac monitor - vital signs
- *Nitroglycerin*
- *Aspirin*
- Pain relief with narcotics
- Notification of emergency department
- Rapid transport to emergency department
- Prehospital screening for PCI or *fibrinolytic* therapy
- 12-lead ECG, computer analysis, transmission:
  - to emergency department

- *"DOOR-TO-REPERFUSION" TEAM PROTOCOL APPROACH*

- Rapid triage of patients with chest pain
- Clinical decision maker established (emergency physician, cardiologist, or other)

Emergency Department Goal: 30 to 90 minutes

ASSESSMENT

- *Immediate:*

- Vital signs
- Oxygen at 4 L/min-Sat<94%
- *Aspirin*, if not given prior
- Start IV
- *Nitroglycerin* SL or spray
- *Morphine* IV
- 12-lead ECG (MD review)
- Focused history & physical
- Chest X-ray
- Blood (electrolytes, cardiac markers, coagulation studies)

TREATMENTS TO CONSIDER if there is evidence of coronary thrombosis plus no reasons for exclusion:

(some but not all may be appropriate)

- *Clopidogrel*
- *Nitroglycerin* IV
- *-Beta Blockers* IV
- *Heparin* IV
- Ace Inhibitors
- Statins
- Glycoprotein Inhibitors
- Consult as needed
- Decide eligibility for
- *PCI/Fibrinolysis*

Pathophysiology of STEMI

Pathophysiology

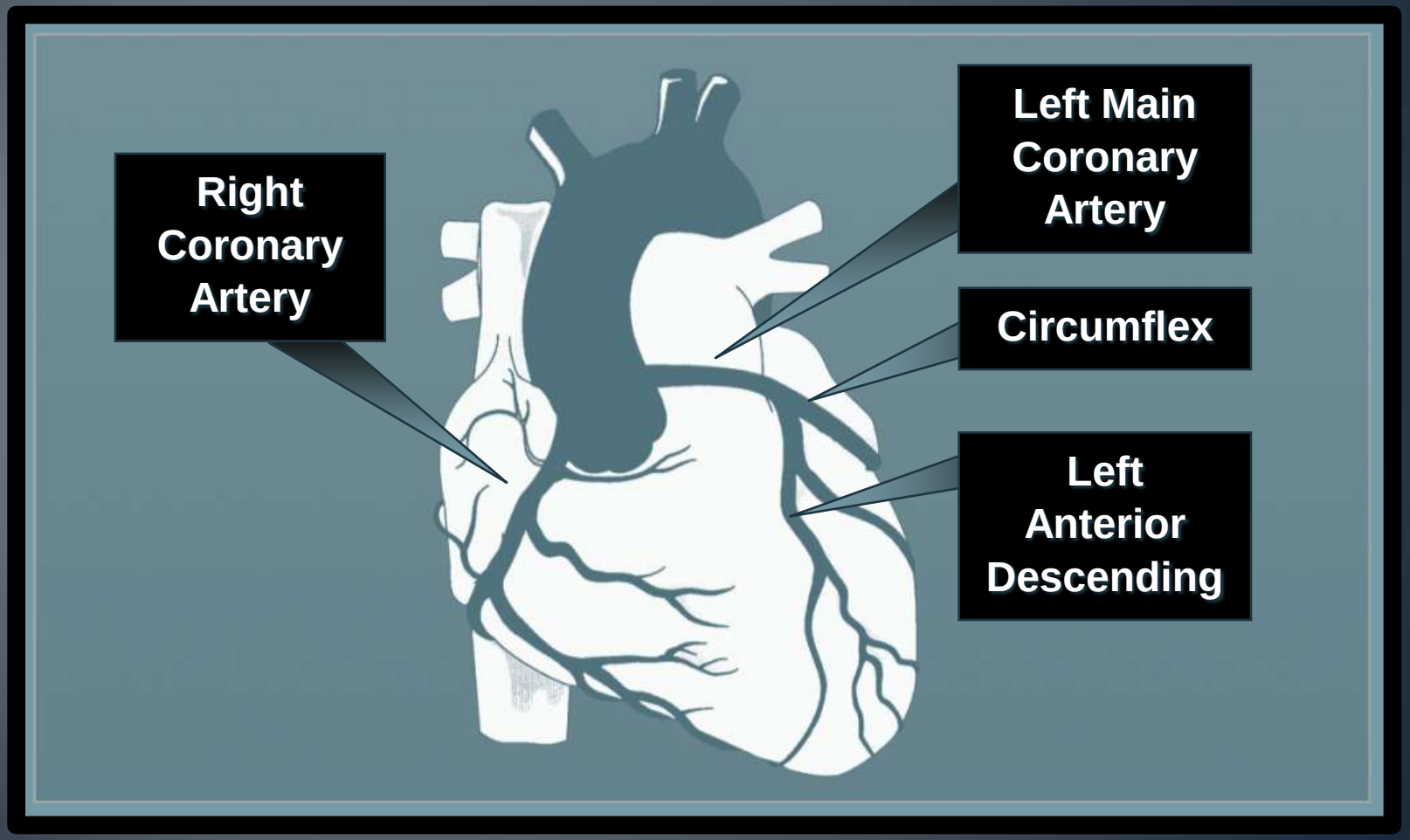
- AMI = Death of Heart Tissue (an evolving process)
- Coronary Occlusion: atherosclerosis / thrombus
- Mainly Left Ventricle (LV)
- Most of LV supplied by Left Coronary

Risk Factors - Coronary Artery Disease

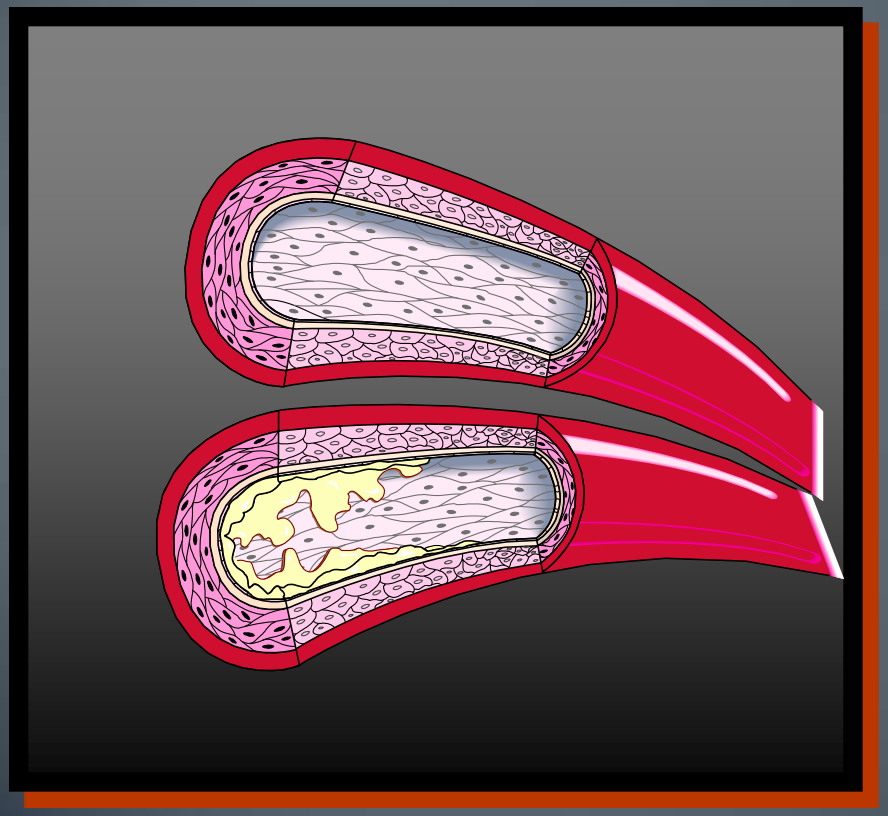
- Hyperlipidemia
- Age
- Male sex
- Tobacco use
- Alcohol use
- Hypertension

- Sedentary lifestyle / obesity
- Family history
- Diabetes mellitus

Coronary Arteries



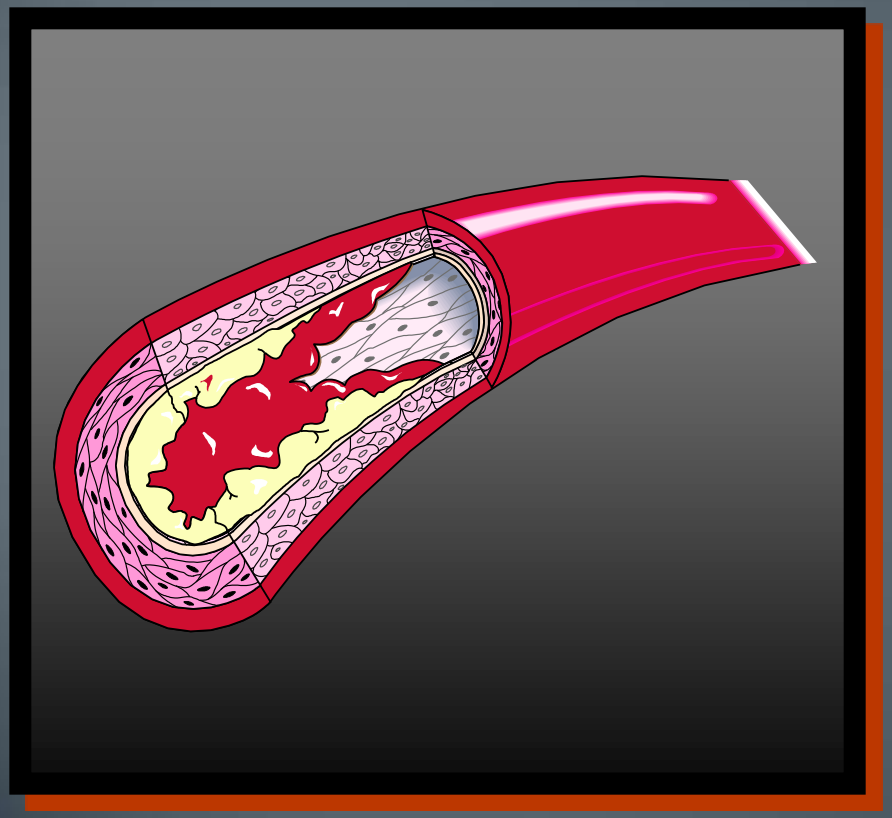
Atherosclerosis (plaque formation)



The *background* for most infarctions:

ATHEROSCLEROTIC NARROWING

Thrombosis (Clot)

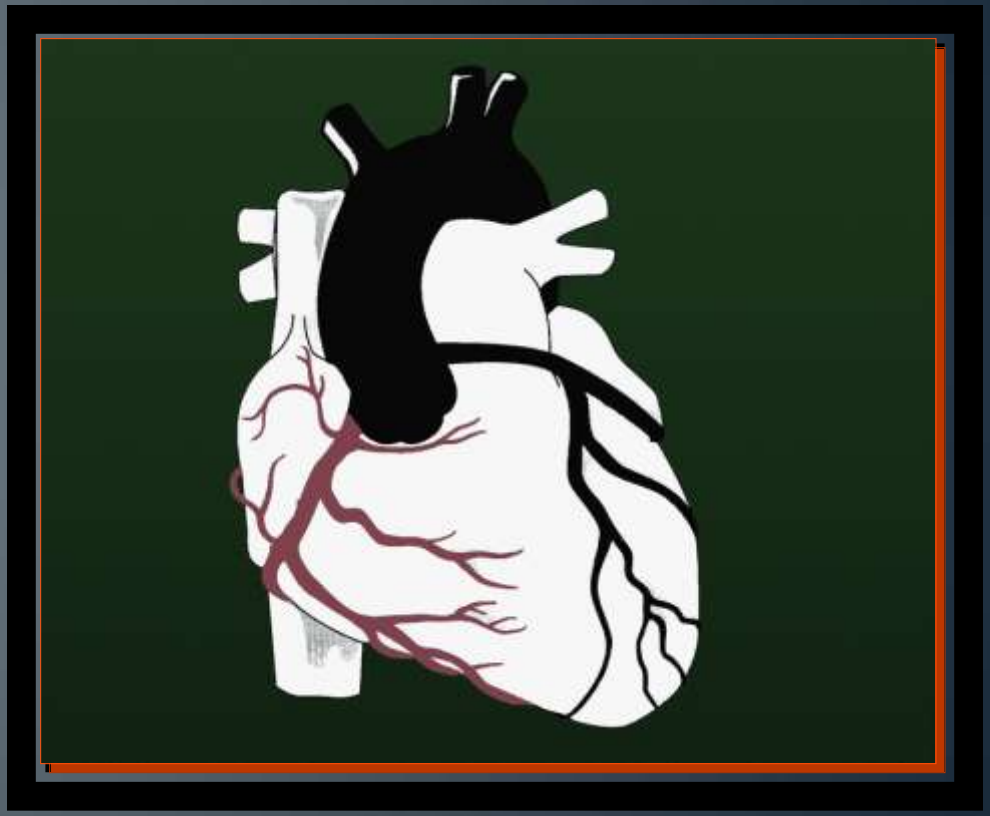


The *immediate cause* of most infarctions:

THROMBUS FORMATION

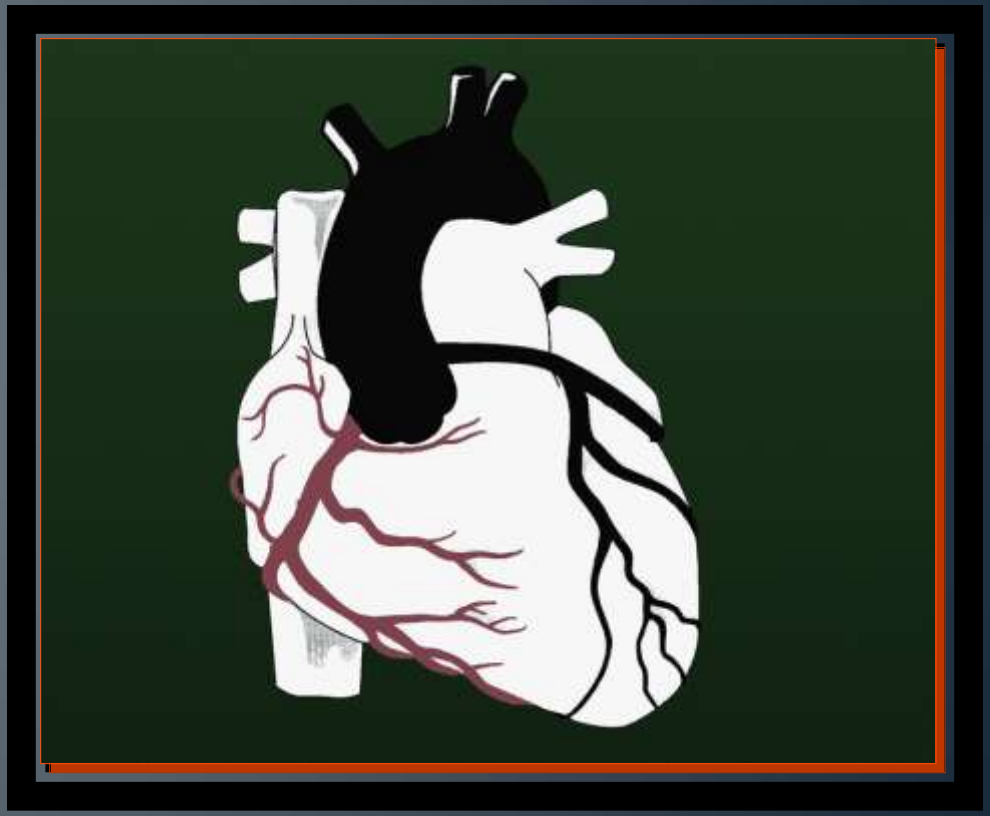
The Right Coronary Supplies

- Inferoposterior L.V.
- Posterior Septum
- Right Ventricle
- SA Node, AV Node

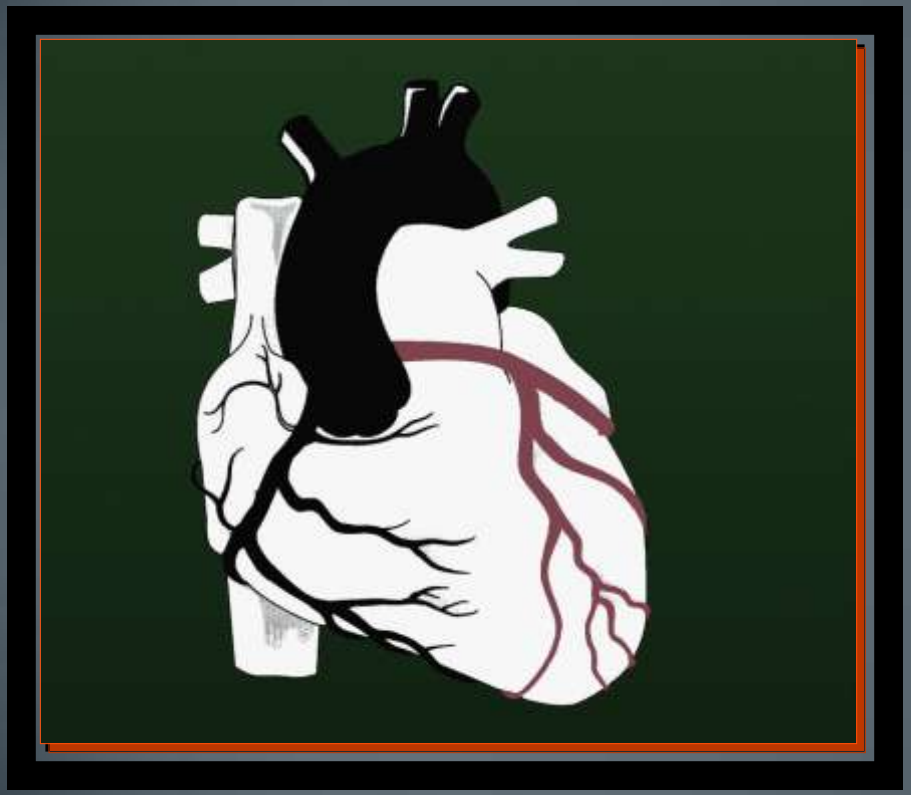


Right Coronary - Clinical Correlations

- Inferior/Posterior M.I.
- May Involve R.V.
- Bradycardia
- Heart-Block
  - (often transient)

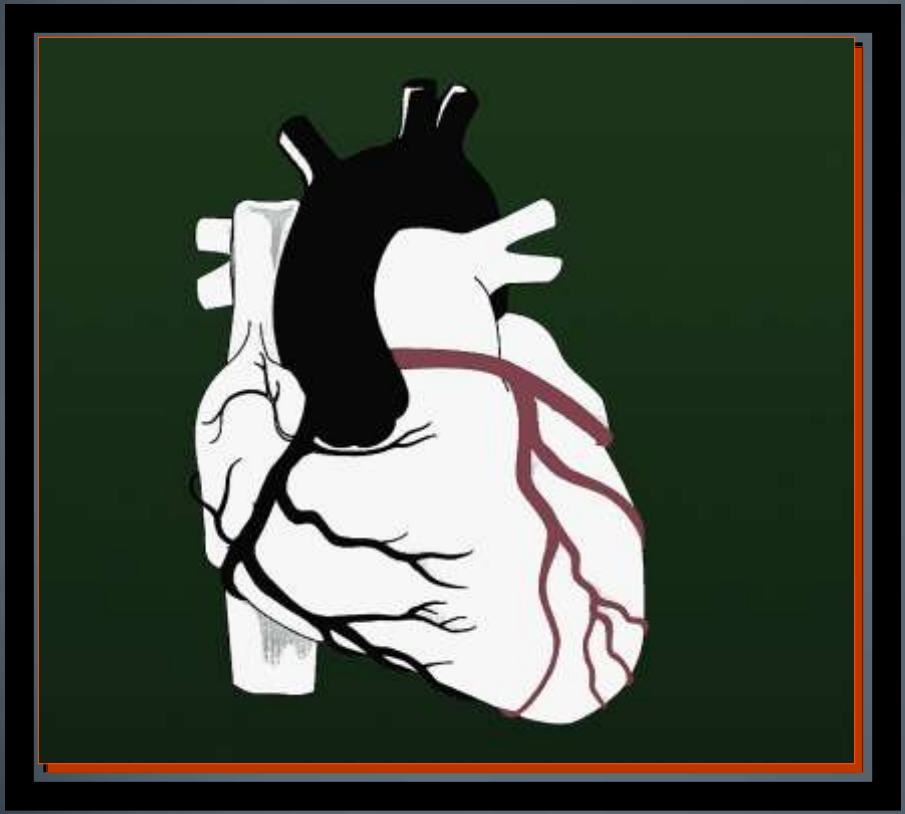


The Left Coronary Supplies



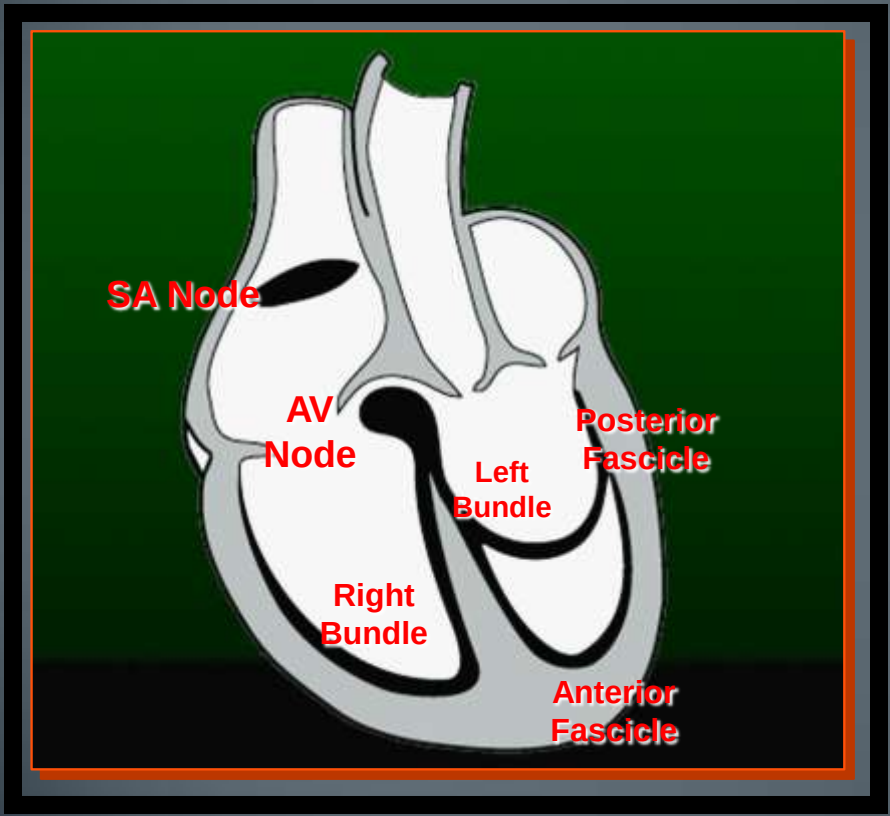
- Left Anterior Descending
  - Anterior L.V.
  - Anterior Septum
  - Bundles in Septum
- Circumflex
  - Posterolateral L.V.

Left Coronary - Clinical Correlations



- Anterior M.I.
- Bundle Branch Block
- Heart Block
- Posterolateral M.I.

The Conduction System



- **CLINICAL CORRELATIONS**

- Bundle Branch Blocks
  - occur at different sites

- Complete Bundle Branch
  - Blocks may obscure the
  - ECG findings of AMI

History & Physical Exam

The “Chest Pain” of AMI

Classic:

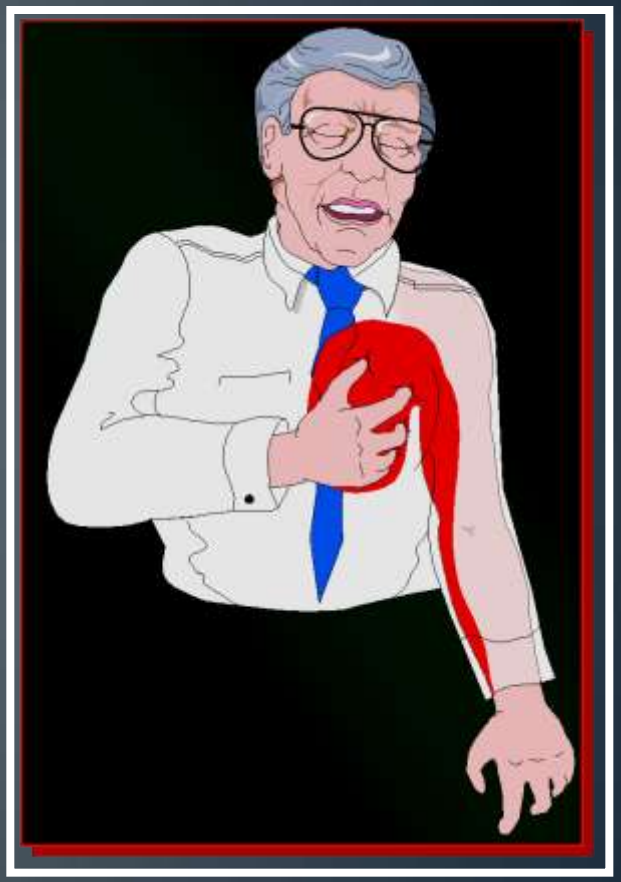
Substantial to left arm

More than 30 minutes

Note:

Often not in the chest

Often not described as pain



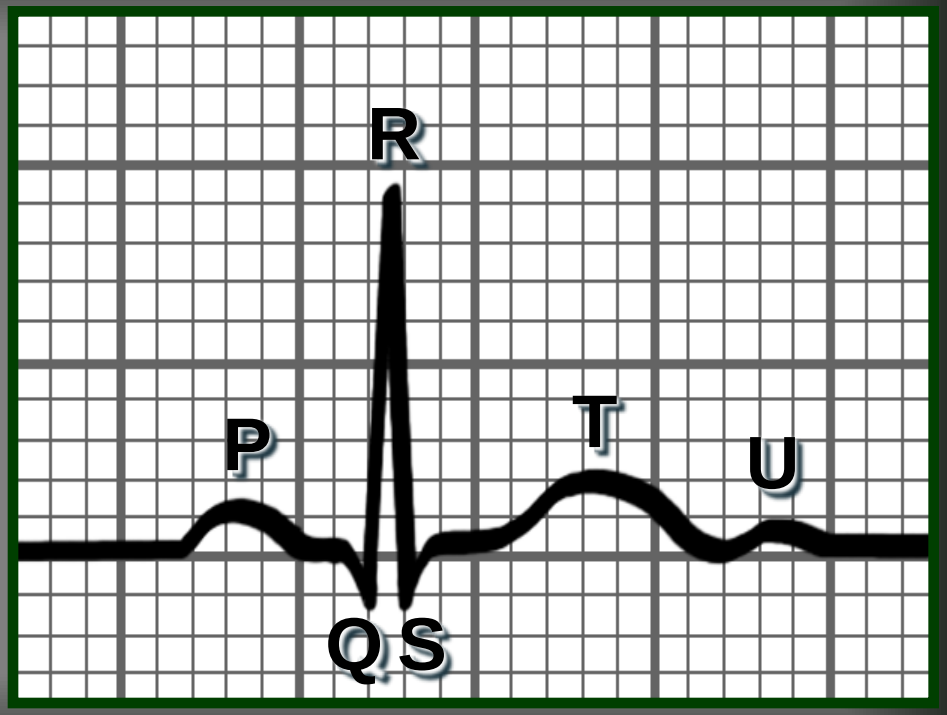
AMI “Chest Pain” Location
(Typically Diffuse)

AMI “Chest Pain” Character

- Classic: Pressure / Tightness
- Heaviness
- Squeezing
- Aching
- Indigestion
- Distress
- Burning
- Discomfort
- Numbness

Pain History (PQRRRST)

Provoked
Quality
Region
Radiation
Relief
Severity
Time



Additional History (SAMPLE)

S ymptoms (other than pain)

A llergies

M edication

P ast history

L ast meal

E vents prior to episode

Chest Pain Differential

- *CARDIOVASCULAR*
- *PULMONARY*
- *GASTROINTESTINAL*
- *MUSCULOSKELETAL*
- *ANXIETY ATTACK*

Chest Pain Differential

CARDIOVASCULAR -

- **Infarction**
- **Angina Pectoris**
- **Dissecting Thoracic Aneurysm**
- **Pericarditis**

** All effect ECG **

Chest Pain Differential

PULMONARY -

- **Embolism**
- **Pneumothorax**
- **Pleurisy**
- **Pneumonia**

Chest Pain Differential

GASTROINTESTINAL -

- Cholecystitis
- Pancreatitis
- Peptic Ulcer
- Esophageal
- Hiatal Hernia

Chest Pain Differential

MUSCULOSKELETAL **-**

- **Cervical Disc**
- **Costochondritis**

ANXIETY ATTACK **- (Hyperventilation)**

General Physical Exam ("MACCS"imize)

Mental (AVPU)

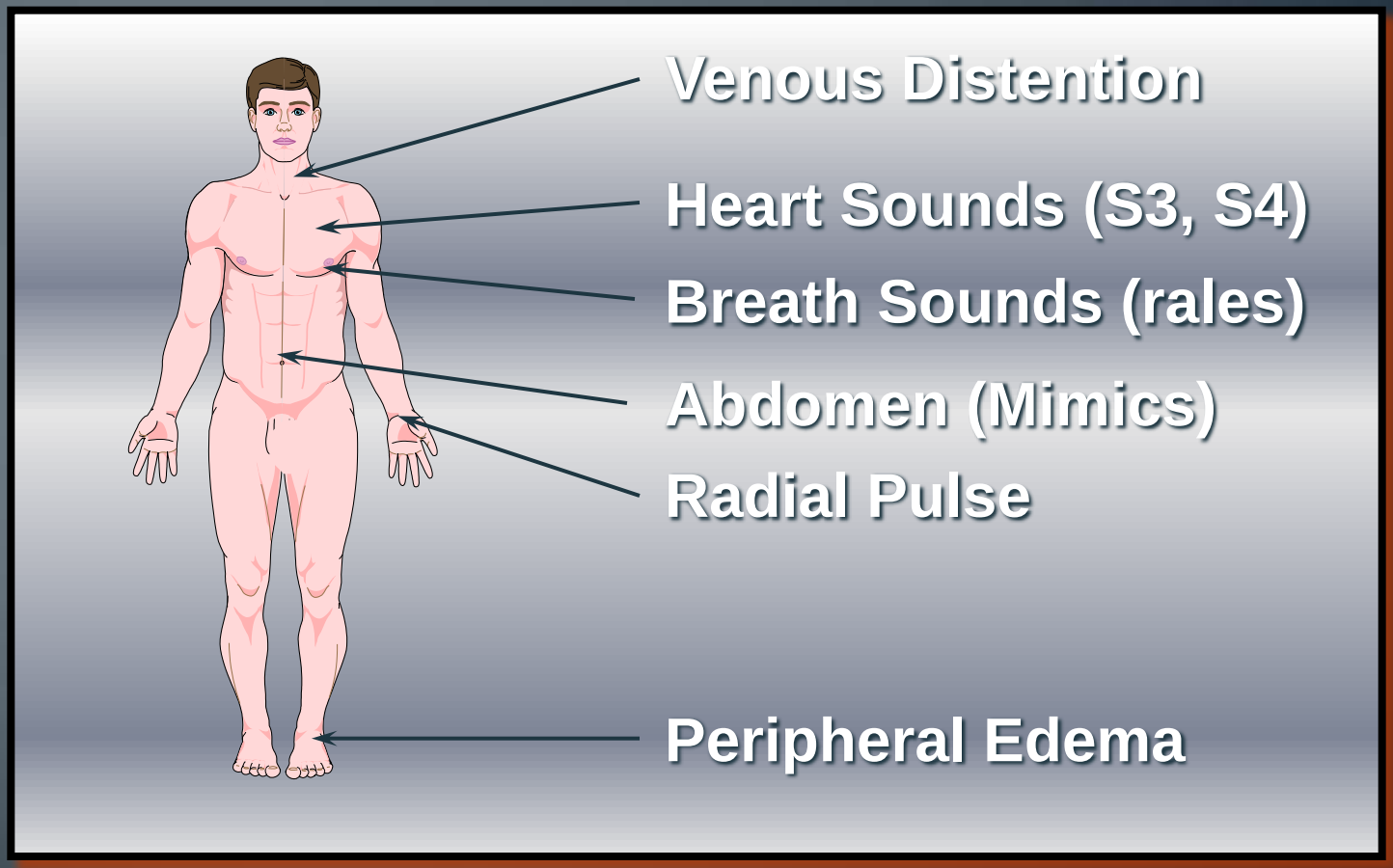
Appearance (skin)

Chest (breath sounds)

Cardiovascular (head to toe)

Stroke (focal signs)

Cardiovascular Examination (Head to Toe)



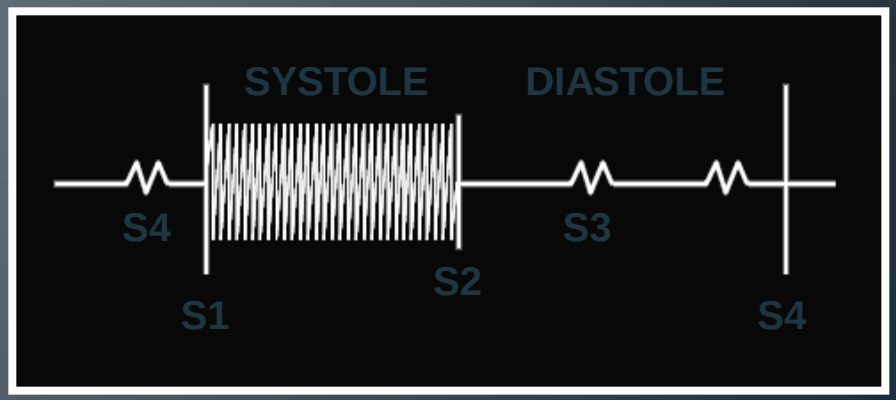
Elevated Central Venous Pressure
> 15 cm

Normal
= 7 cm
or less

Sternal
angle
= 5 cm

Auscultatory Areas - Listen at Apex

- Normal: S1, S2
- Heart Failure: S3, S4 systolic murmur
- Pericarditis: rub



Breath Sounds for EMS

- **Vesicular:** Normal
- **Rales (crackles):** Pulmonary Edema
- **Wheezes (whistles):** Bronchospasm
  "Cardiac asthma"
- **Friction rub:**
  (like sandpaper) Pleuritis

Acute Myocardial Infarction
High Risk Profile Patients

- Tachycardia: HR > 100 bpm
- Hypotension: BP < 100 mm Hg
- Pulmonary Edema: rales > 1/2 way up
- Shock: BP < 90 and Pulmonary Edema
- Conduction Abnormalities -
  AV Block and Intraventricular (BBB)

12 Lead Essentials

Indications for 12 Lead ECG Include:

- “Chest Pain”
- Palpitations/Dysrhythmias
- Shortness of Breath
- Overdoses
- Syncope / Dizziness
- Impending Doom
- Unexplained Sweating or Nausea and Vomiting

CAUTIONS:

- **First treat life threatening problems and chest pain**
- **Do not delay transport of critically ill patients**

The 12 Lead ECG Includes

6 Limb Leads (Vertical Plane)

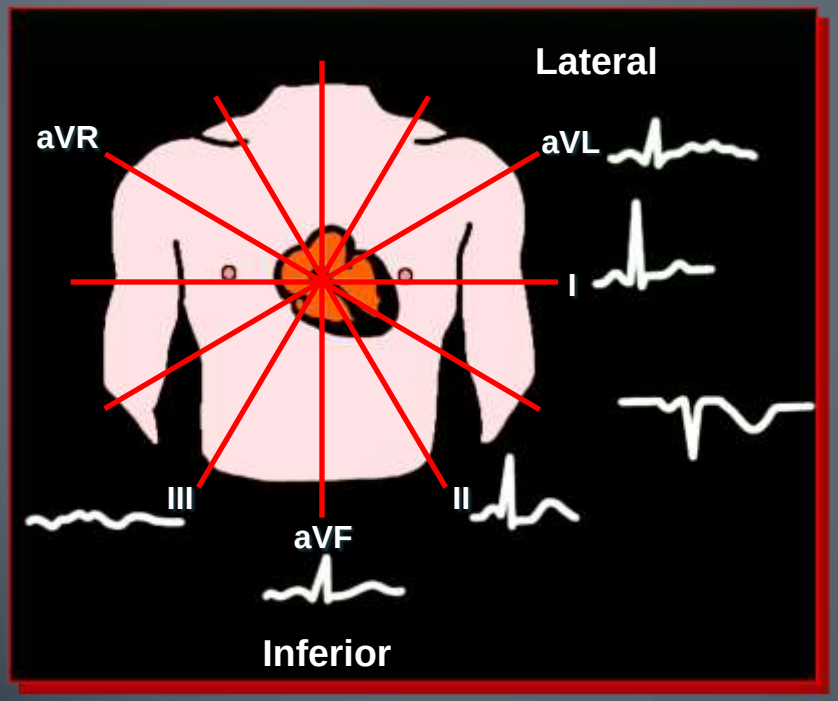
I, II, III, aVR, aVL, aVF

6 Limb Leads (Horizontal Plane)

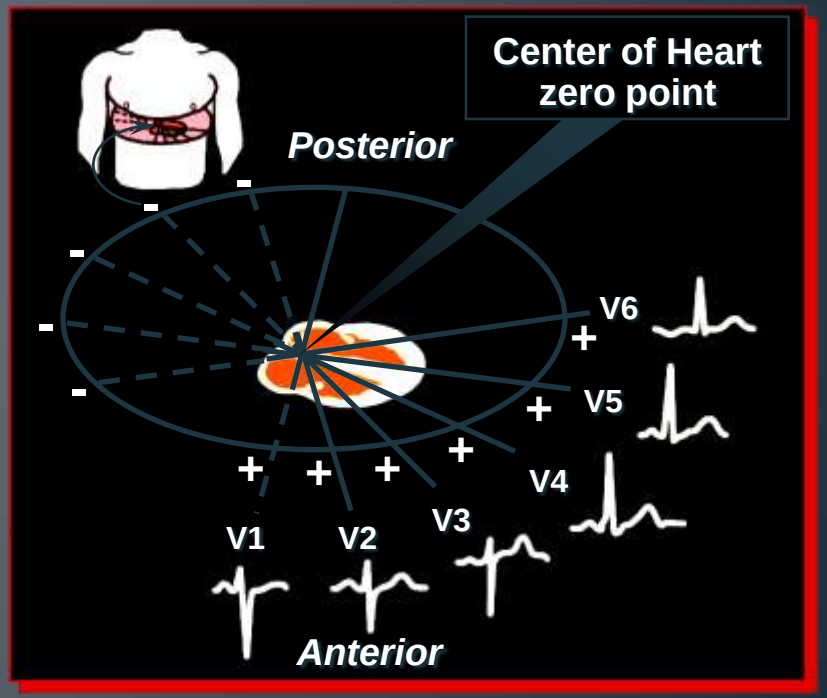
V1 through V6

Vertical and Horizontal Planes

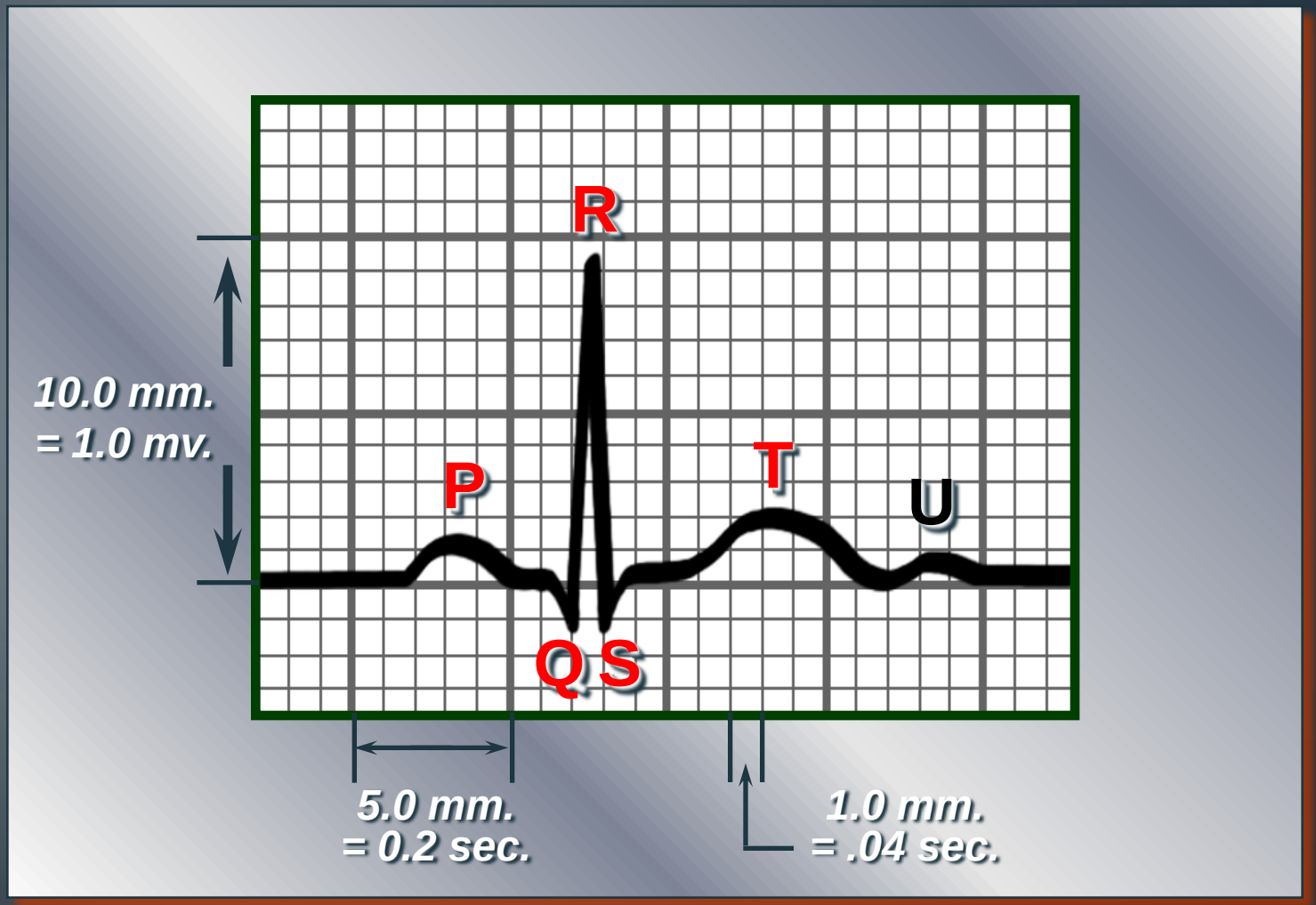
Limb Leads *(Vertical Plane)*



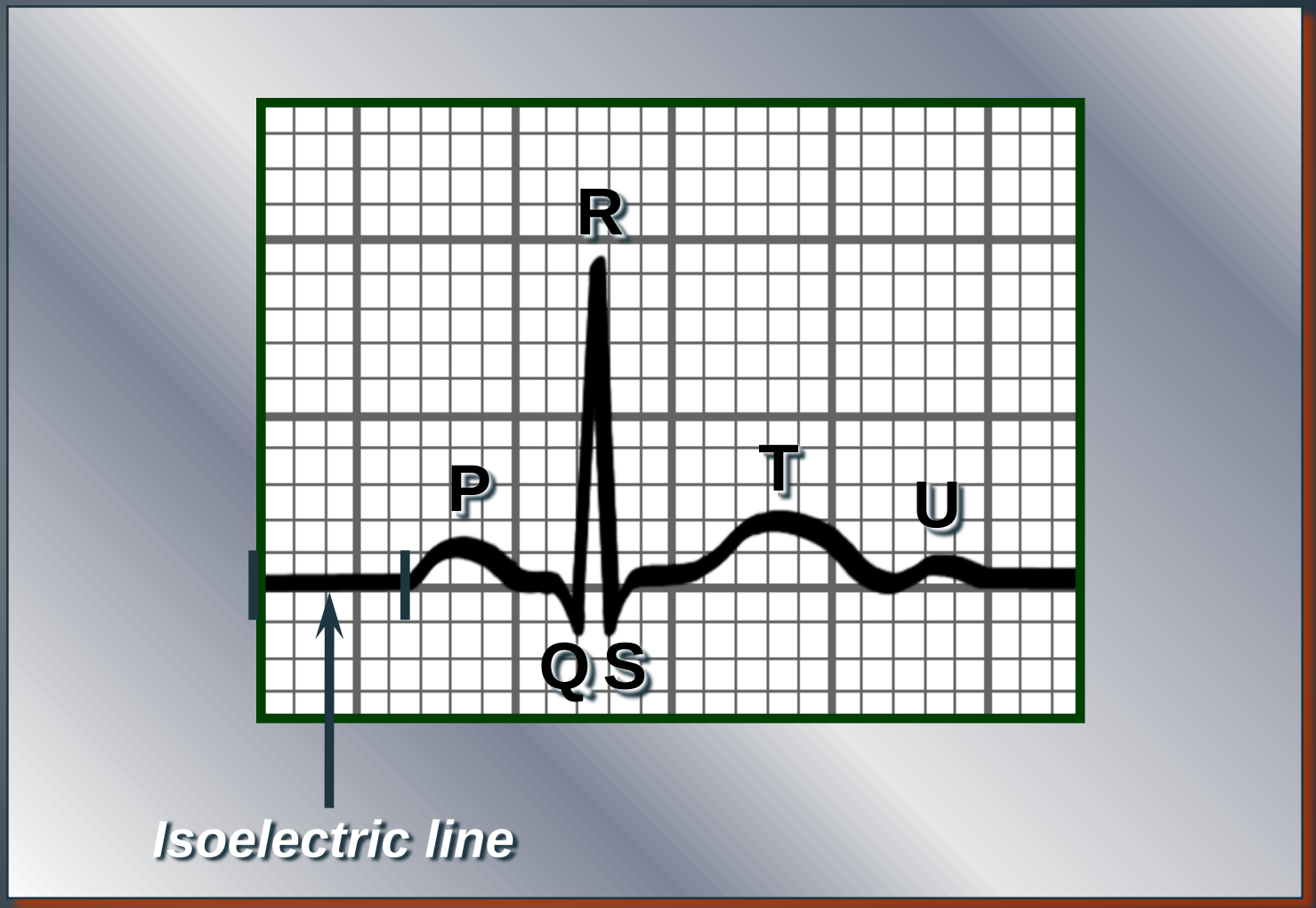
Chest Leads *(Horizontal Plane)*



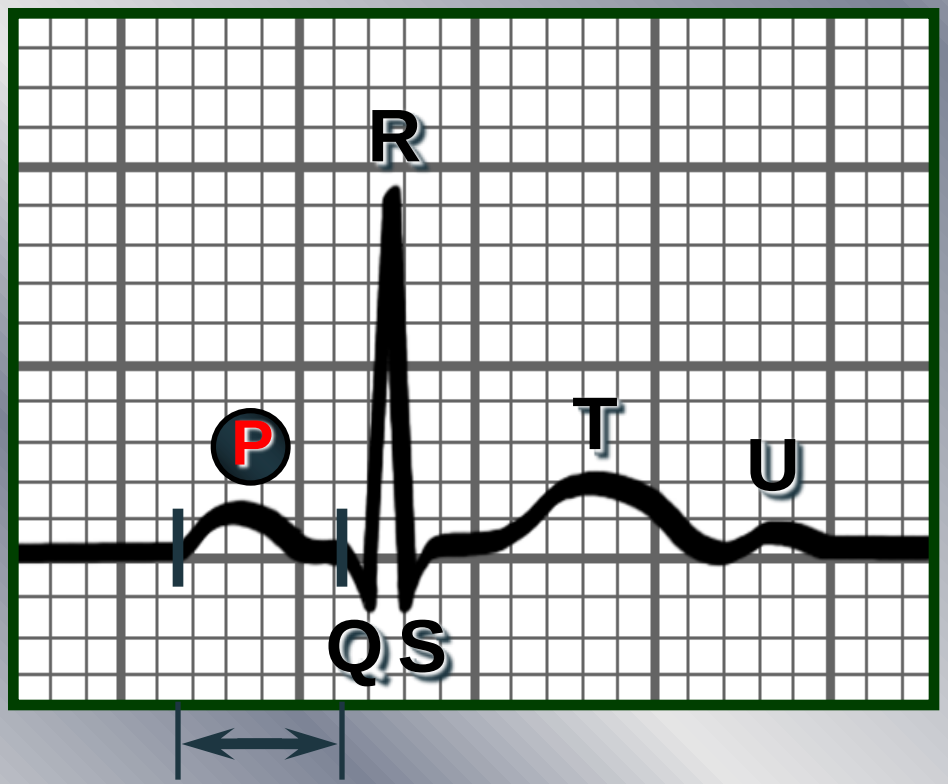
Complexes, Intervals, Segments



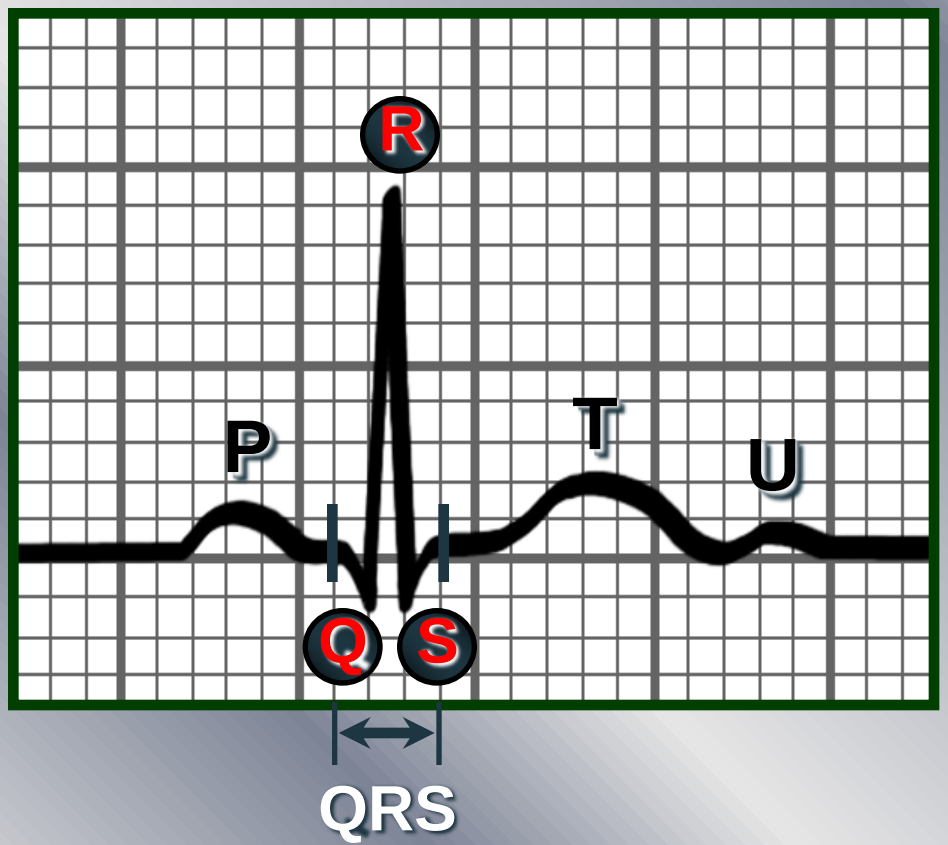
Isoelectric Line (reference for ST elevation)



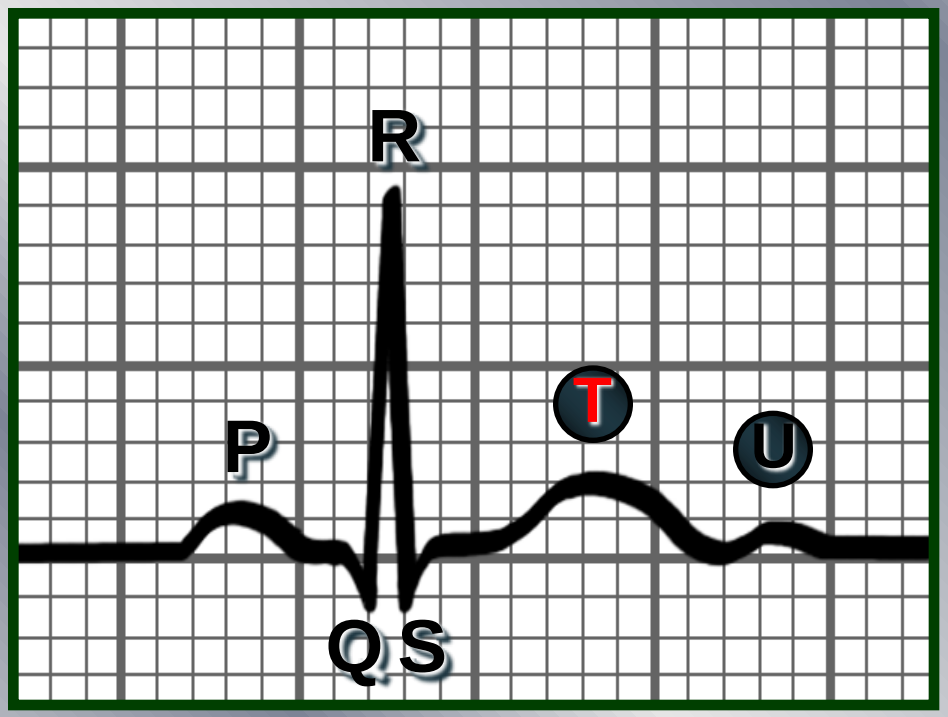
P Wave (atrial depolarization)



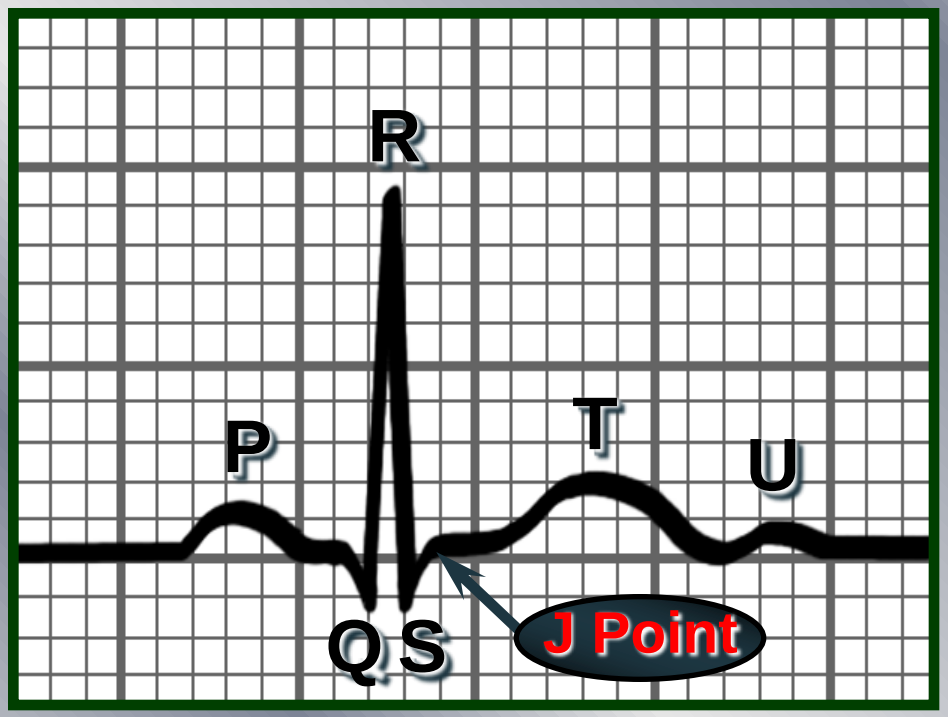
QRS Complex (ventricular depolarization)



T (ventricular repolarization)

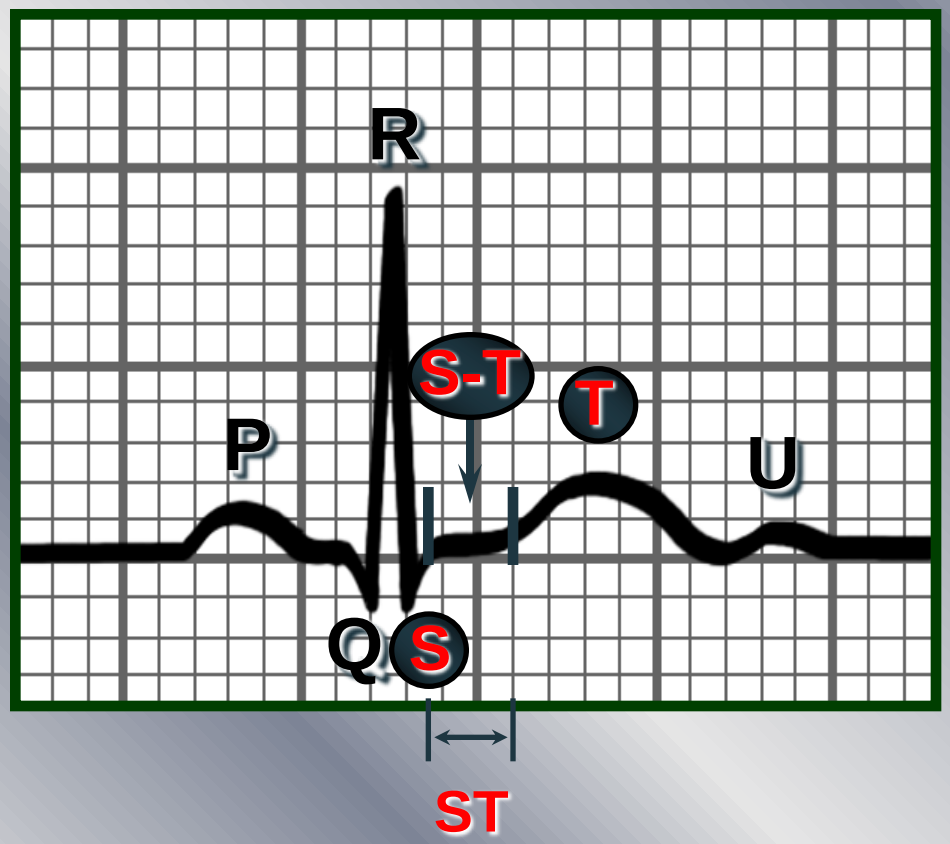


J Point (junction between QRS and ST)



The J Point is not always identifiable

ST Segment (read for injury - STEMI)



AMI - Guide to Interpretation

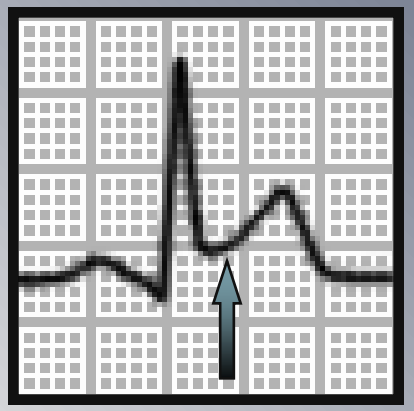
After Rate and Rhythm:

QRS - Is LBBB present?

If answer is no,

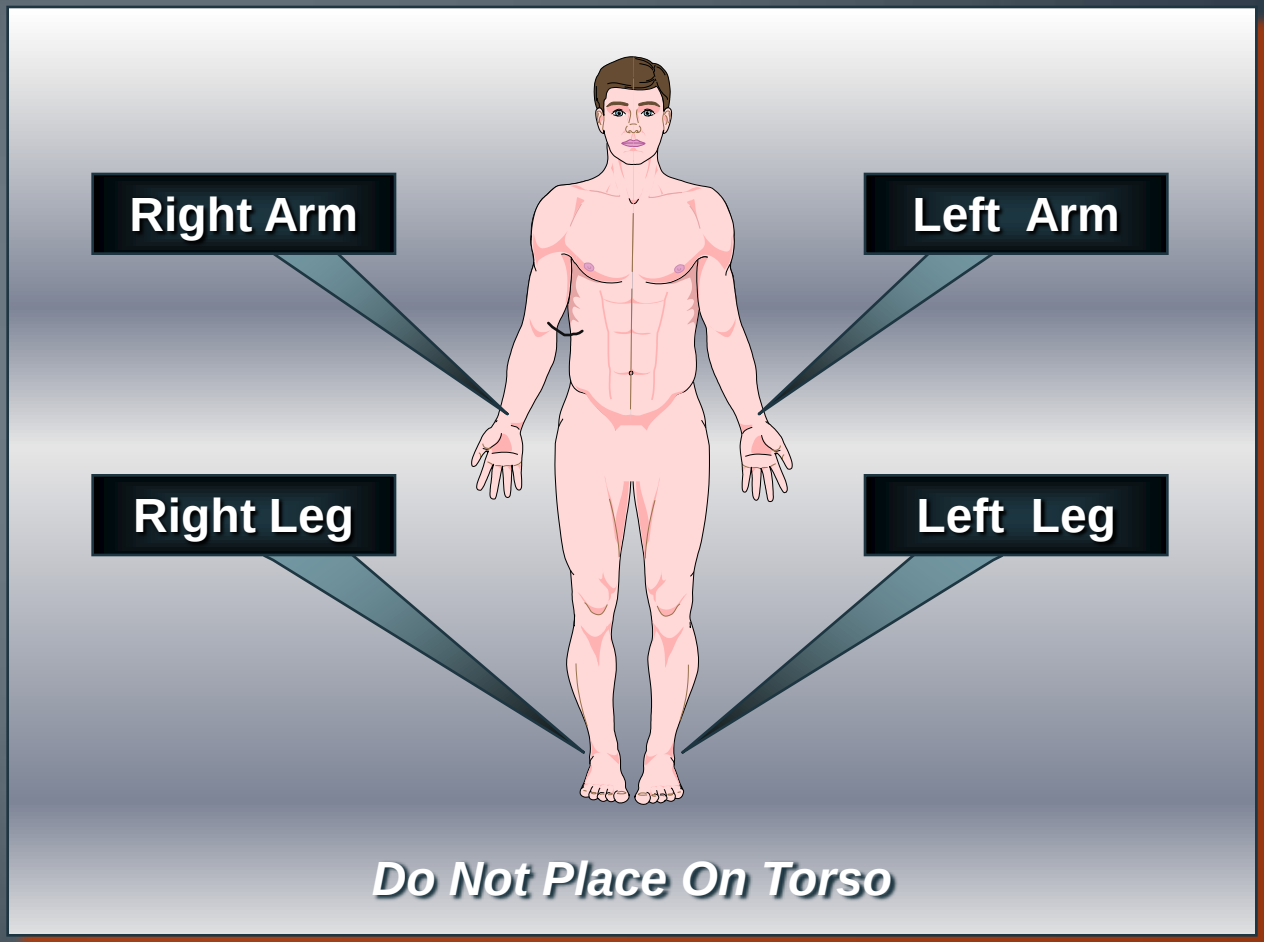
Read the ST segments.

ST - Is elevation ≥ 1 mm. present in at least two contiguous leads?

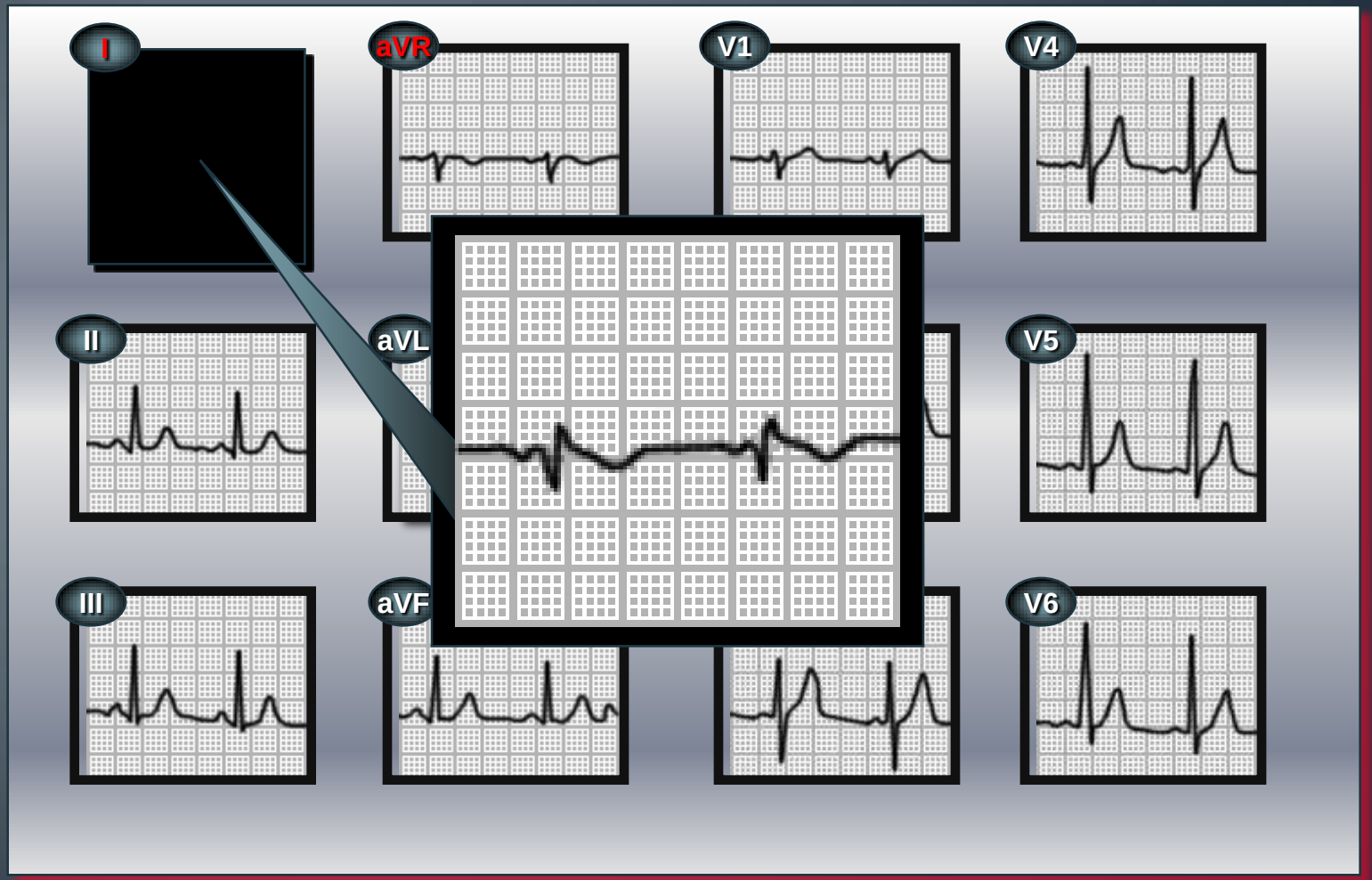


12 lead application

Limb Lead Placement - 12 Lead ECG

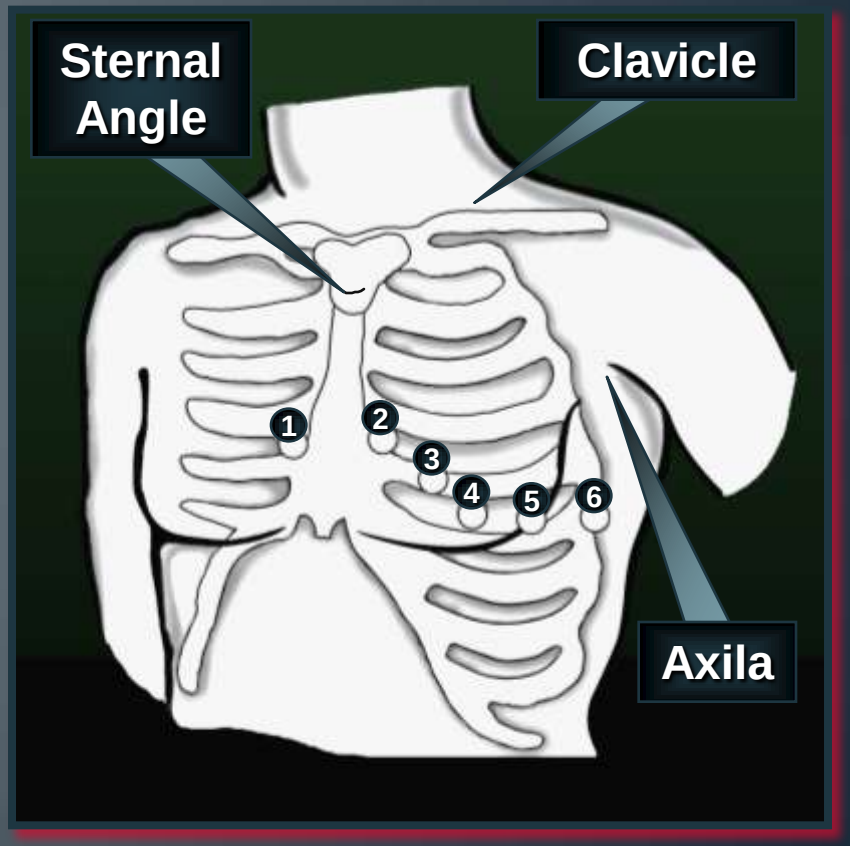


Arm Leads Reversed (Negative P in Lead I)



Chest Electrode Placement - Specifics

- **V1** 4th Intercostal Space (ICS), Right Parasternal
- **V2** 4th ICS, Left Parasternal
- **V4** 5th ICS, Midclavicular Line (must place prior to V3)
- **V3** Between V2 and V4
- **V5** Level = V4, Anterior Axillary Line
- **V6** Level = V4, Mid Axillary Line



Standardization

Correct (1 mV.)

Under (0.5 mV.)

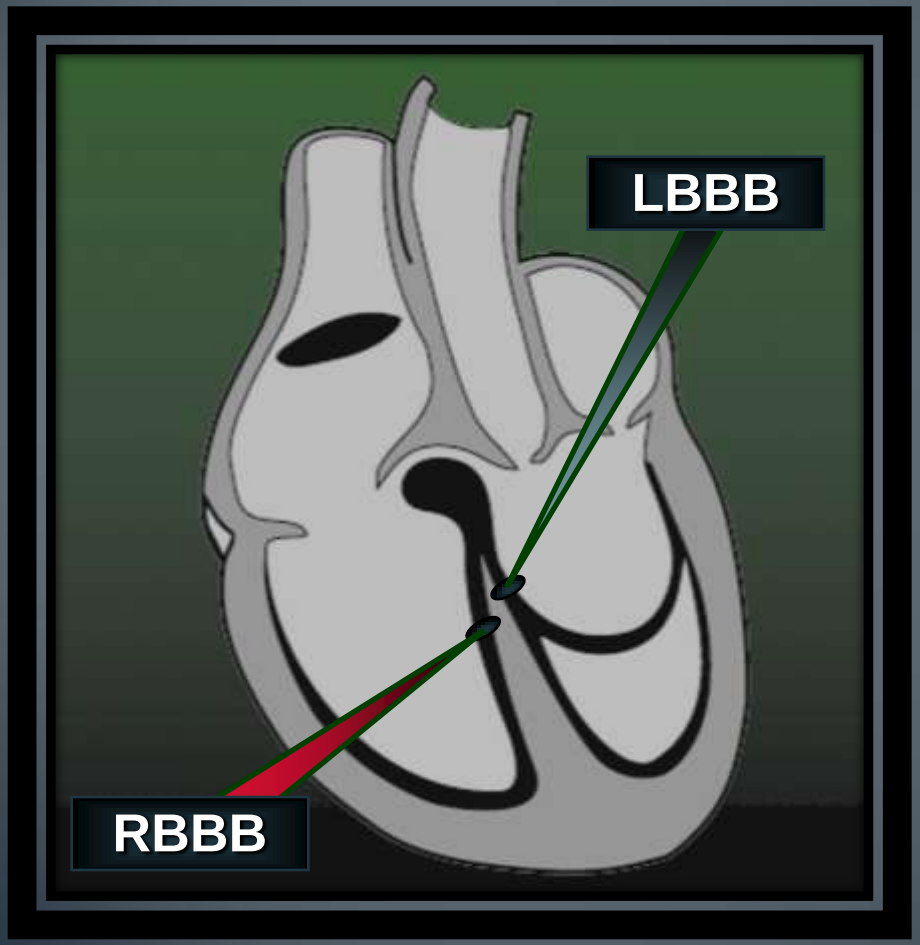
Over (1.5 mV.)

ECG Changes of STEMI

AMI - ECG Messages

- Remember inferior and anterior
- Worry most about anterior
- Identify significant ST elevation
  - STEMI

The Conduction System



CLINICAL CORRELATIONS

- BBB may occur at different sites in the conduction system
- BBB may obscure the ECG findings of AMI

CBBB - Significance

QRS ≥ .12 sec. (≥ 3 small boxes)

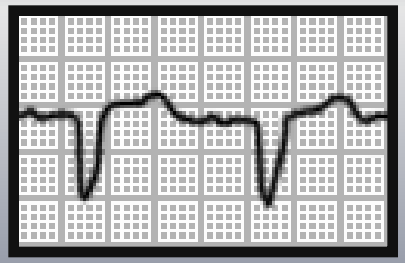
LBBB -	RBBB -
treat as AMI if symptoms present	read ST segments Note: may be difficult

When develops during AMI, implies extensive ischemia

Bundle Branch Block - QRS ≥ .12 sec.

Lead V1 - turn signal:

QRS
down = left

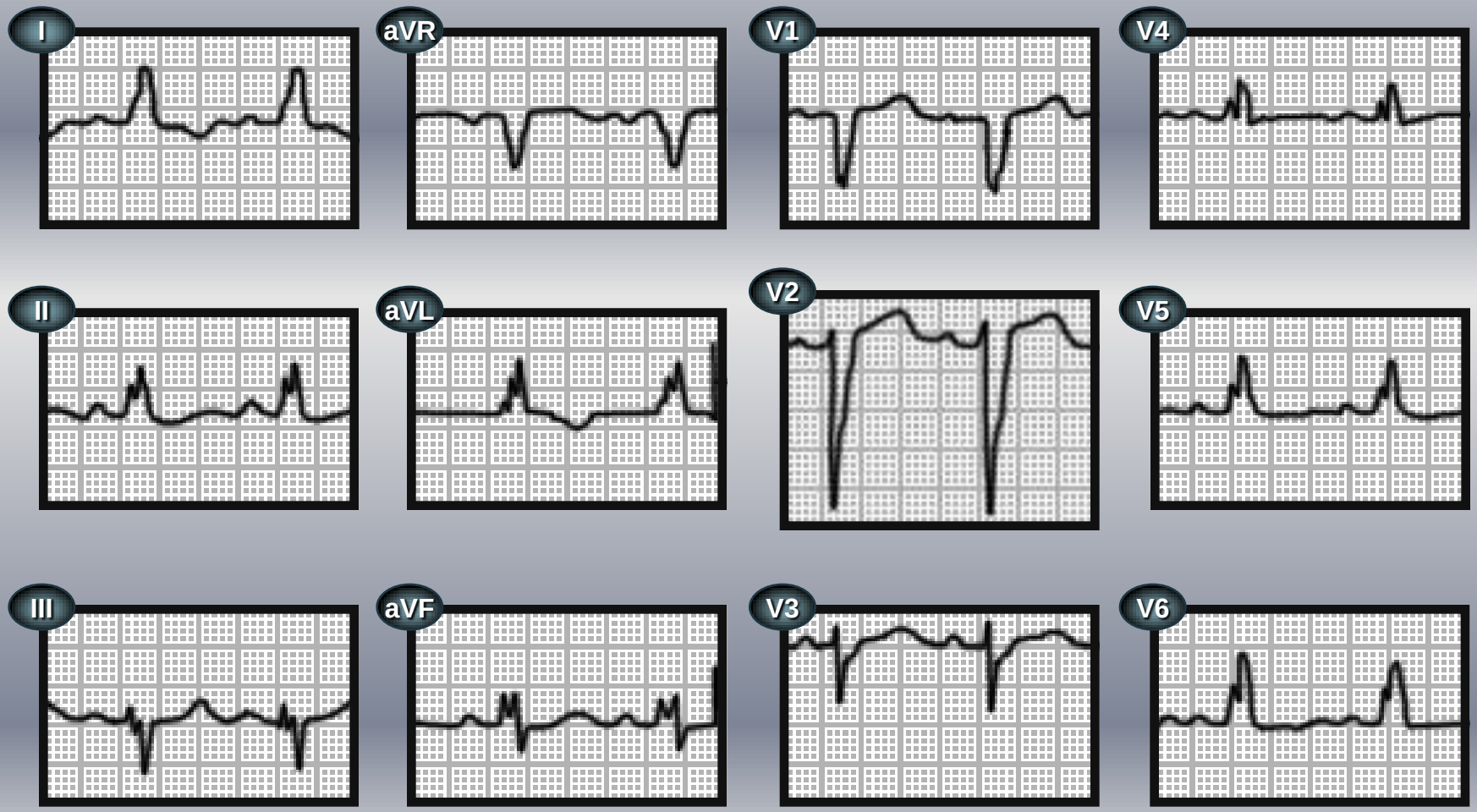


Left BBB

QRS
up = right

Right BBB

Complete Left Bundle Branch Block



Complete Right Bundle Branch Block

AMI - Guide to Interpretation

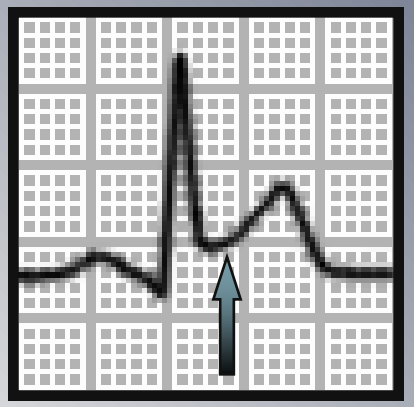
After Rate and Rhythm:

QRS - Is LBBB present?

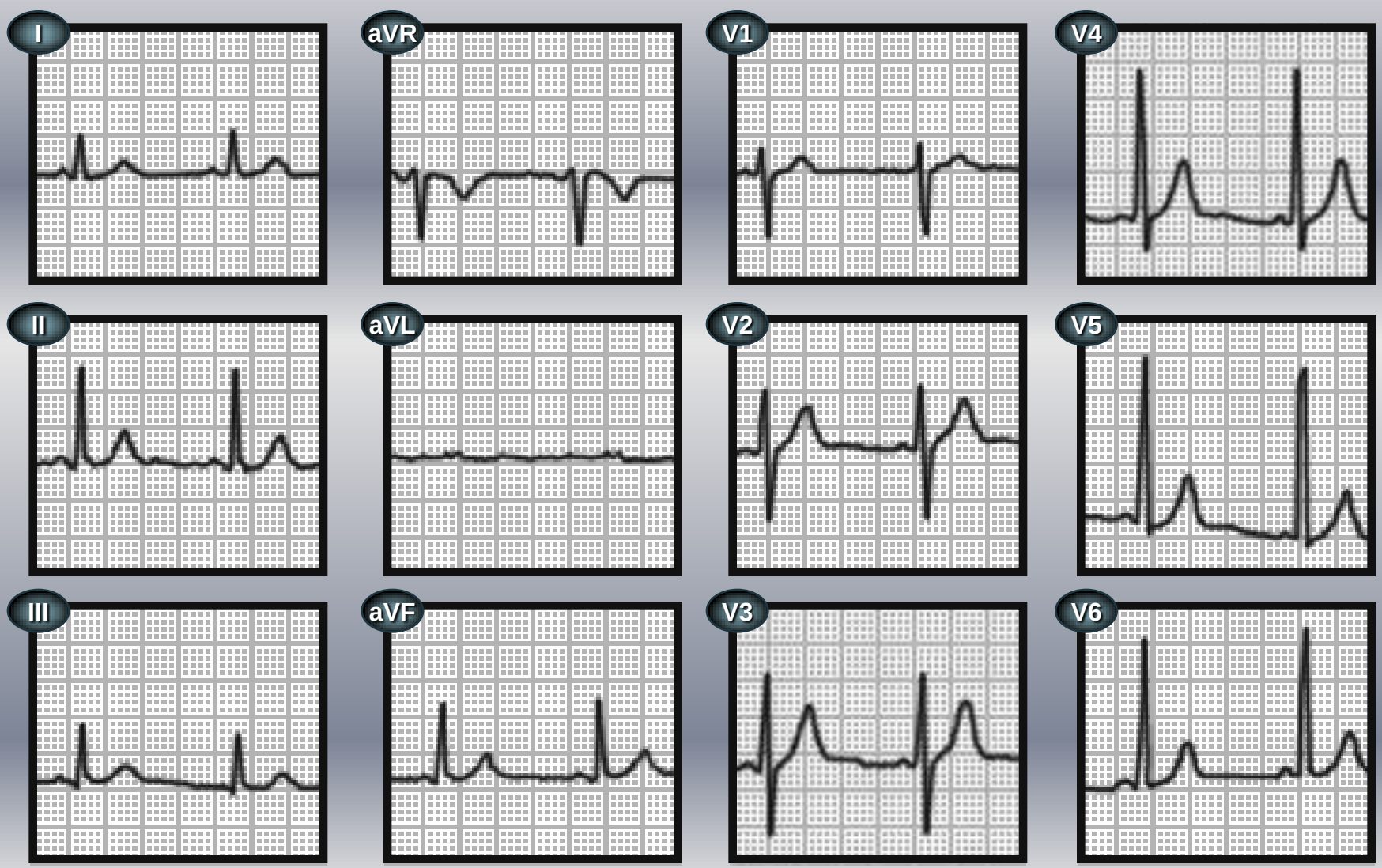
If answer is no,

Read the ST segments.

ST - Is elevation ≥ 1 mm. present in at least two contiguous leads?



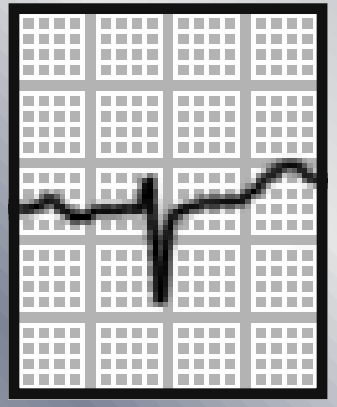
Normal Electrocardiogram



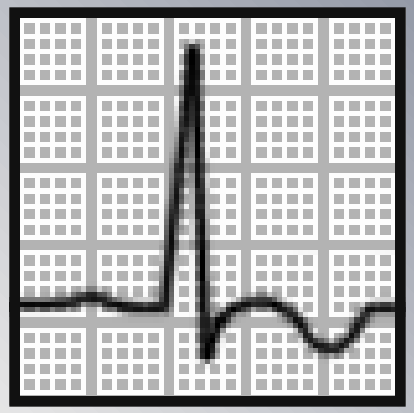
AMI - Locations and Leads

LOCATIONS	LEADS
Inferior	II, III, aVF
Anterior	V1 - V6
Anteroseptal	V1 – V2
Lateral	I, aVL, V5, V6

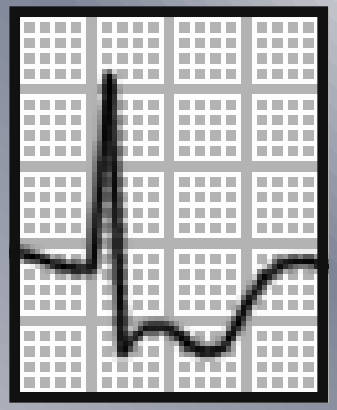
ST-T Wave Changes



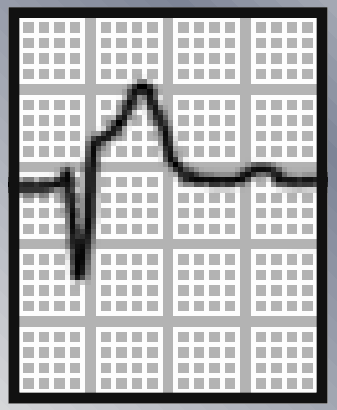
Normal



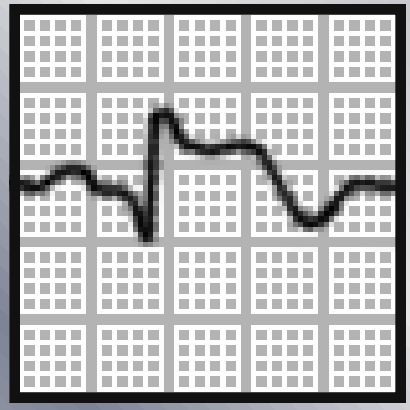
T Wave Inversion



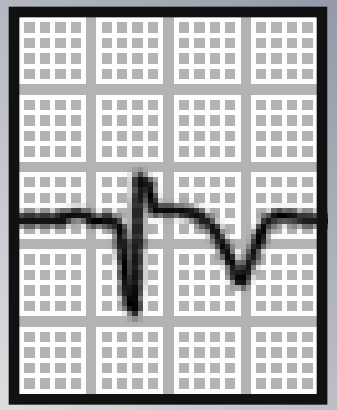
ST Depression



ST Elevation



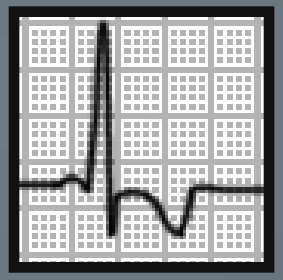
Q Wave / ST Elevation



Q Wave / Normal ST / Inverted T

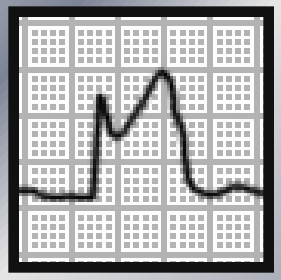
Transmural AMI (associated with thrombus)

Ischemia:



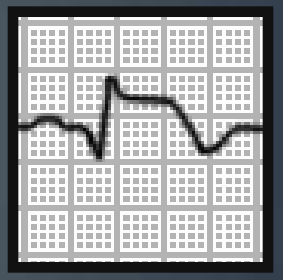
T Inversion

Injury:



ST Elevation

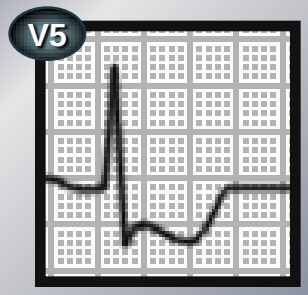
Infarction:



Q Wave (Pathologic)

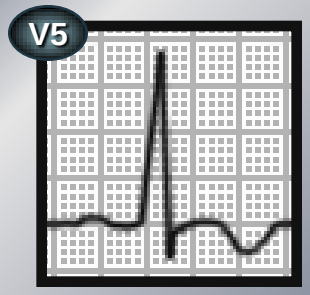
AMI Extent and Progression

Subendocardial



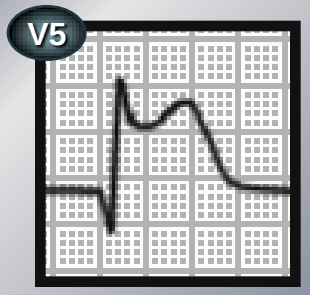
ST Segment Depression

Non Transmural (Non Q Wave)



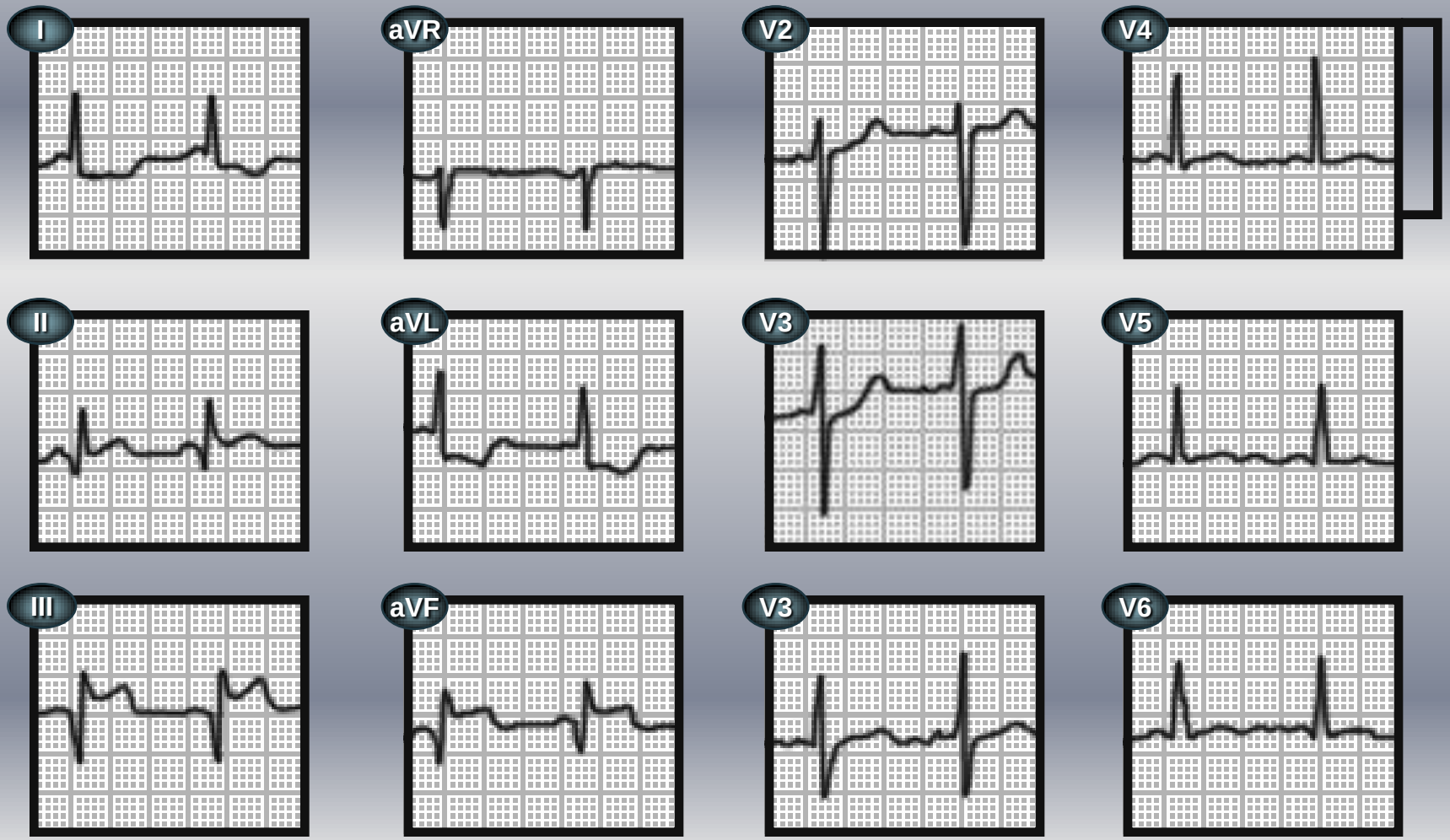
T Wave Inversion

Transmural Thrombus Usual

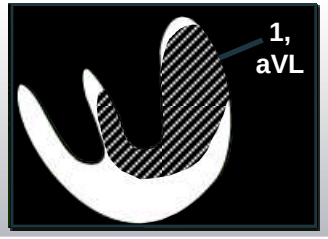


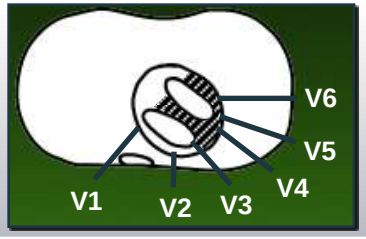
Q Wave and ST Segment Elevation

Inferior MI (II, III, aVF)

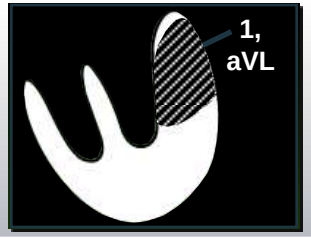


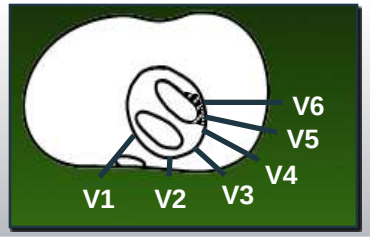
Anterior MI (V1 - V6)

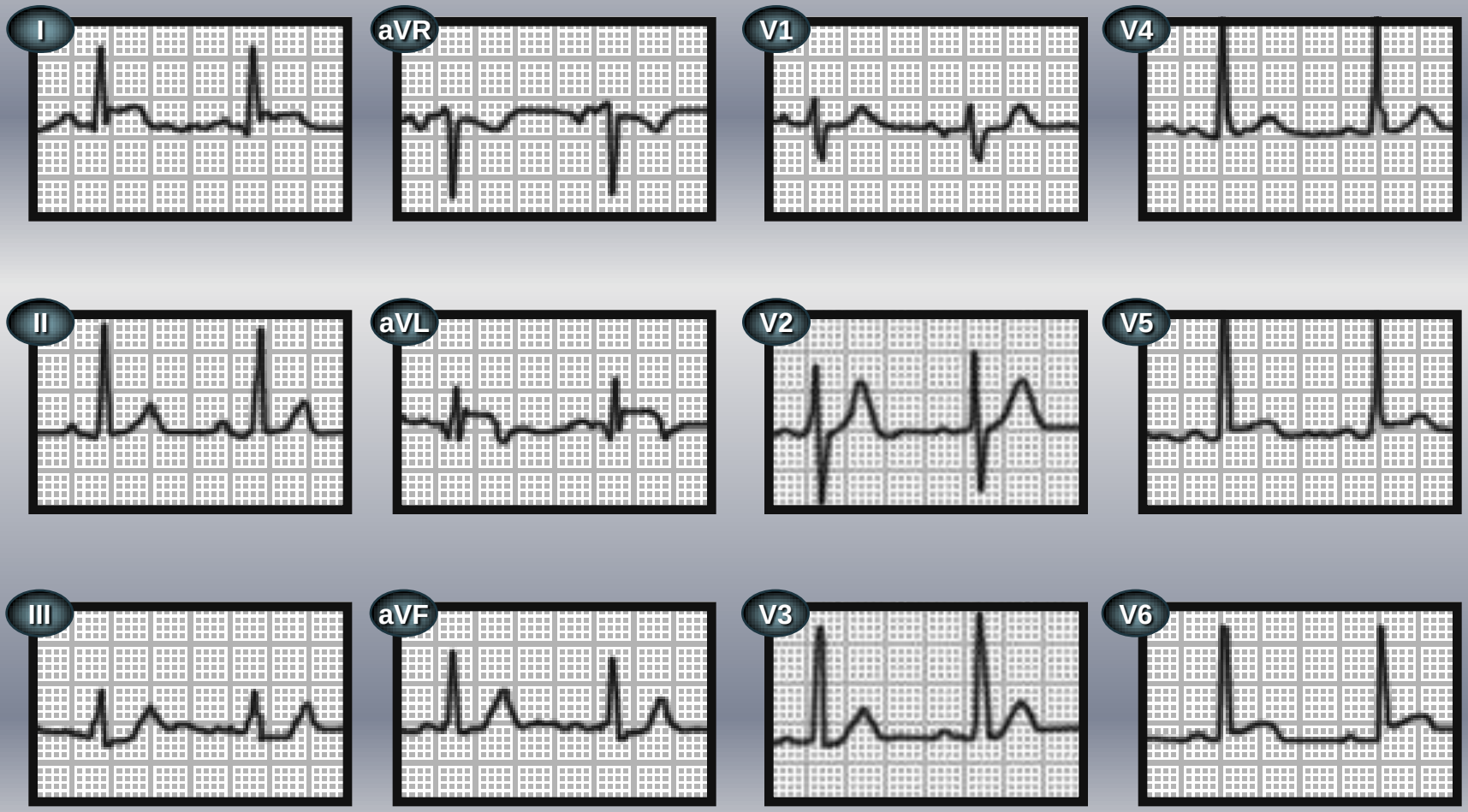




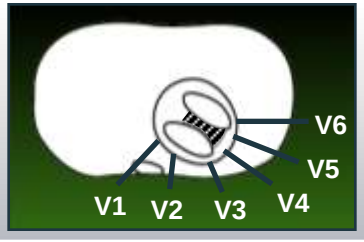
Anterolateral MI
I, aVL, V5, V6)

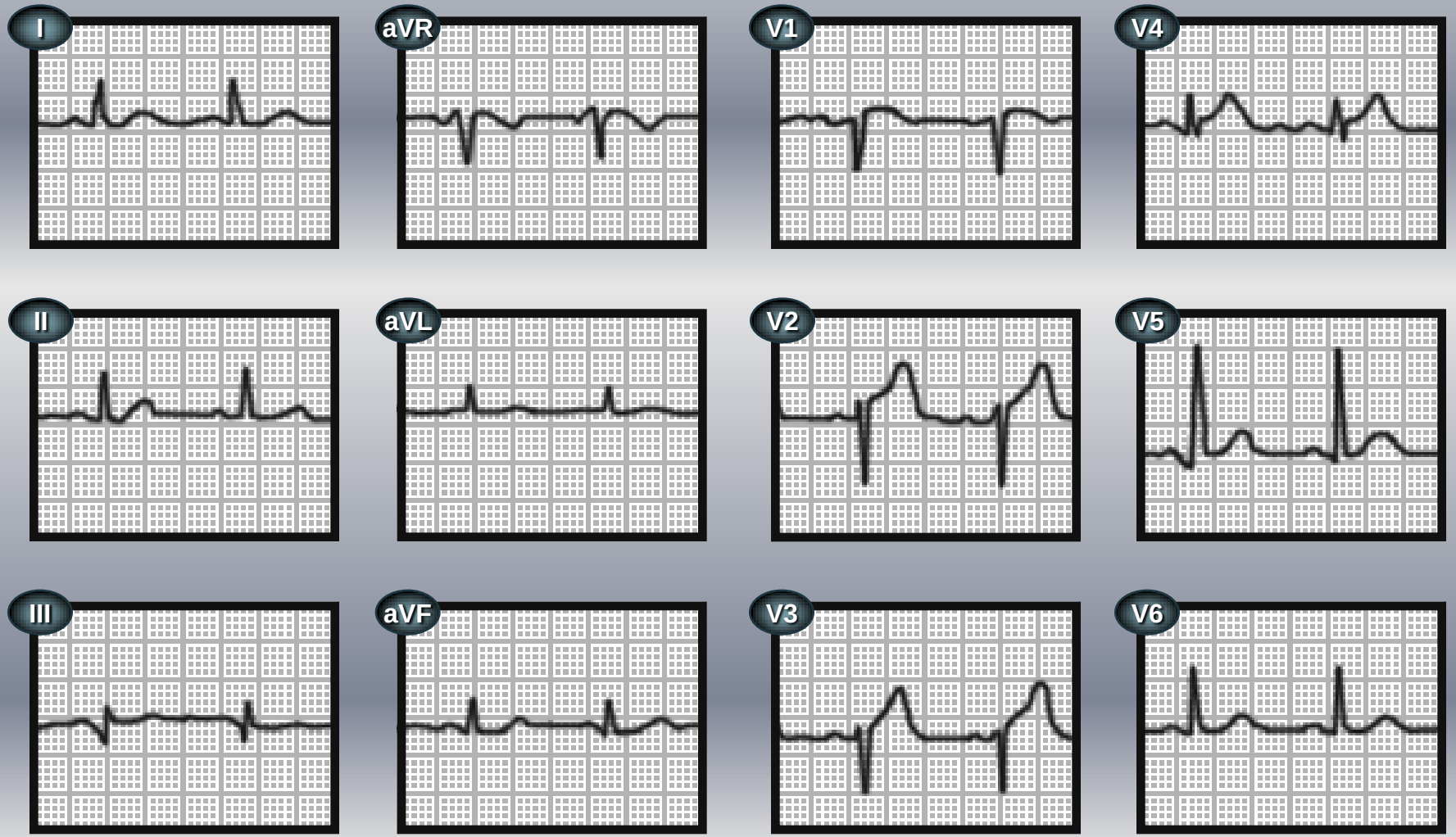






Anterior MI (V1 - V4)

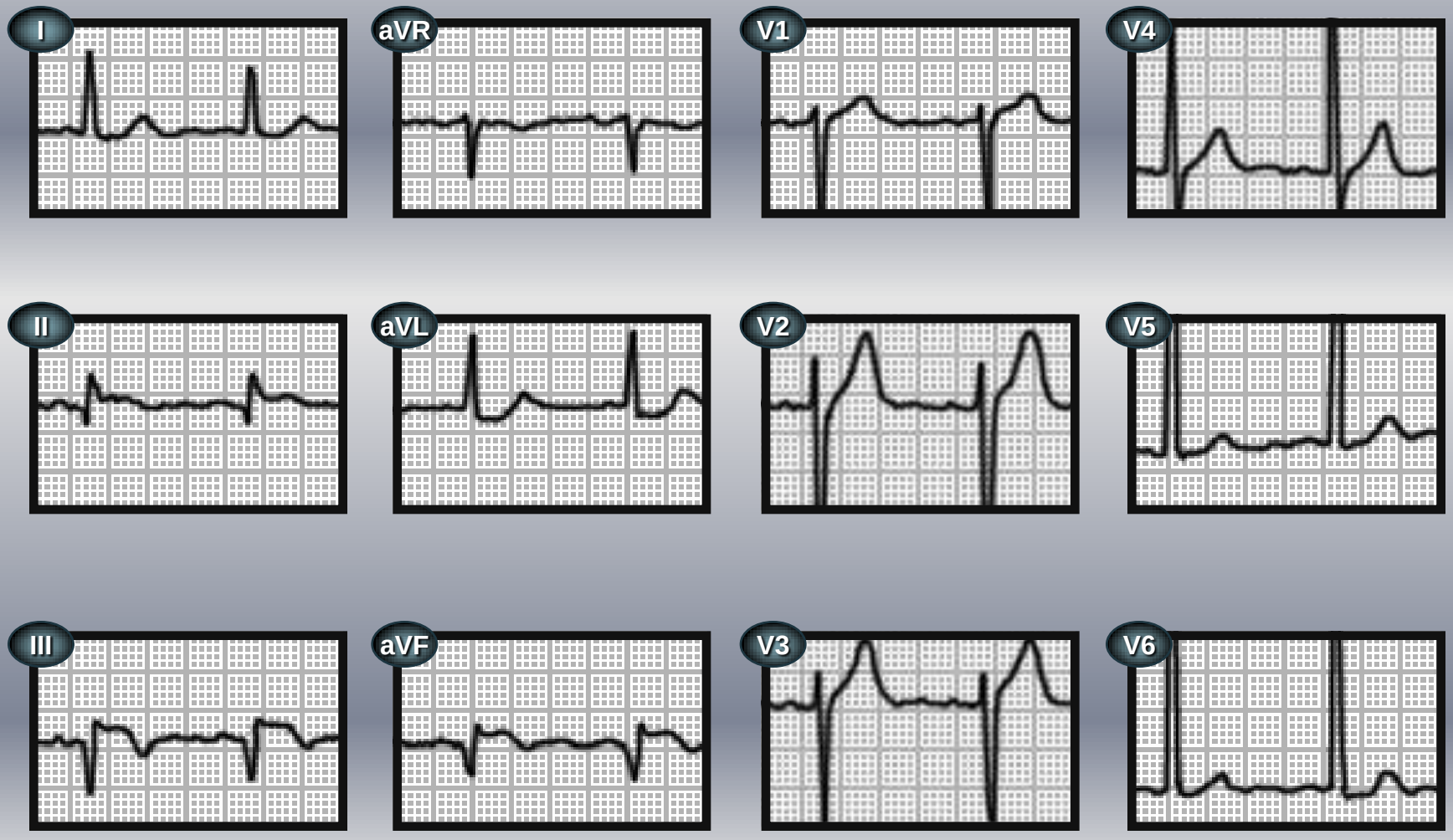




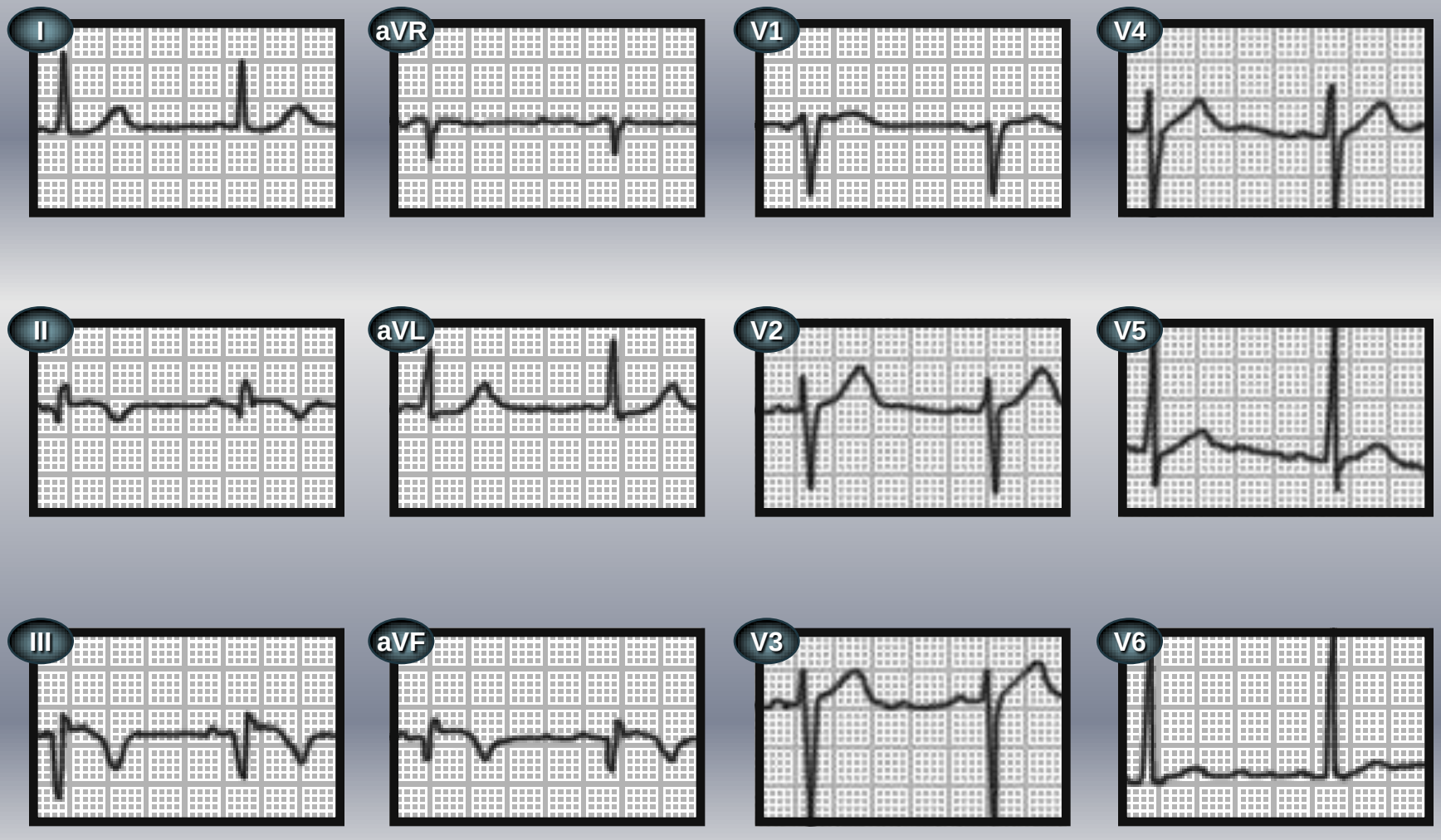
Inferior MI - Initial ECG

(1 of 3)

Inferior MI - Interim ECG (2 of 3)



Inferior MI - Discharge ECG (3 of 3)

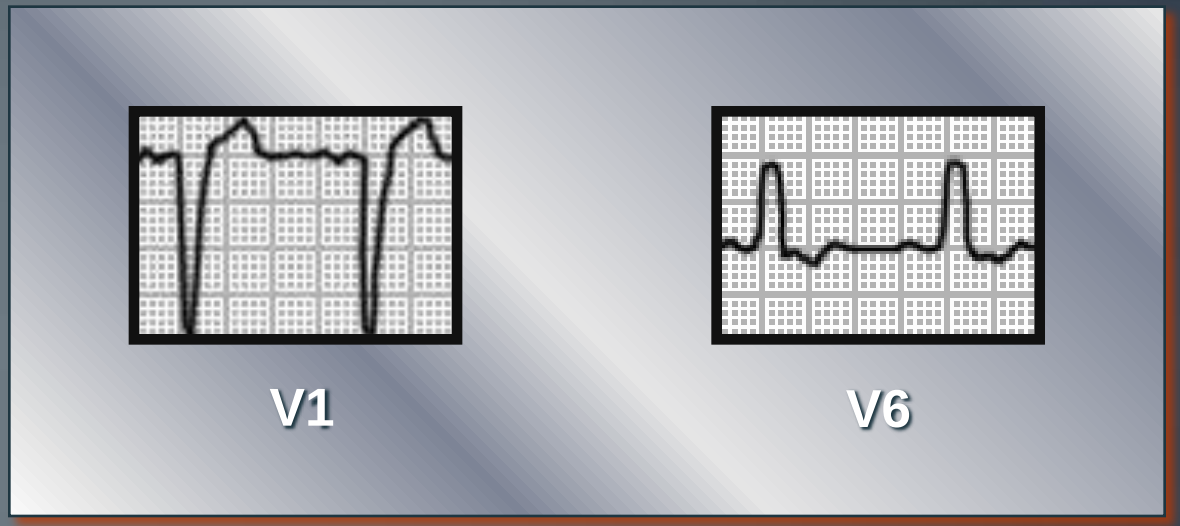


ECG Mimics of STEMI

ECG Mimics of AMI - History May Help!

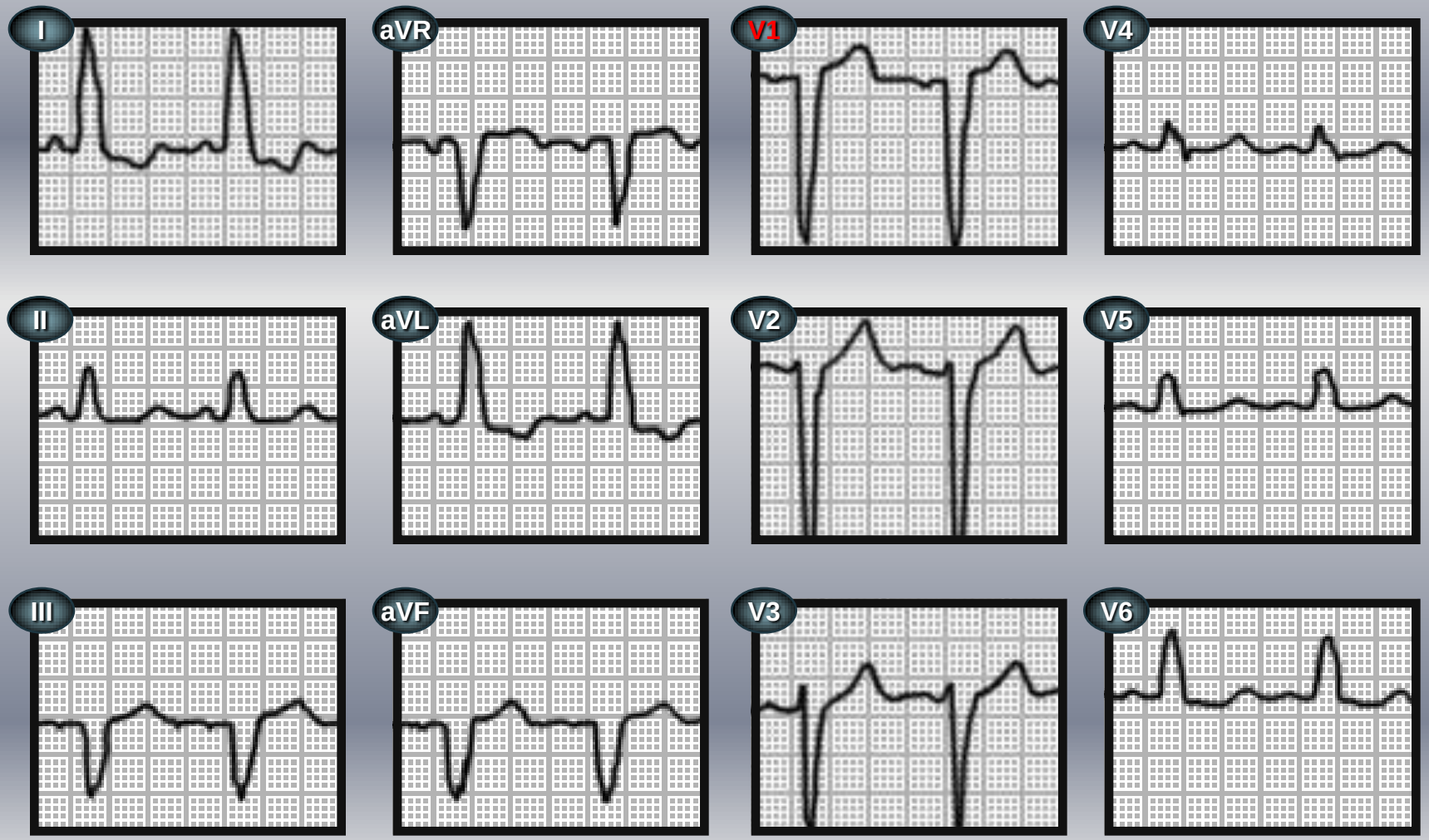
- Complete LBBB
- Early Repolarization
- Ventricular Rhythms
- LV Hypertrophy
- Ventricular Pacemakers
- Pericarditis

Complete Left Bundle Branch Block

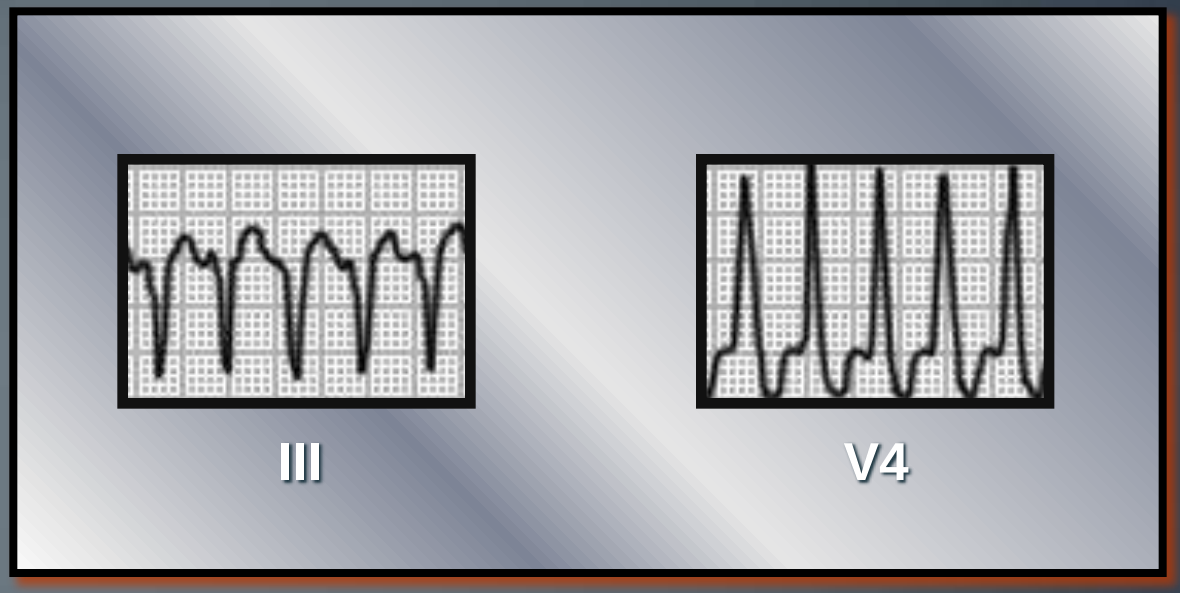


- Sinus P with wide QRS (> 3 small boxes)
- LBBB and history suggestive of acute MI (Class I recommendation for thrombolysis)

Complete Left Bundle Branch Block

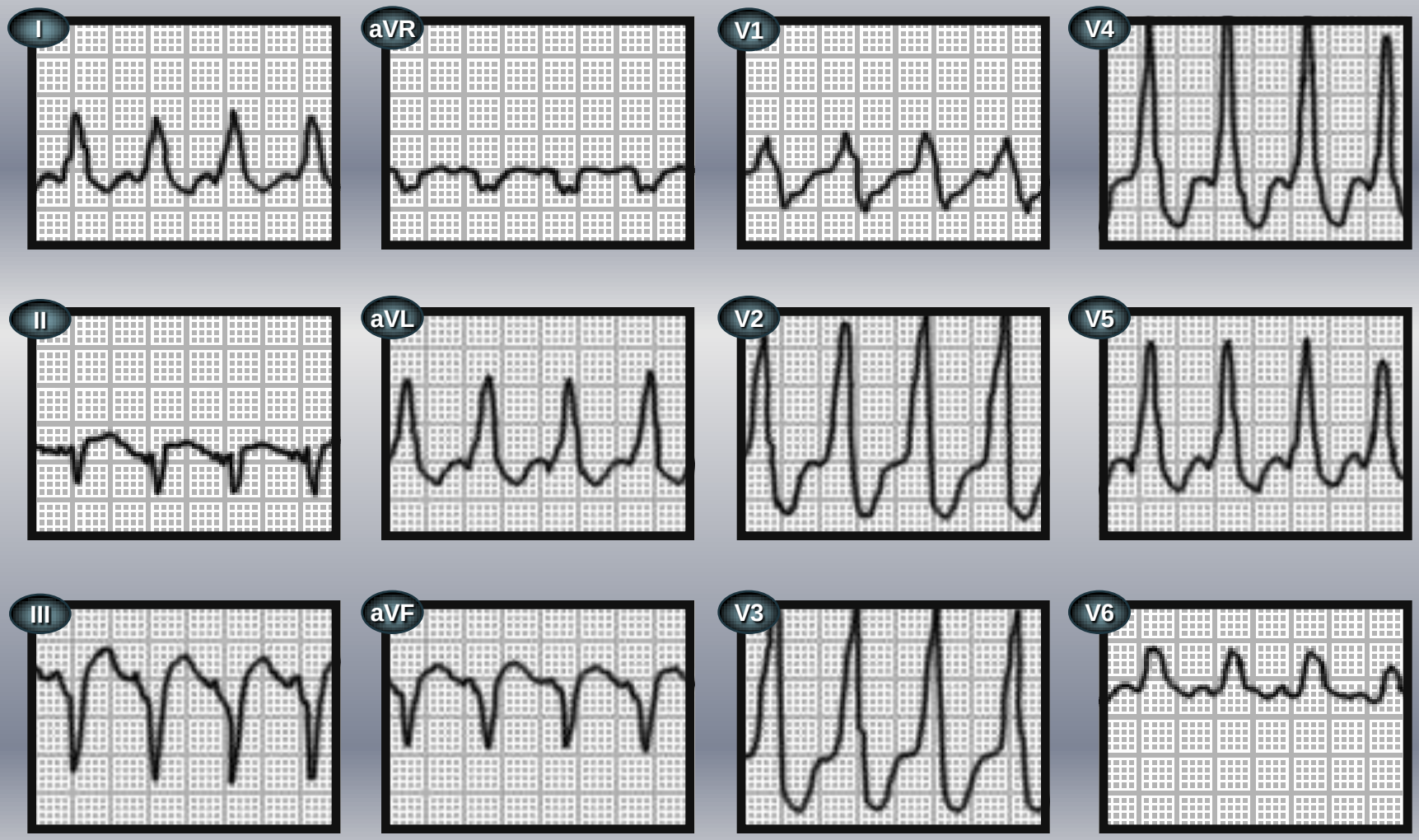


Ventricular Dysrhythmia

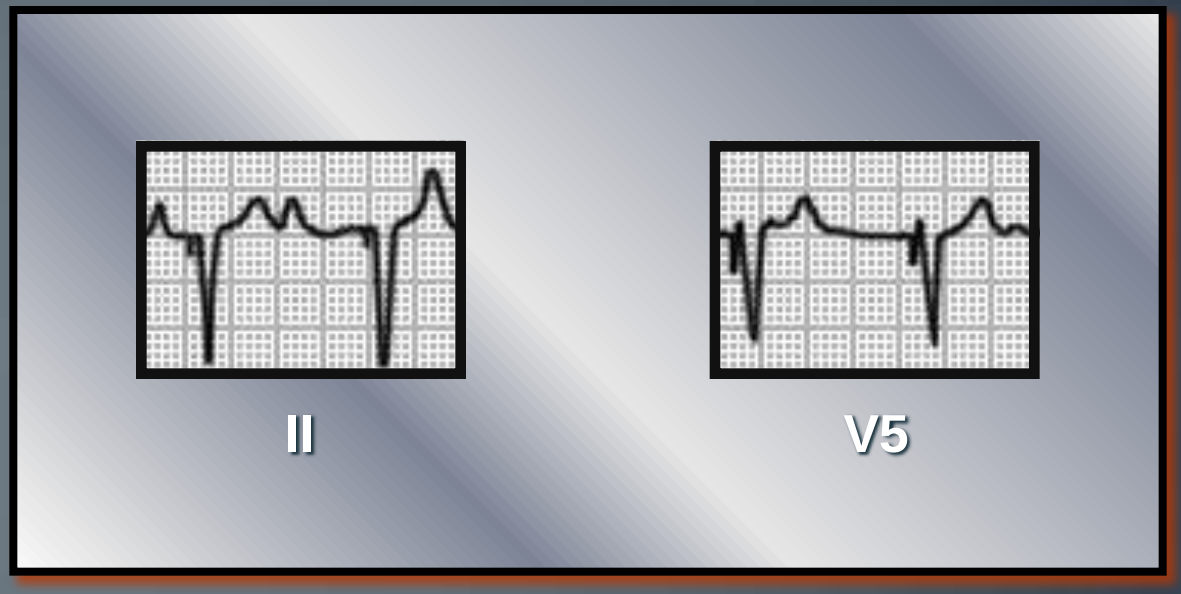


- QRS wide and unrelated to P waves
- Cannot interpret ST - T waves

Ventricular Dysrhythmia

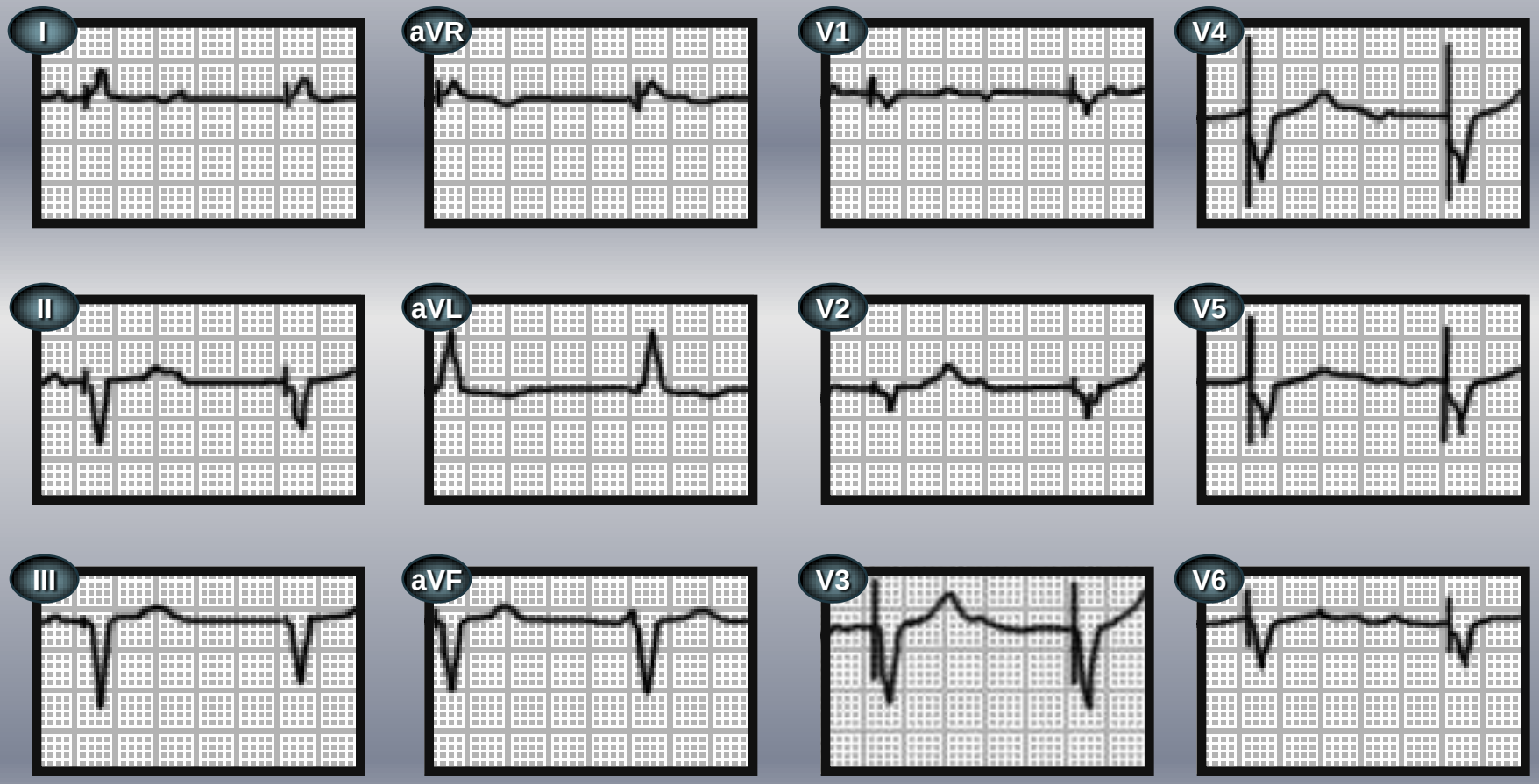


Ventricular Pacemaker

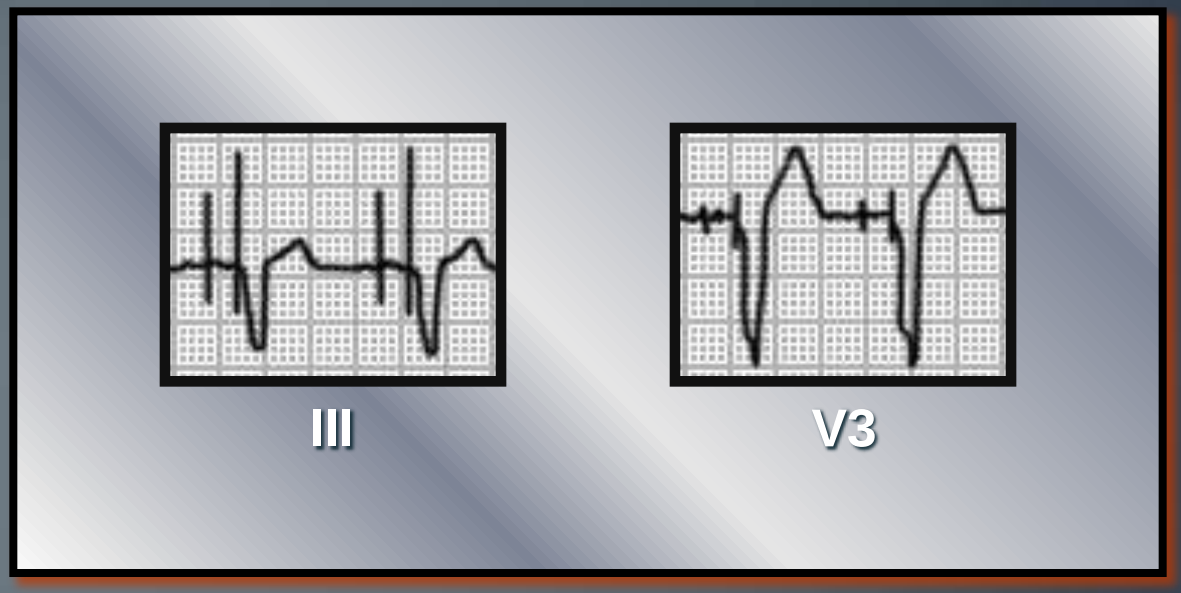


- Spike followed by wide QRS
- Cannot interpret ST - T waves

Ventricular Pacemaker

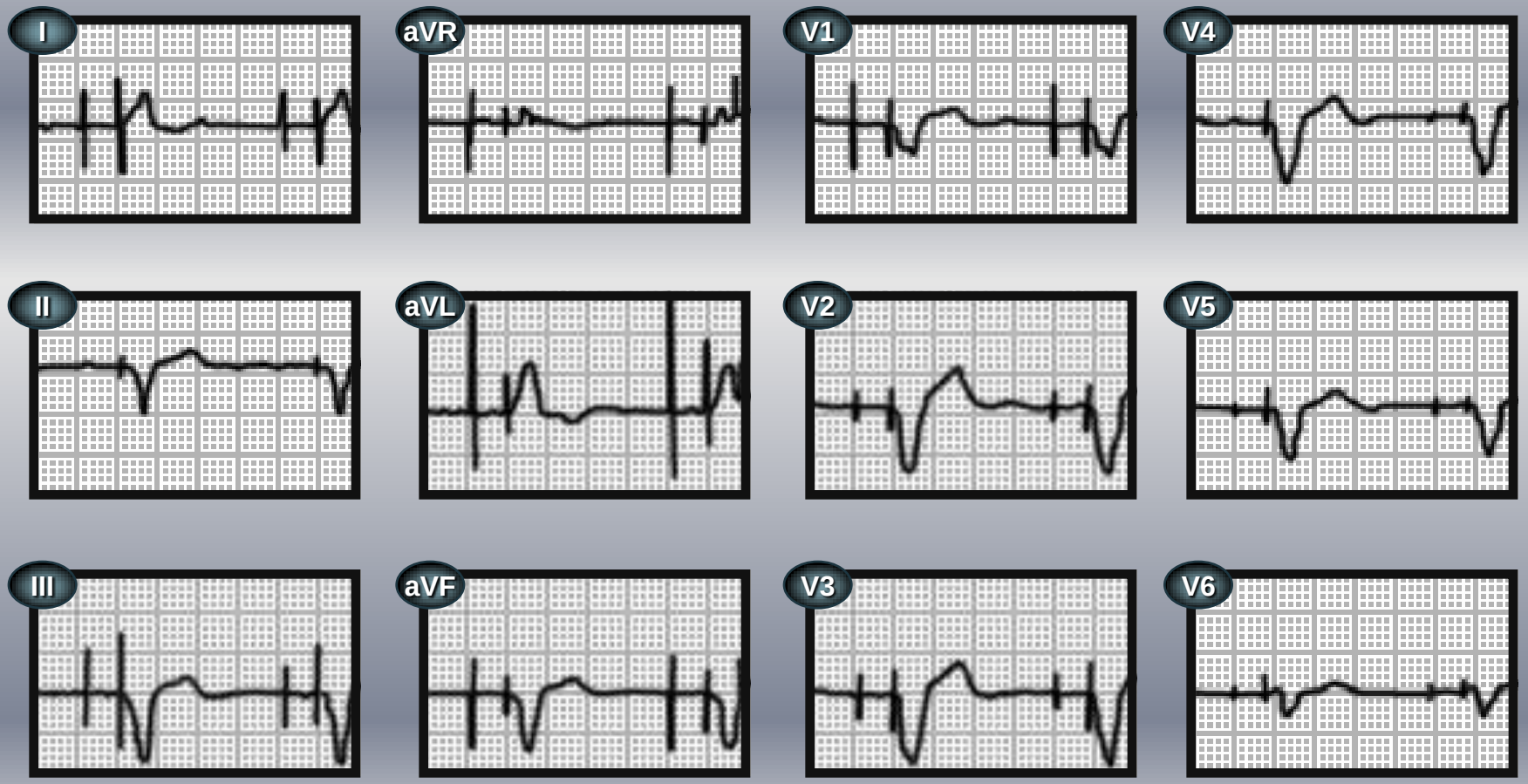


A-V Sequential Pacemaker

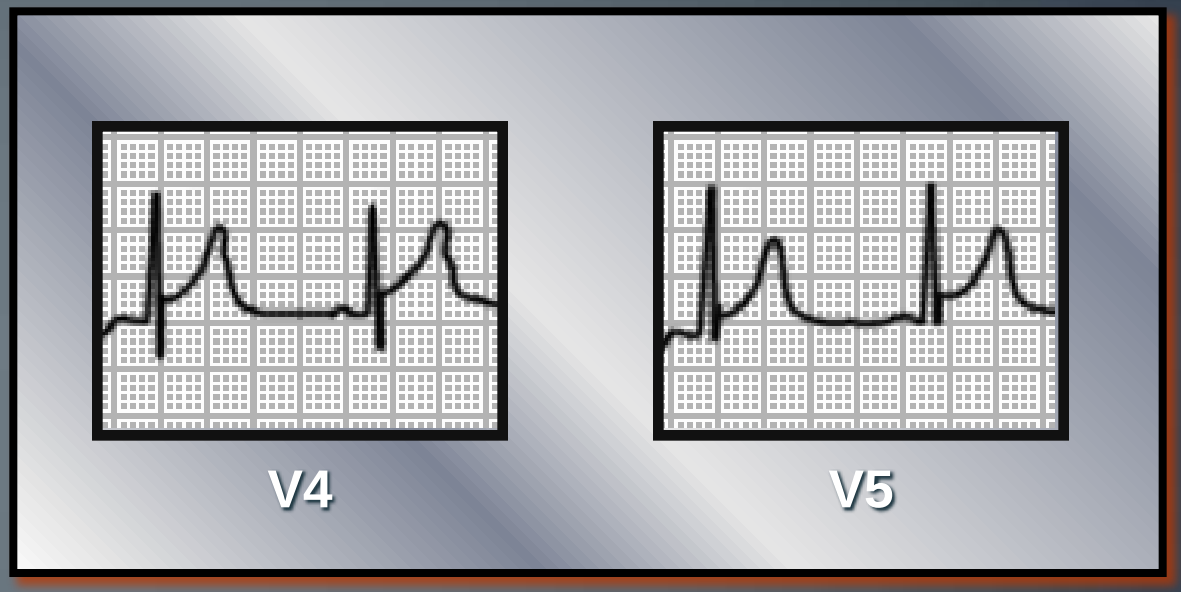


- Spike followed by P wave
- 2nd spike followed by wide QRS

A-V Sequential Pacemaker



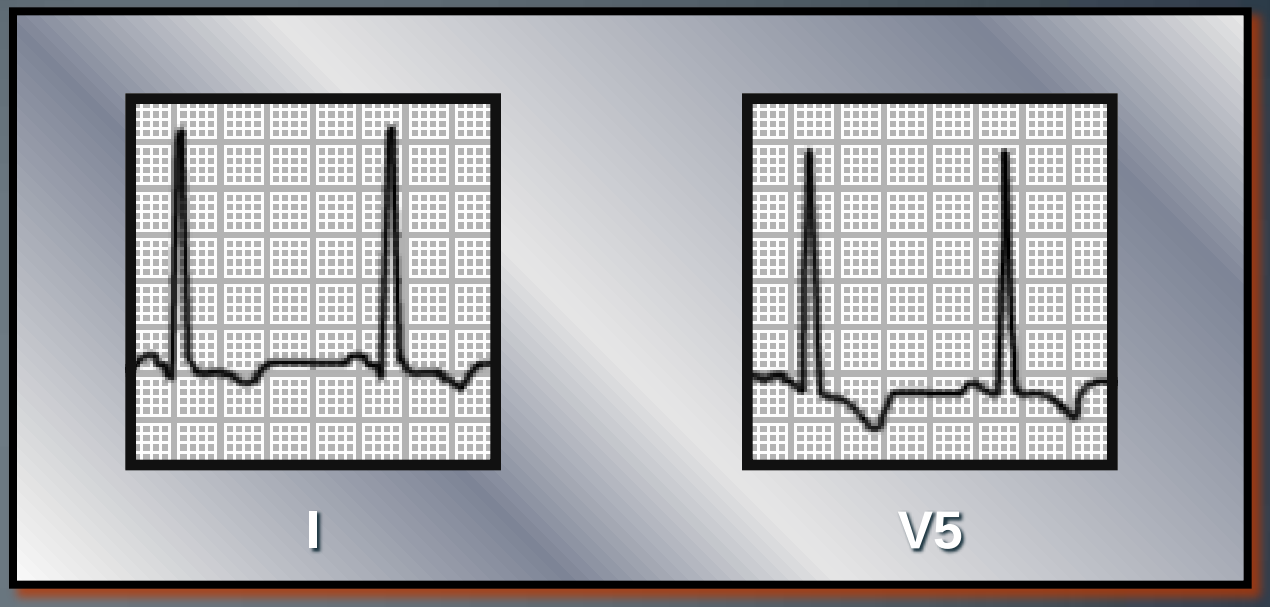
Early Repolarization



- J and Concave ST elevation V Leads
- Normal variant / young males

Early Repolarization

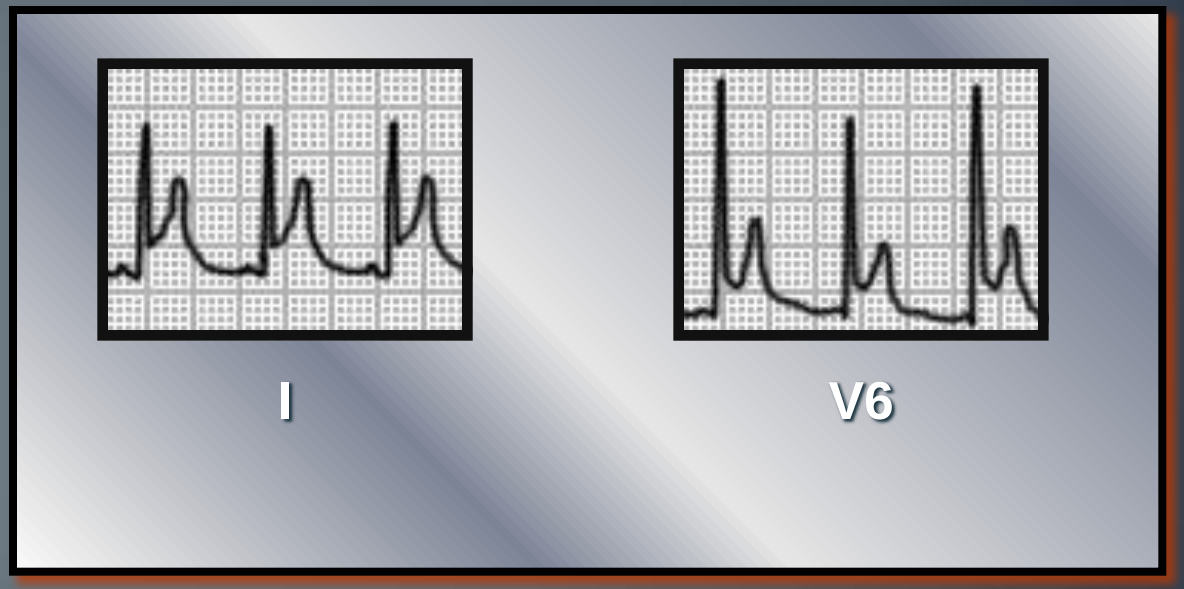
Left Ventricular Hypertrophy (LVH)



- Tall R waves in leads reflecting L.V. (R wave V5 or V6 > 26 mm)
- ST - T changes due to L.V.H.

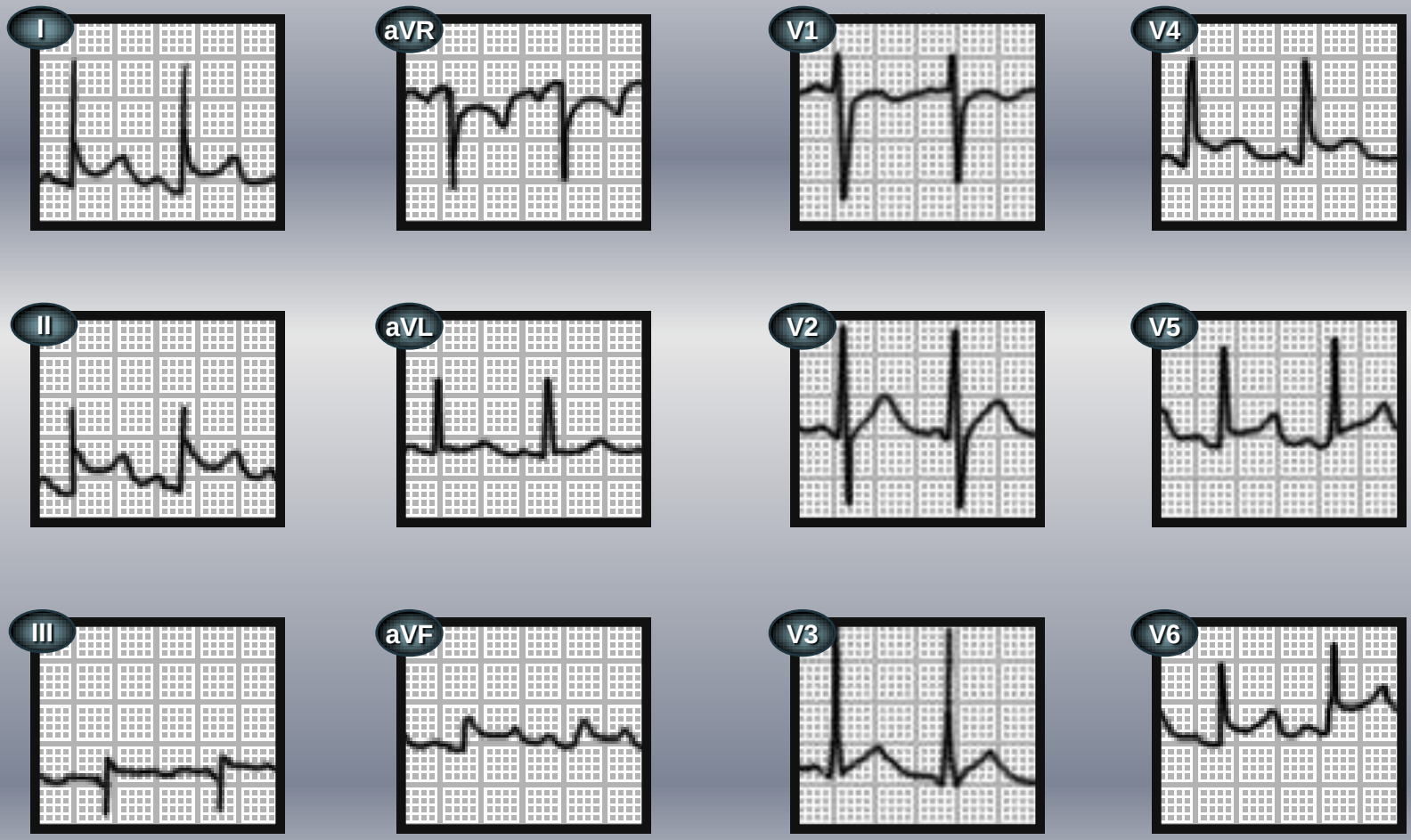
Left Ventricular Hypertrophy

Acute Pericarditis



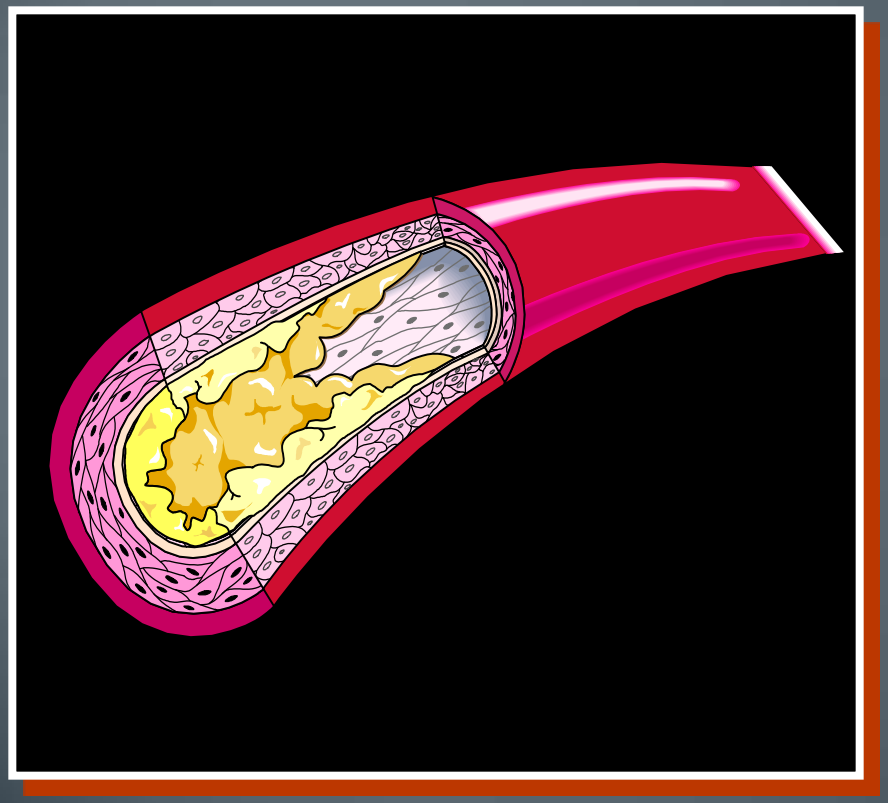
- ST segment elevation most leads
- “Flu” history and atypical chest pain

Pericarditis



STEMI Treatment

Thrombosis (Clot)

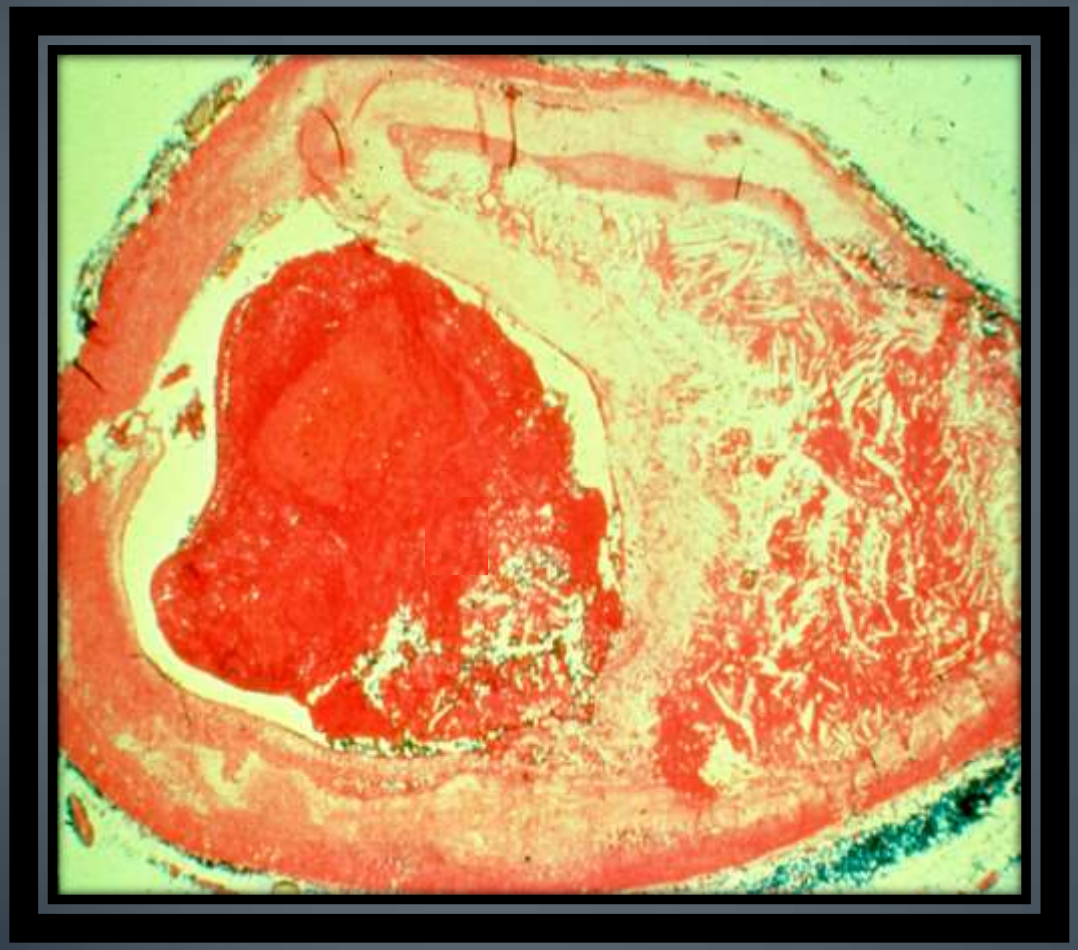


The *immediate cause*

of most infarctions:

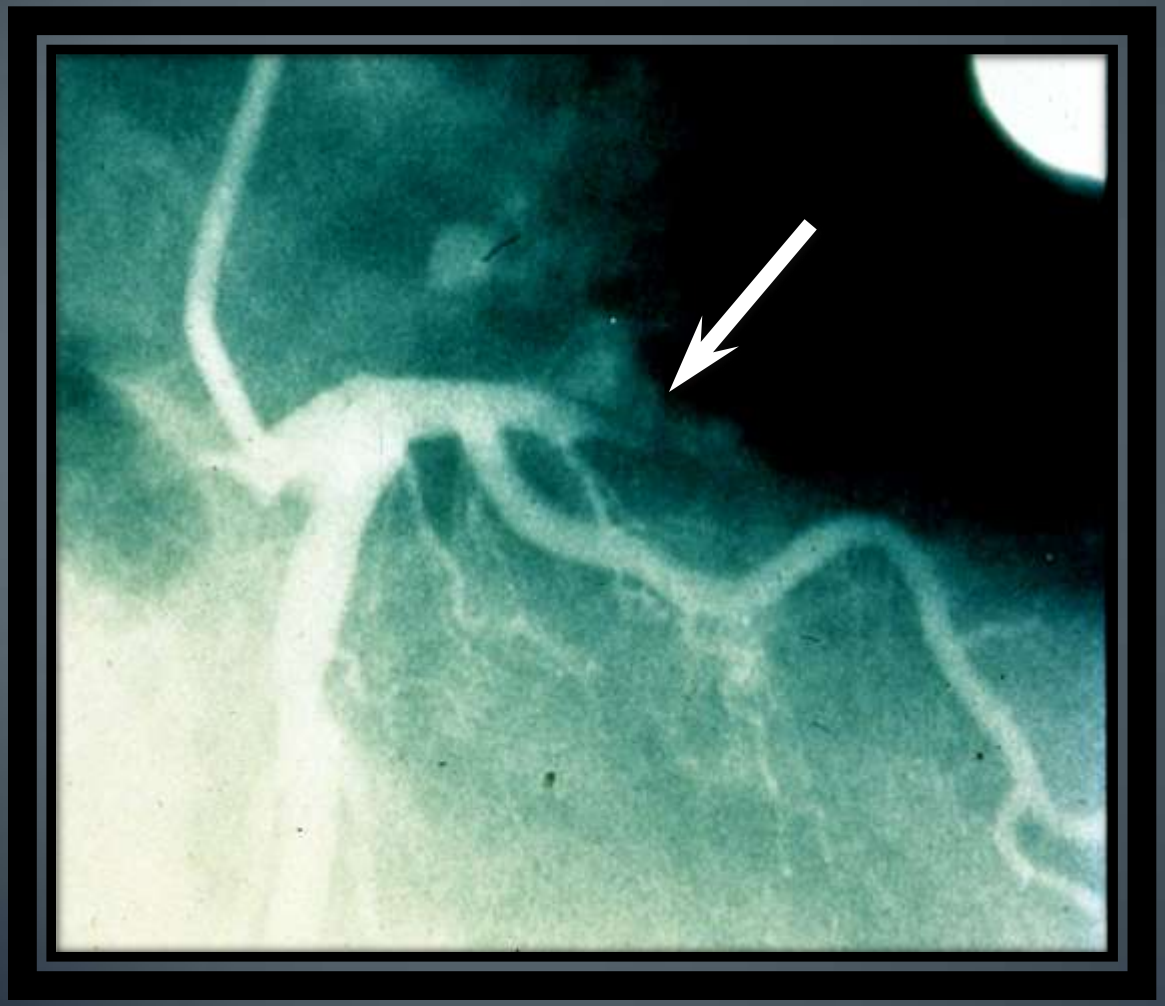
THROMBUS FORMATION

Occluded Coronary Artery - cross section



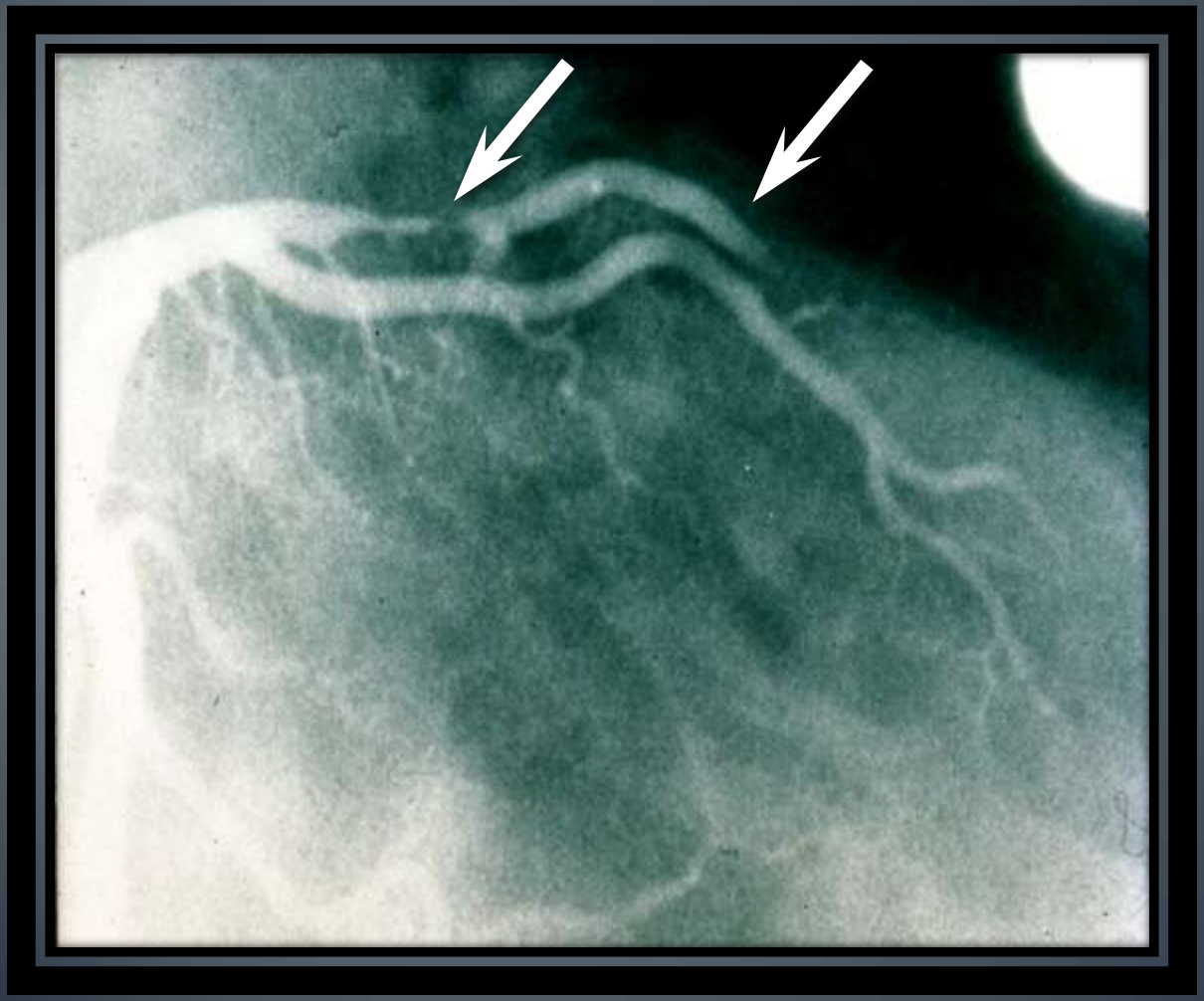
Atherosclerosis and Thrombus

Left Anterior Descending (LAD)



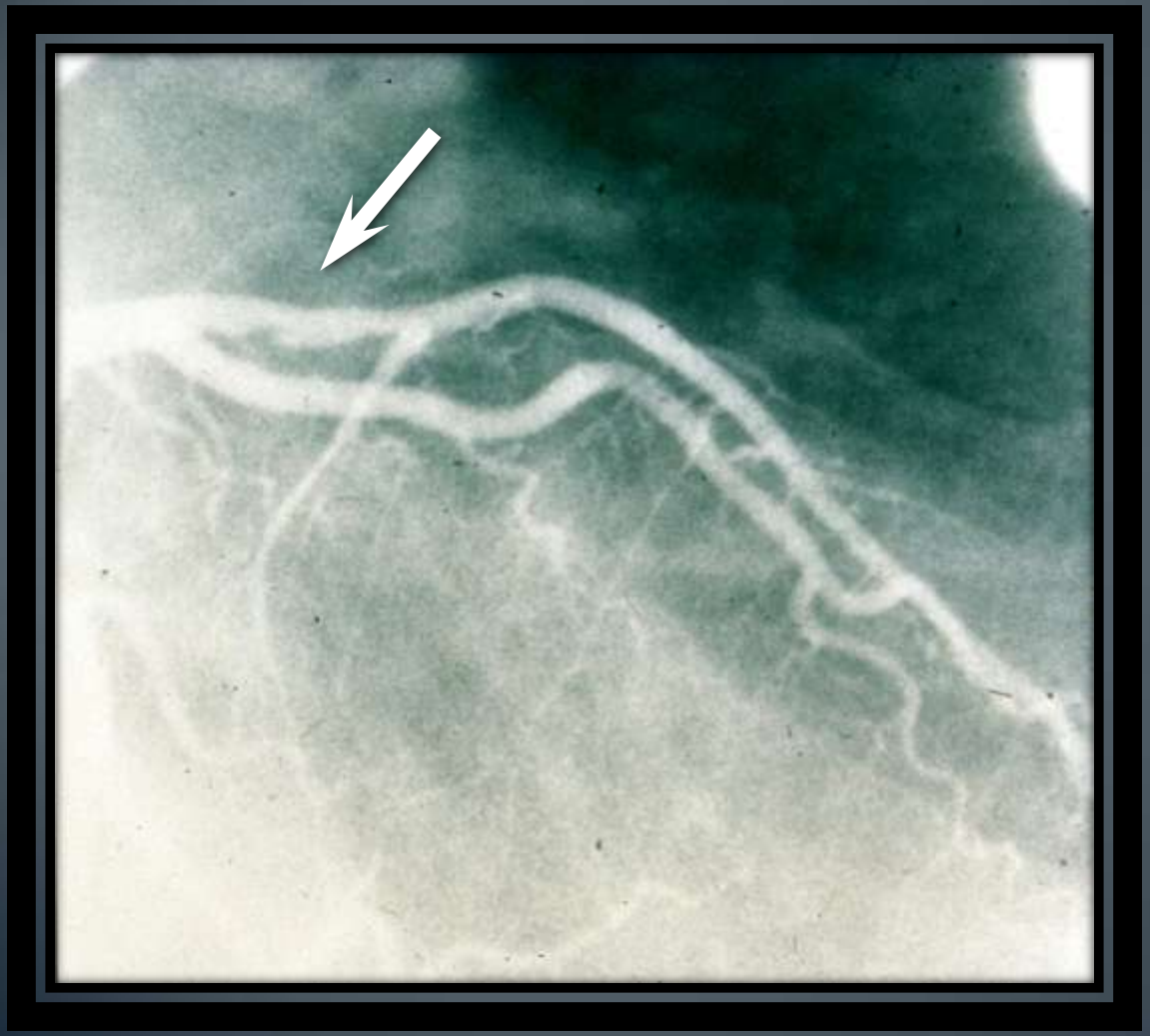
Totally Occluded by Thrombus

LAD - 15 Minutes After Treatment



Flow Partially Restored

LAD - 90 Minutes After Treatment



Further Resolution of Thrombus

Immediate Interventions for AMI

Initial Assessment:

Airway - ensure patency (prevent aspiration)

Breathing - oximeter, O_2

Circulation - vital signs, rhythm monitoring, IV

Therapy of AMI

GOAL:

Reduce Infarct Size

METHOD:

- **Decrease oxygen demand**
- **Increase oxygen supply**

Decrease Oxygen Demand

DRUG	USE	MECHANISM	CAUTIONS
Nitroglycerin	Ischemic pain	May dilate coronary arteries	Headache Hypotension Vasodilators *e.g., Viagra*
Morphine Sulfate	Severe ischemic pain Pulmonary Edema	Dilates peripheral veins and arteries, reducing heart's volume and pressure load	Nausea, Vomiting Hypotension Respiratory Depression
		Acts on pain sites in brain	

Increase Oxygen Supply

DRUG	USE	MECHANISM	CAUTIONS
Anti-Platelet: Aspirin	Prevents clot formation	Decreases platelet "stickiness"	Bleeding Gastric Ulcers
Fibrinolysis: Retavase TNKase Streptokinase	Dissolves the clot occluding coronary artery	Activates plasmin which lyses the thrombus	Bleeding Exclusion Criteria for Thrombolytics

Fibrinolytics ("Clot busters")

AMI Cause:	**Thrombus in majority**
If Rx Early:	**Flow ↑ , damage ↓**
Indications:	**Persistent symptoms of < 12 hours duration** **ST elevation of STEMI**
Contraindications:	**Exclusion criteria**

Fibrinolytic Inclusion Criteria

- **Persistent symptoms consistent with AMI for > 30 minutes and < 12 hours (chest pain or equivalent)**
- **ECG changes**
  - **ST segment elevation 1 mm. in at least 2 contiguous vertical leads, or 2mm. In 2 contiguous horizontal leads**
  - **QRS is.12 sec. with LBBB (not RBBB)**

Inferior - II, III, aVF, Anterior - V1-V6, Lateral - 1, aVL

Fibrinolytic Exclusion Criteria Include:
(Be Sure: BSSSS)

- **B**leeding (active or known problems)
- **S**troke (TIA, brain and spinal surgery)
- **S**treptokinase (previously received - allergy)
- **S**urgery (recent or trauma - traumatic CPR)
- **S**evere Hypertension

Cardiac Event Protocol

- *EMS SYSTEM APPROACH THAT SHOULD ADDRESS:*

- Oxygen - IV - cardiac monitor - vital signs
- *Nitroglycerin*
- *Aspirin*
- Pain relief with narcotics
- Notification of emergency department
- Rapid transport to emergency department
- Prehospital screening for PCI or *fibrinolytic* therapy
- 12-lead ECG, computer analysis, transmission:
  - to emergency department

- *"DOOR-TO-REPERFUSION" TEAM PROTOCOL APPROACH*

- Rapid triage of patients with chest pain
- Clinical decision maker established (emergency physician, cardiologist, or other)

Emergency Department Goal: 30 to 90 minutes

ASSESSMENT

- *Immediate:*

- Vital signs
- Oxygen at 4 L/min-Sat<94%
- *Aspirin*, if not given prior
- Start IV
- *Nitroglycerin* SL or spray
- *Morphine* IV
- 12-lead ECG (MD review)
- Focused history & physical
- Chest X-ray
- Blood (electrolytes, cardiac markers, coagulation studies)

***TREATMENTS TO CONSIDER** if there is evidence of coronary thrombosis plus no reasons for exclusion:*

(some but not all may be appropriate)

- *Clopidogrel*
- *Nitroglycerin* IV
- *-Blockers* IV
- *Heparin* IV
- Ace Inhibitors
- Statins
- Glycoprotein Inhibitors
- Consult as needed
- Decide eligibility for
  - *PCI/Fibrinolysis*

Precious minutes saved life of Christmas tree grower

Cherri and Gary Trump of Pinecrest Tree Farm in Blue Springs. Gary benefited last summer from a heart attack protocol recently introduced in Beatrice Fire Rescue