

How Doctors Think in the ED

Working up the Patient with Chest Pain

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Objectives

- Share my story of 31 years at OSU
- Hear and eventually solve a case of chest pain (William Morgan)
- Learn how doctors think and the two types of thinking they use
- Learn the 6 immediately life threatening chest pain diagnosis
- Describe the usual work-up of chest pain in the ED
- Describe how we diagnose these 6 causes of chest pain

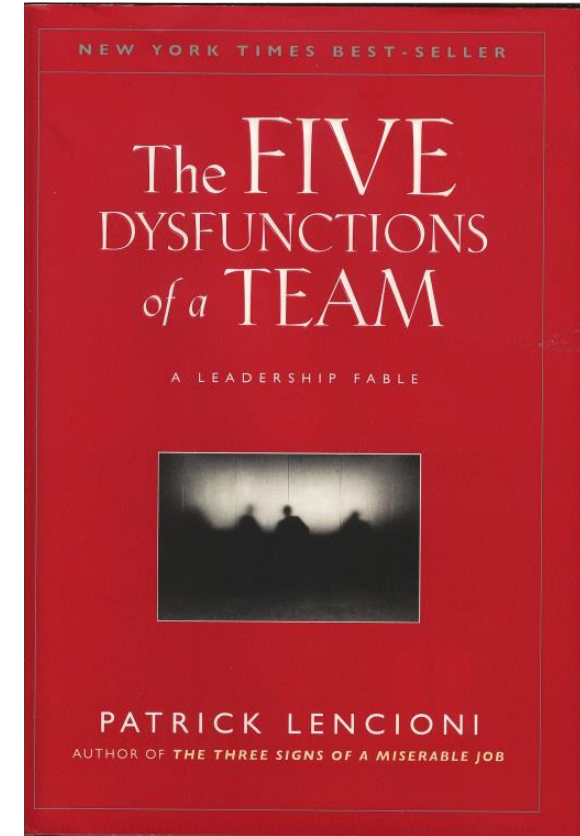


DISCLOSURES

- No other monetary benefits from any pharmaceutical companies
- NIH funding in the past
- >50 Jerry Garcia ties and 15 are Christmas ties
- Bought a new sport coat just for cruises from Macy's
- Favorite drink is the Classic frozen Margarita with Grand Marnier or Blackberry Bourbon from Molly Woos
- Favorite TV shows: Seinfeld, Curb Your Enthusiasm, Law and Order
- Most recent movie, "Get Out" by Jordan Peele

My Story – Vulnerability Trust

- 31 years at OSU
- Early years
- Married 1980
- Education
- OSU 1988
- Education
- Research
- Leadership (VCE)
- MBA 2016



The Real Story - (Type 1 and a Pacer)

- 23 yo weight loss and lots of urination
Eye doctor appointment Friday before start of medical school
Needed glasses but vision remained blurry
Back to eye doctor on Tuesday positive urine 4+ glucose
Type 1 Diabetes (on insulin)
- 59 yo just noticed that when I ran just became tired running
My internist checked labs and a stress test
During stress test recovery skipping beats
Wife (RN) noted heart rate in the 30s
Third degree heart block, diagnosis of cardiac sarcoid
Pacemaker – defibrillator = Heart block with a pacer



Questions?



A Case of Chest Pain from How Doctors Think (given to students and residents)

- William Morgan 67 yo M who was retired mail carrier with hypertension and a complaint of chest pain. His hypertension was hard to control. He had an UGI, CXR, EKG and a stress test, all normal. Just before discharge he sat up with severe chest pain, wide eyed, had trouble taking breaths and could not speak.



From How Doctors Think

“The MGH selection committee had made a mistake offering me an internship. After all these years of preparation I ended up with an empty head and my feet fixed to the floor.”

Enter Dr. Burnside (cardiologist) ...

Saw this happen

Listened with stethoscope

We gotta get him to OR!

67 yo Male William Morgan with CP

Summary

- Patient with a negative work up (stress, UGI, CXR and labs)
- Then sudden and severe chest pain
- Dr. Burnside heard something on cardiac exam
- Required an emergency lifesaving surgery
- Life was saved

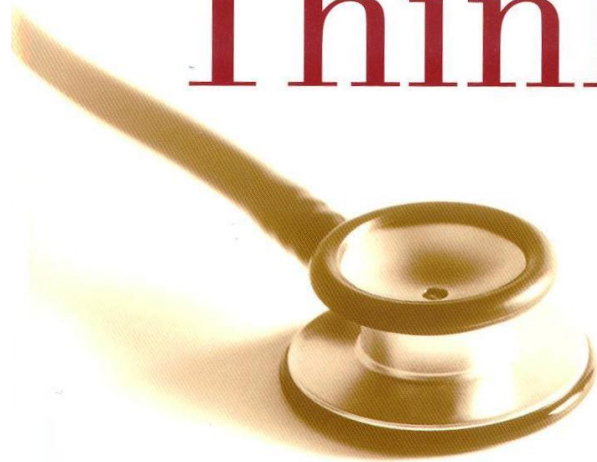
67 yo Male with CP – 3 Questions

1. What are the 6 immediately life threatening causes of chest pain?
2. Which of these causes did William Morgan have?
3. What type of thinking was Dr. Burnside using?

"Must reading for every physician who cares for patients and every patient who wishes to get the best care." — *Time*

NEW YORK TIMES BESTSELLER

How Doctors Think



JEROME GROOPMAN, M.D.

WITH A NEW AFTERWORD

How Do Doctors Think?

- **Catch-as-catch-can**; trainees observe senior physicians and assimilate the approach to diagnosis and treatment (apprenticeship; see one, do one, teach one)
- **Decision trees**; preset algorithms and practice guidelines
 - What if vague complaints? Multiple complaints?
 - Do they expand knowledge or constrain it?
- **Evidence based medicine**
 - Too much reliance on numbers?
 - At best EBM can compliment decisions
- **Bayesian analysis**
- **Normative**; compile a list, determine likelihood, consequences of making or missing each dx + use Bayesian probability to narrow the list (seldom used in practice)

The Importance of Cognitive Errors in Diagnosis and Strategies to Minimize Them



Pat Croskerry, MD

Halifax, Nova Scotia

Academic Medicine 2003;78:775-780

The Importance of Cognitive Errors in Diagnosis and Strategies to Minimize Them

Pat Croskerry, MD, PhD

ABSTRACT

In the area of patient safety, recent attention has focused on diagnostic error. The reduction of diagnostic error is an important goal because of its associated morbidity and potential preventability. A critical subset of diagnostic errors arises through cognitive errors, especially those associated with failures in perception, failed heuristics, and biases; collectively, these have been referred to as *cognitive dispositions to respond* (CDRs). Historically, models of decision-making have given insufficient attention to the contribution of such biases, and there has been a prevailing pessimism against improving cognitive performance through debiasing techniques. Recent work has catalogued the major cognitive biases in medicine; the author lists these and describes

a number of strategies for reducing them ("cognitive debiasing"). Principle among them is metacognition, a reflective approach to problem solving that involves stepping back from the immediate problem to examine and reflect on the thinking process. Further research effort should be directed at a full and complete description and analysis of CDRs in the context of medicine and the development of techniques for avoiding their associated adverse outcomes. Considerable potential exists for reducing cognitive diagnostic errors with this approach. The author provides an extensive list of CDRs and a list of strategies to reduce diagnostic errors.

Acad. Med. 2003;78:775–780.

Table 1. General properties of the two systems

Property	System 1: Intuitive	System 2: Analytical
Reasoning style	Heuristic Associative Concrete	Normative Deductive Abstract
Awareness	Low	High
Prototypical	Yes	No, based on sets
Action	Reflexive, skilled	Deliberate, rule based
Automaticity	High	Low
Speed	Fast	Slow
Channels	Multiple, parallel	Single, linear
Propensities	Causal	Statistical
Effort	Minimal	Considerable
Cost	Low	High
Vulnerability to bias	Yes	Less so
Reliability	Low, variable	High, consistent
Errors	Common	Few
Affective valence	Often	Rarely
Predictive power	Low	High
Hard-wired	May be	No
Scientific rigour	Low	High
Context importance	High	Low

Sources: Adapted from Dawson (1993), Croskerry (2005) and Evans (2008).

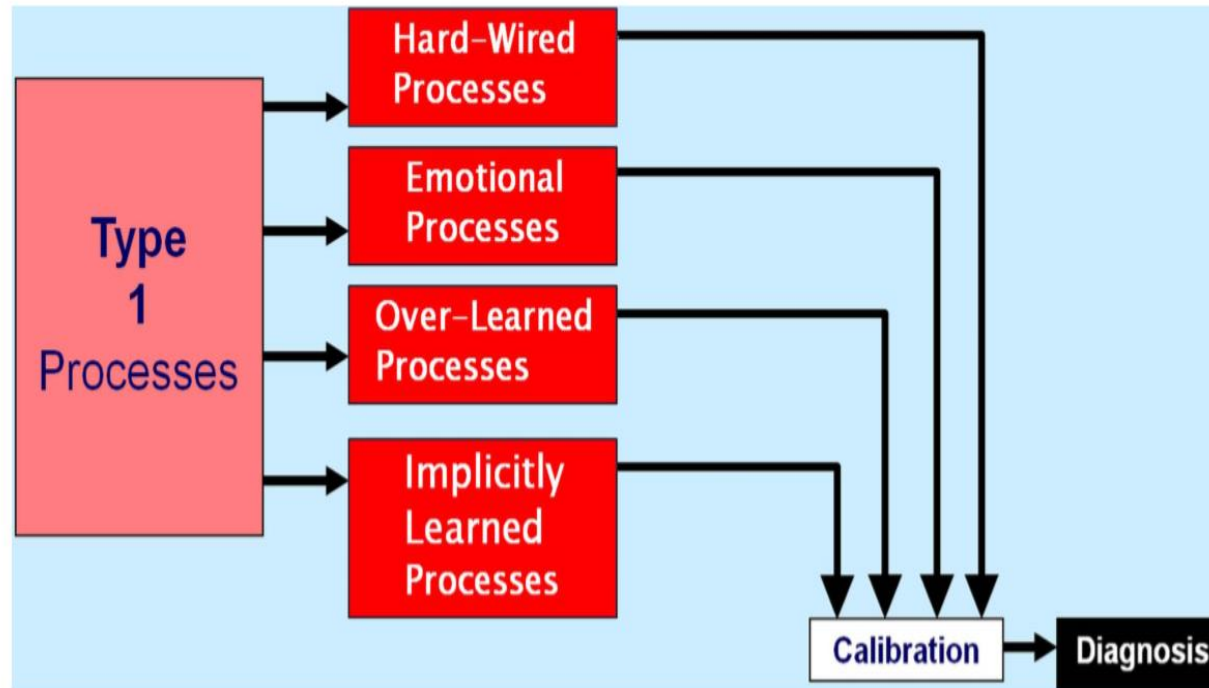
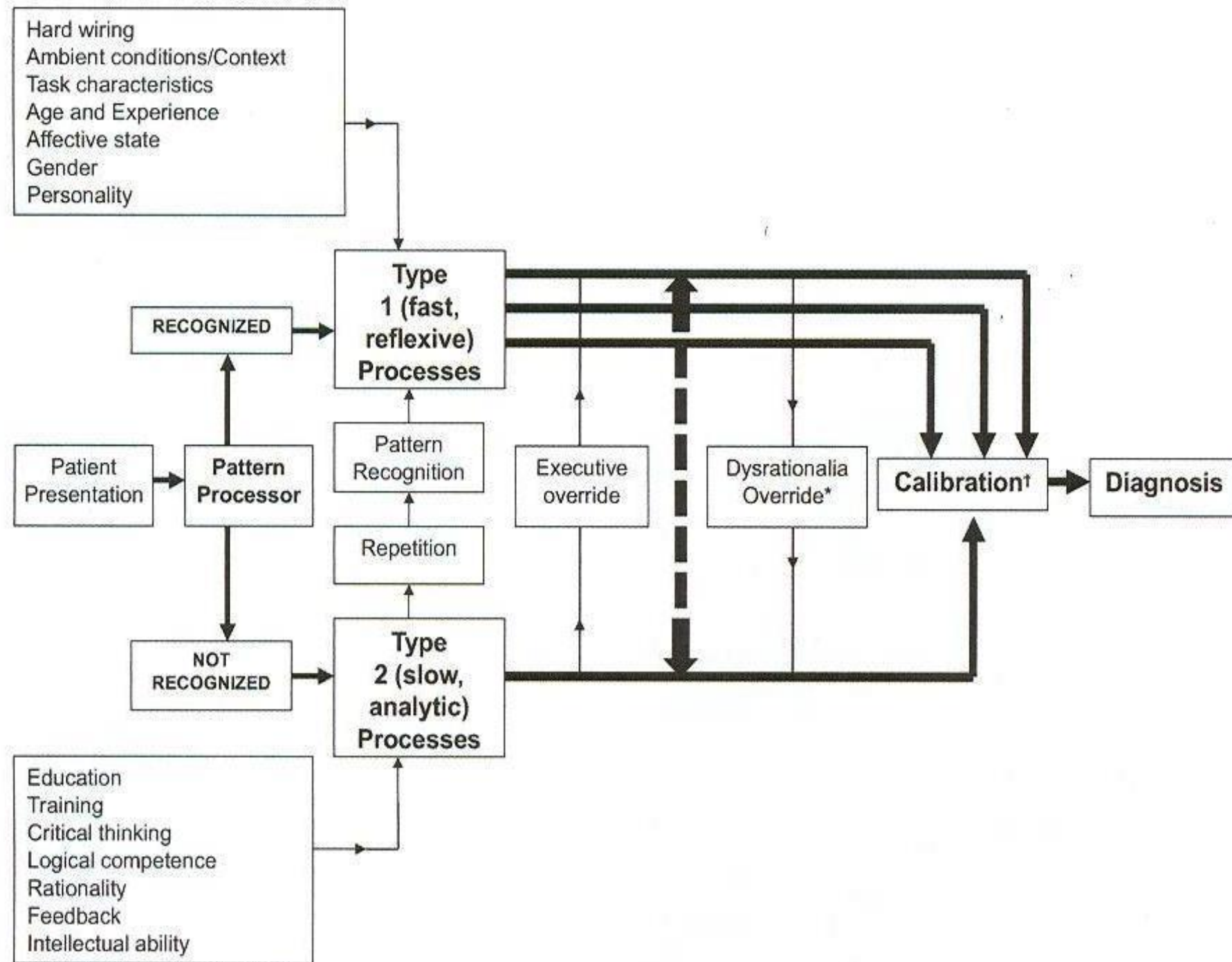


Figure 2 Origins of biases in Type I processes. This is a modified section of the dual process model of diagnosis expanding upon the origins of Type 1 processes (based on Stanovich).²⁷



Dual process theory of thought

System 1

Fast / Automatic

Emotional

- Impulses / Drives
- Habits
- Beliefs



System 2

Slow / Effortful

Logical

- Reflection
- Planning
- Problem solving



THE NEW YORK TIMES BESTSELLER

THINKING, FAST AND SLOW



DANIEL
KAHNEMAN

WINNER OF THE NOBEL PRIZE IN ECONOMICS

"[A] masterpiece . . . This is one of the greatest and most engaging collections of insights into the human mind I have read." —WILLIAM EASTERLY, *Financial Times*

#1 international bestseller

blink

by the author of *THE TIPPING POINT*



The Power of Thinking
Without Thinking

Malcolm Gladwell

"A real pleasure . . . *Blink* brims with surprising insights about our world and ourselves." —*Salon*

Facts about Dual Process Theory

- Verified by functional MRI, brain glucose utilization, studies of patients with brain lesions (Acad Med 2019;94:187-194)
- Novices and Trainees spend more time in the analytical mode and experienced clinicians spend more time in the intuitive mode. Experts have largest repertoire of cases, few errors and instant dx.
- Experts have more experience and more deliberate practice and this may take 10 years or 10,000 hours. (Anders Ericksen and Malcolm Gladwell)

Jerome Groopman's 3 Questions to Ask Your MD??

- 1. What else could this be?**
- 2. Is there anything that doesn't fit?**
- 3. Is it possible I have more than one problem?**

“I want you to know what I know and what I don't know”



So far...

- Learned a lot about me
- Case of chest pain (William Morgan)
- How doctors think
- Dual process theory
- **Six immediately life-threatening chest pain**
- Describe the usual work-up of chest pain in the ED
- Describe how we diagnose these 6 causes of chest pain

Chest Pain

What are the six immediately life threatening causes of chest pain??



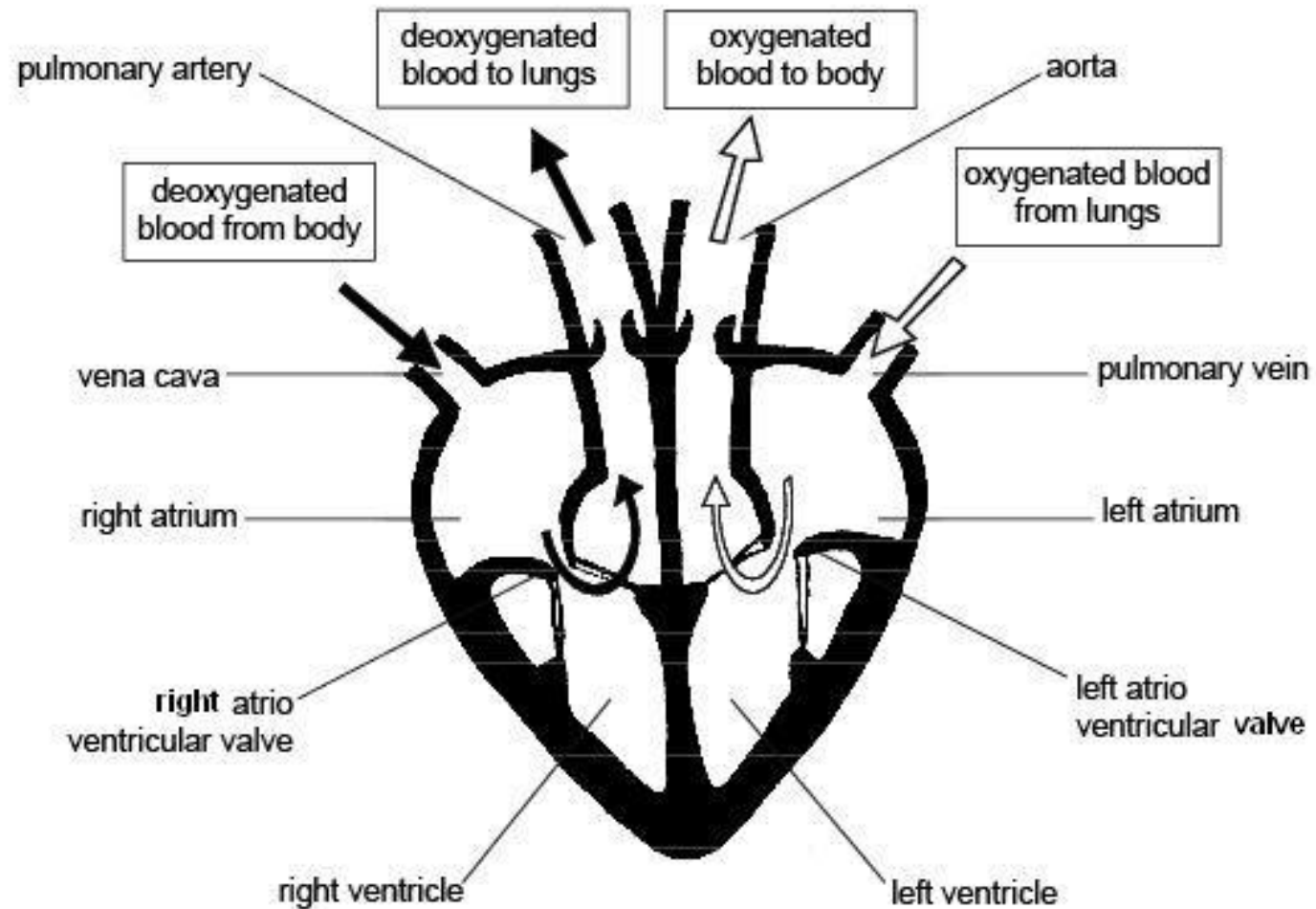
Immediately Life Threatening Causes of CP??

(Name 6)

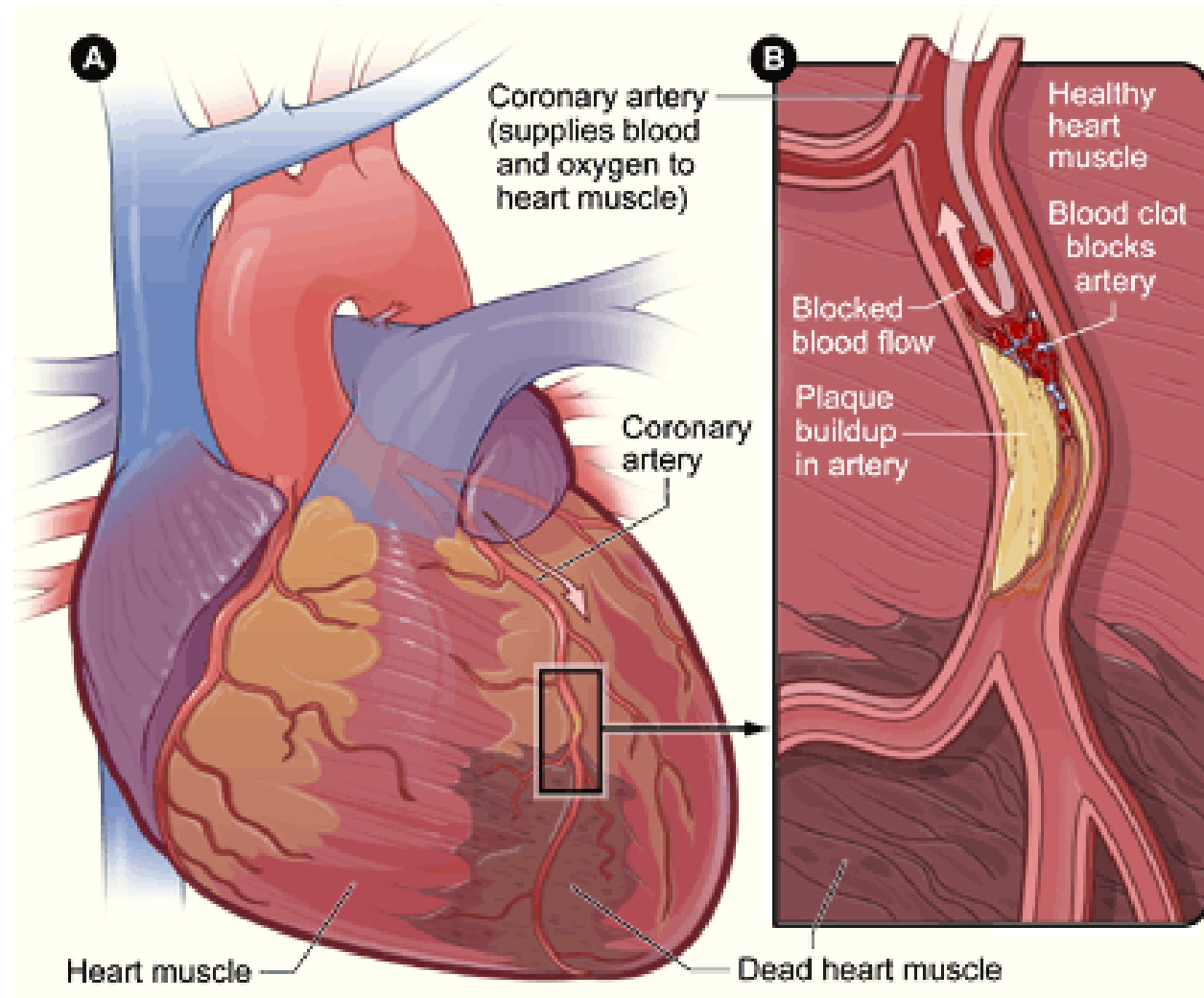
1. Acute Coronary Syndrome (ACS)
2. Pulmonary Embolus (PE)
3. Pericarditis with cardiac tamponade
4. Aortic Dissection
5. Tension Pneumothorax
6. Esophageal Rupture

Our work up always considers these causes

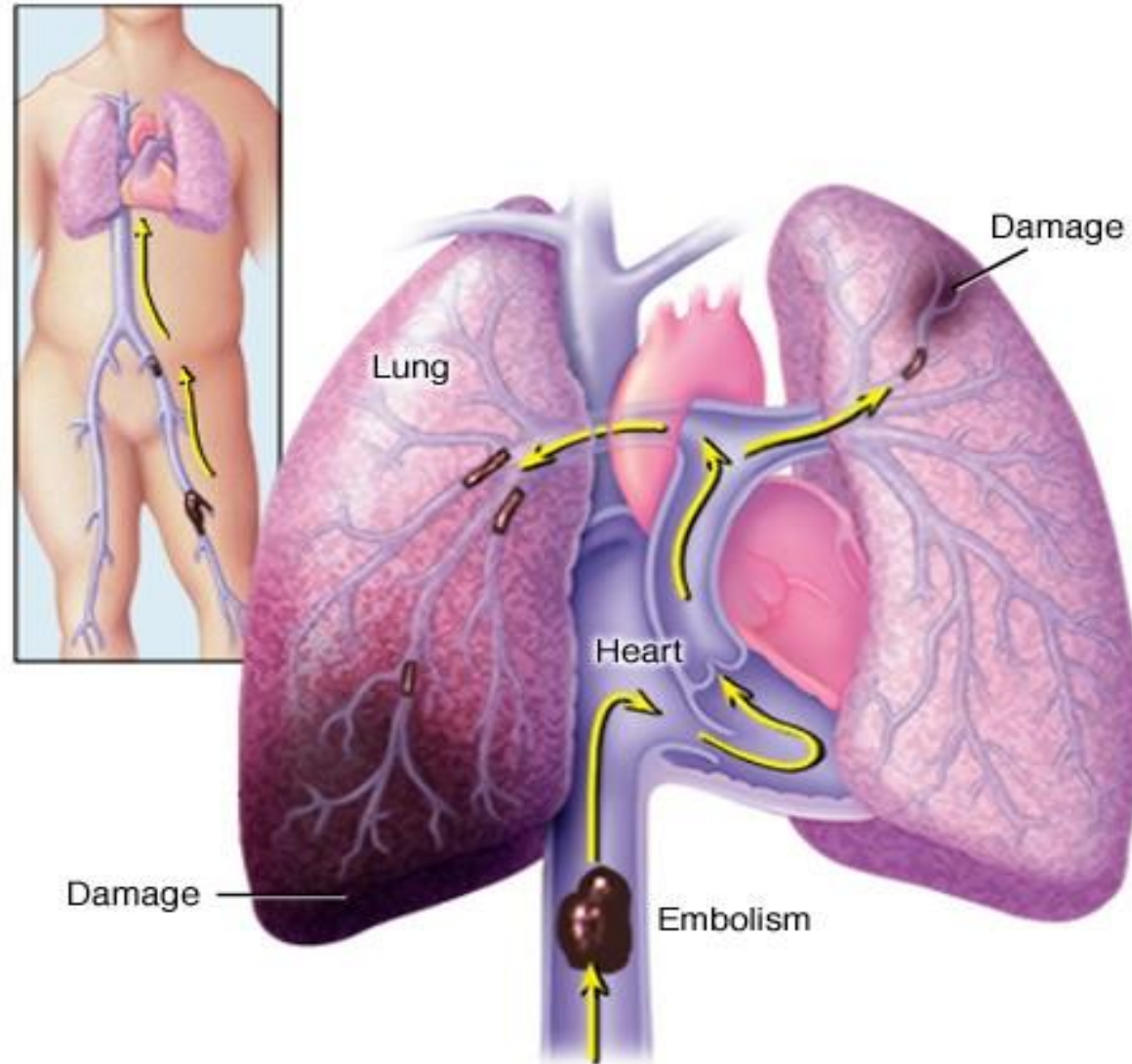
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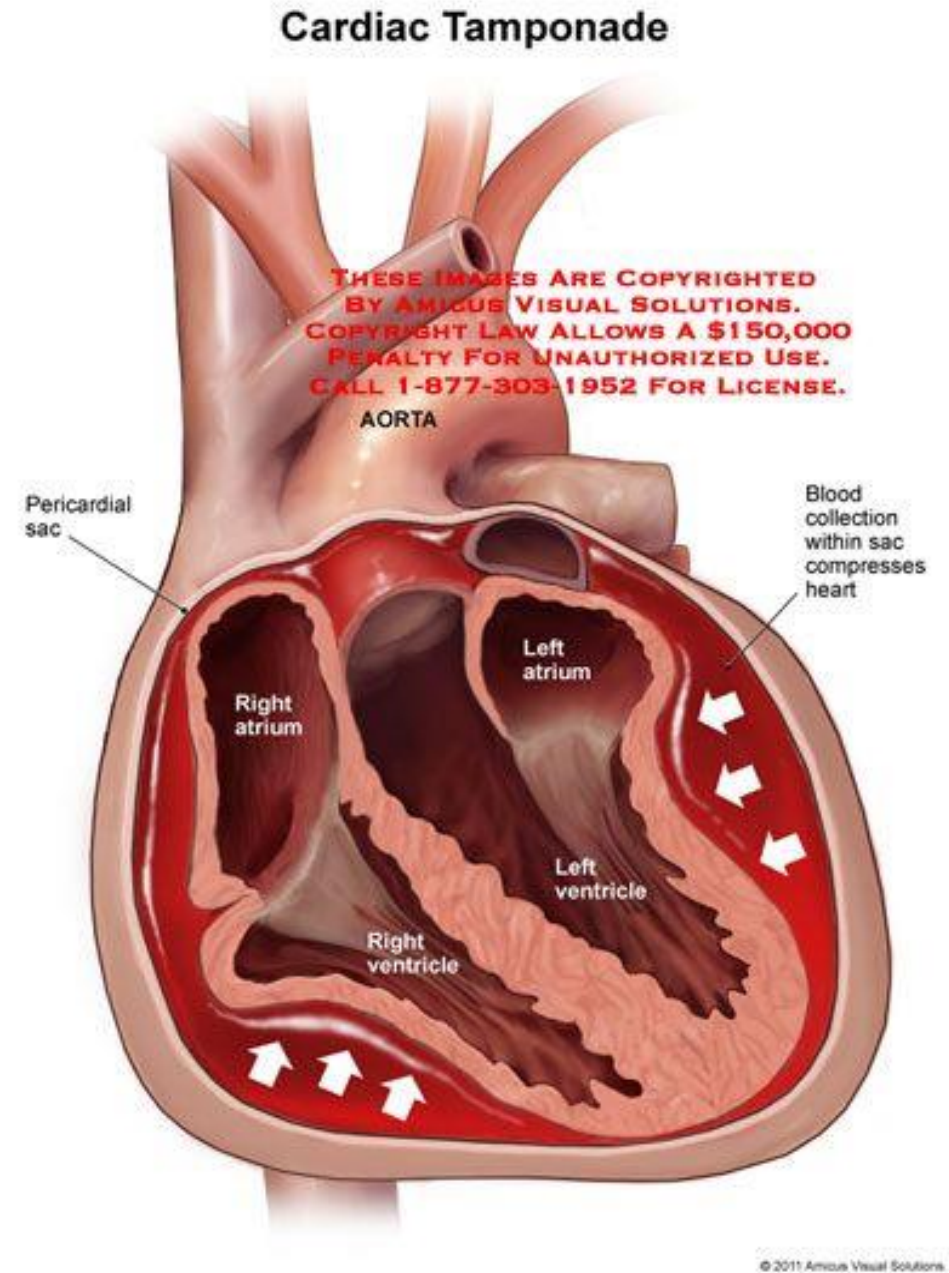
1. Acute Coronary Syndrome



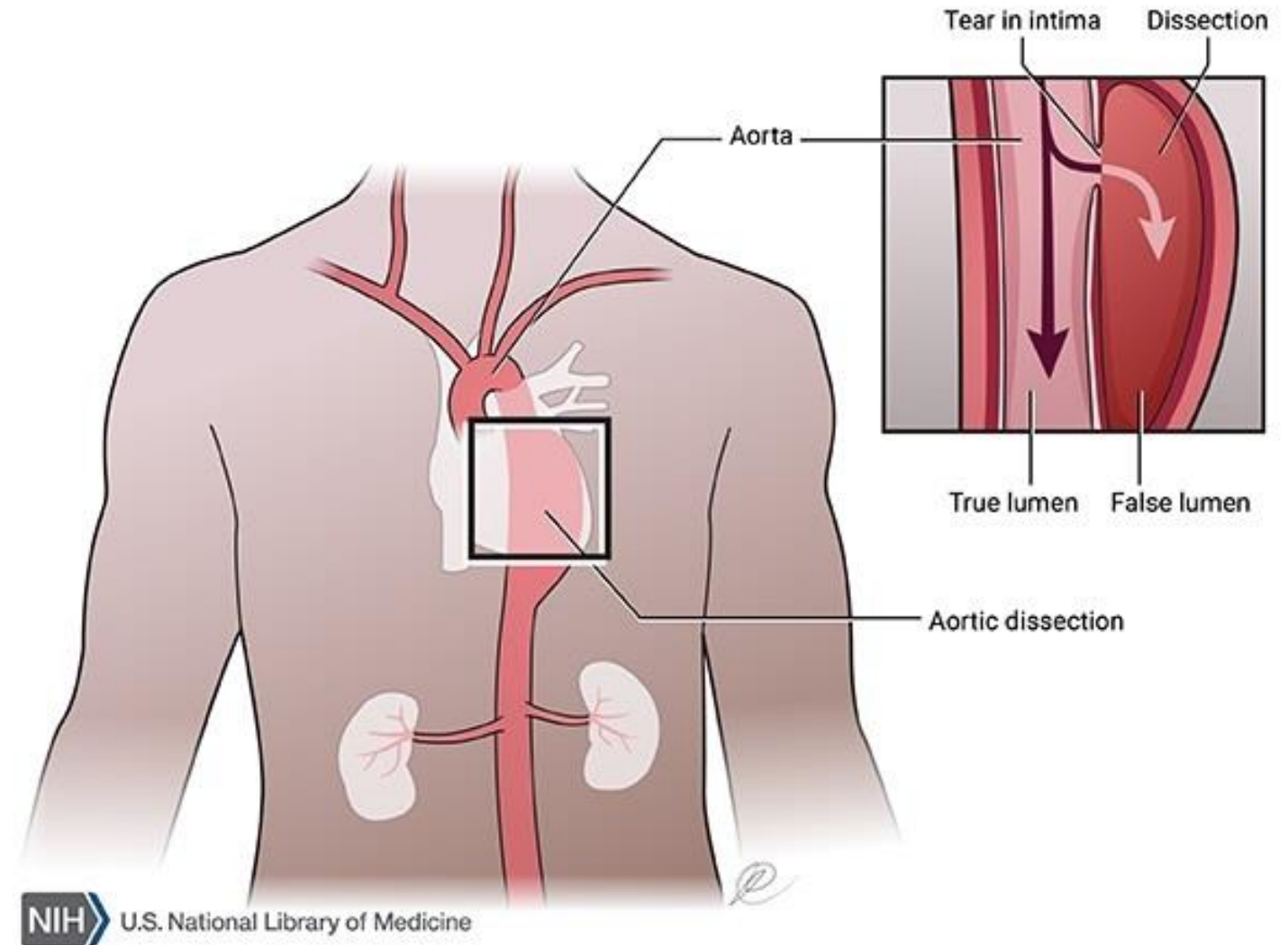
2. Pulmonary Embolus



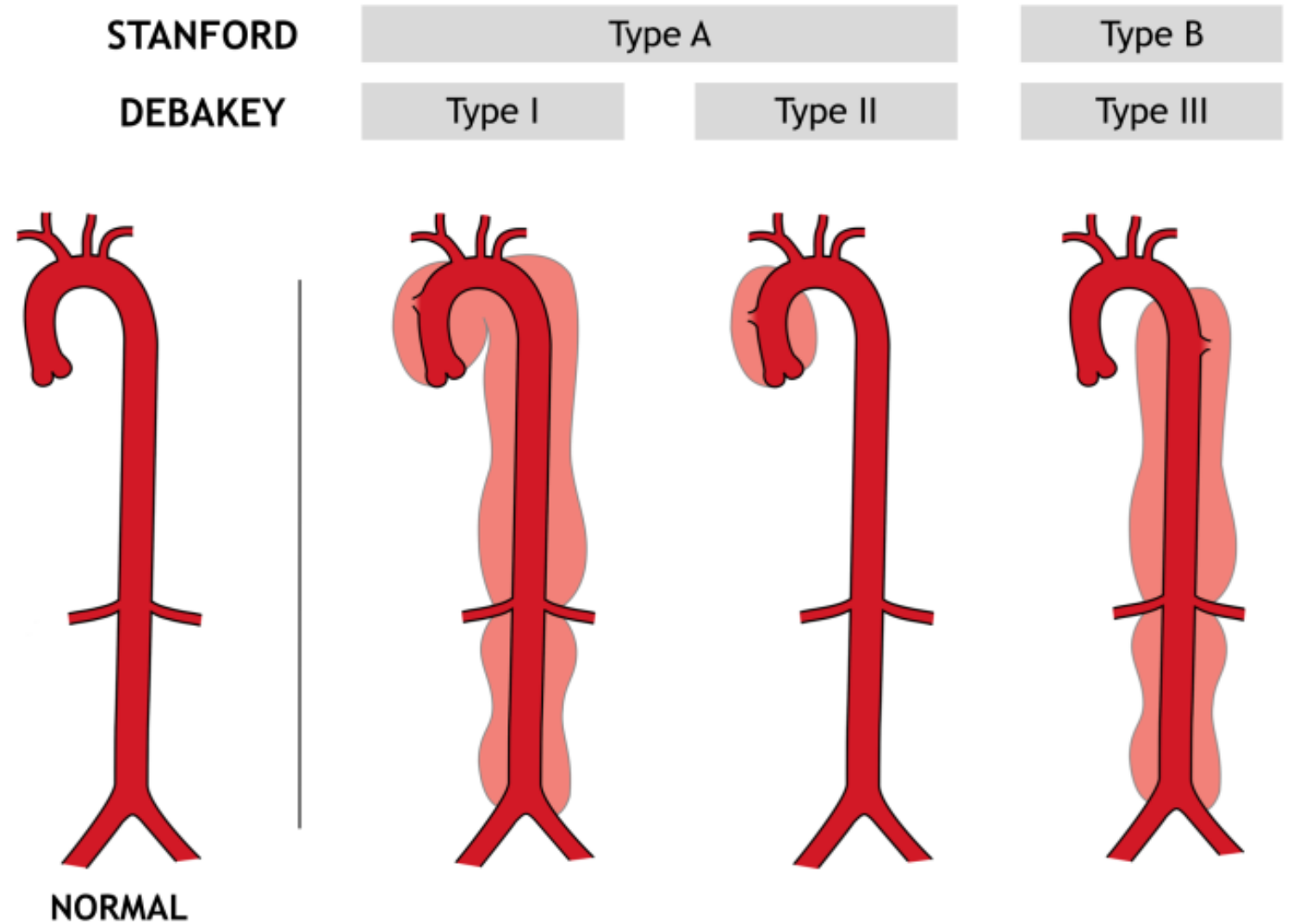
3. Pericardial Tamponade



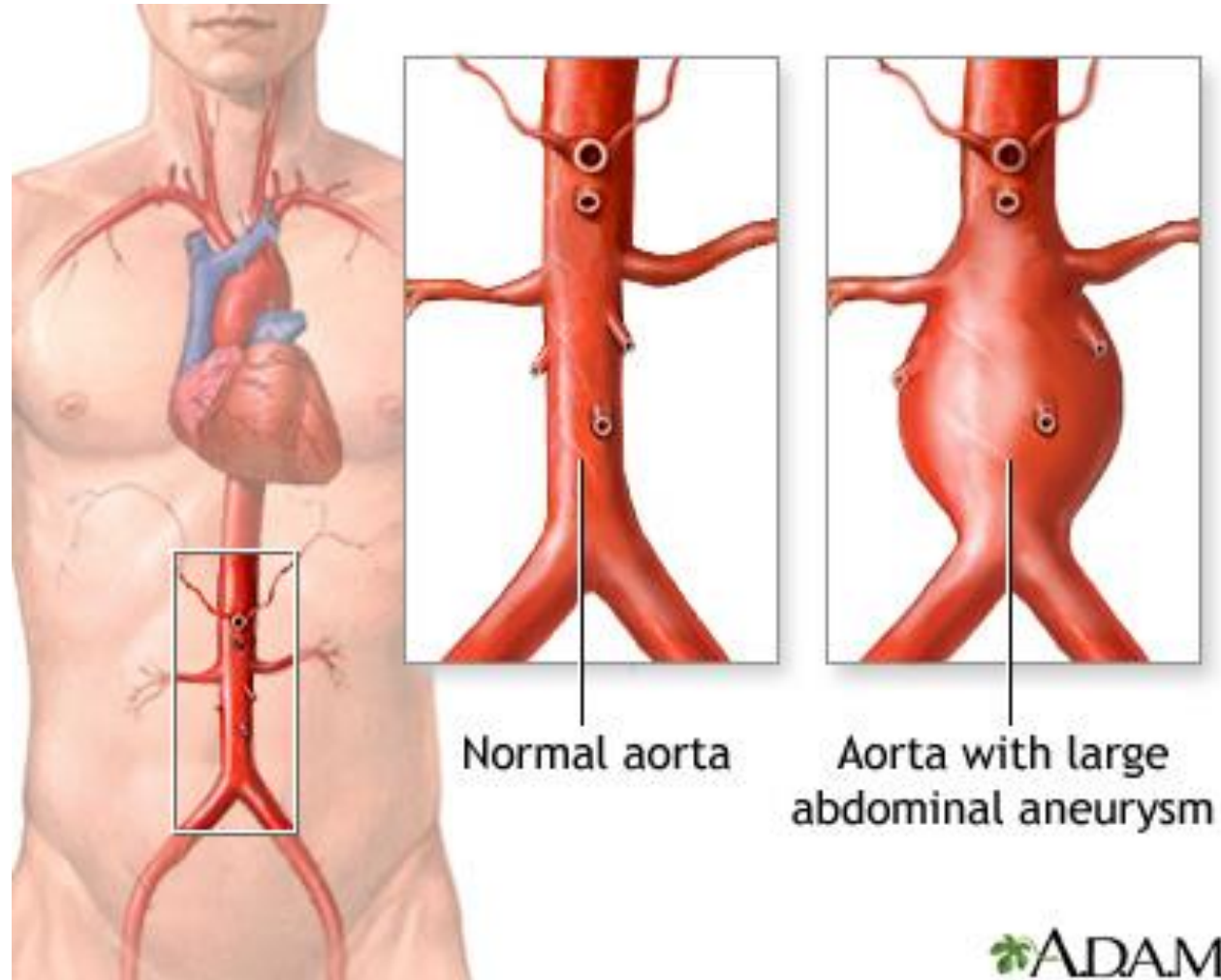
4. Aortic Dissection



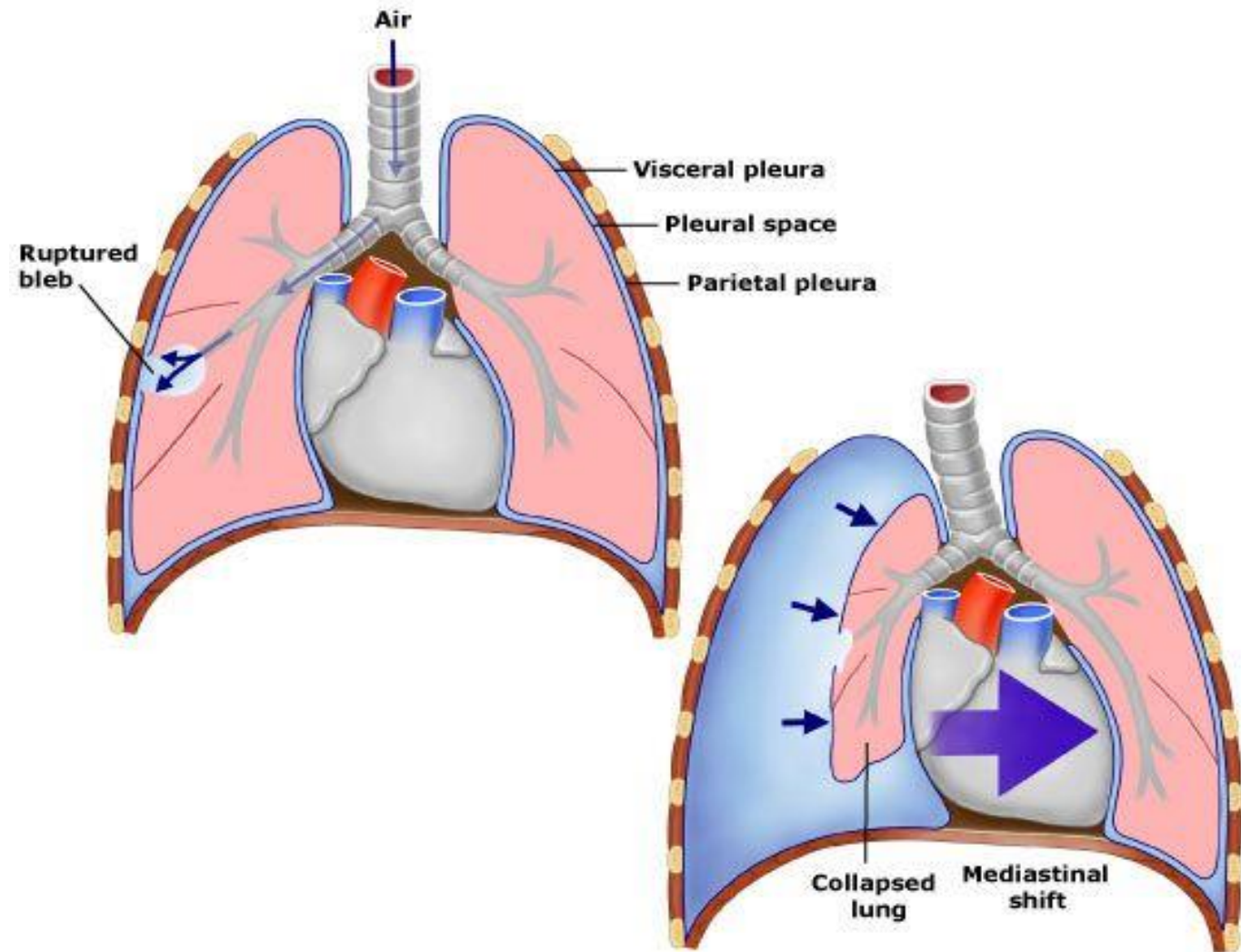
4. Aortic Dissection



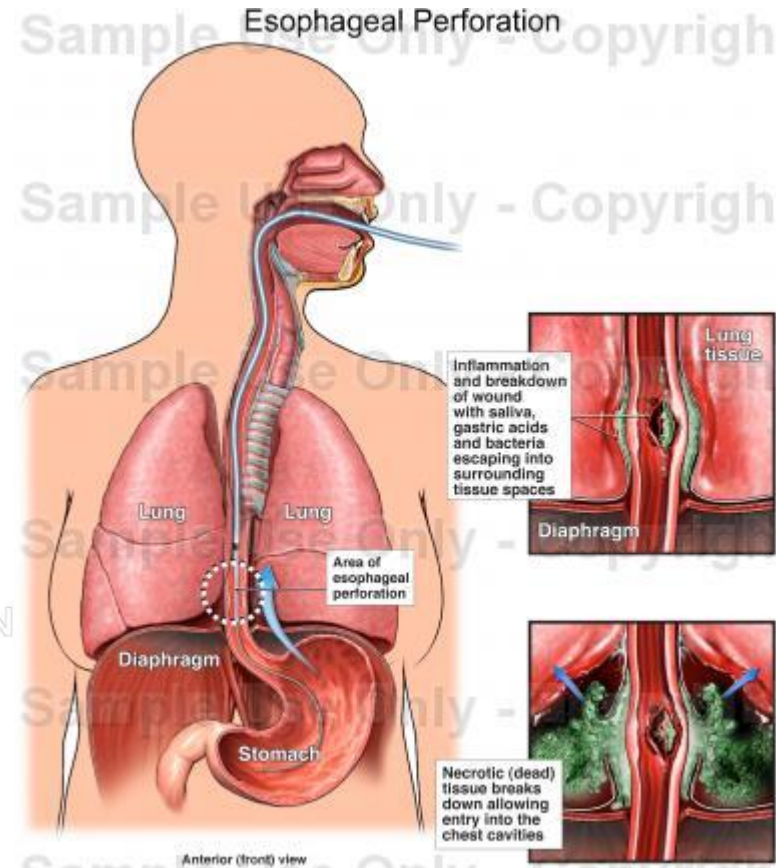
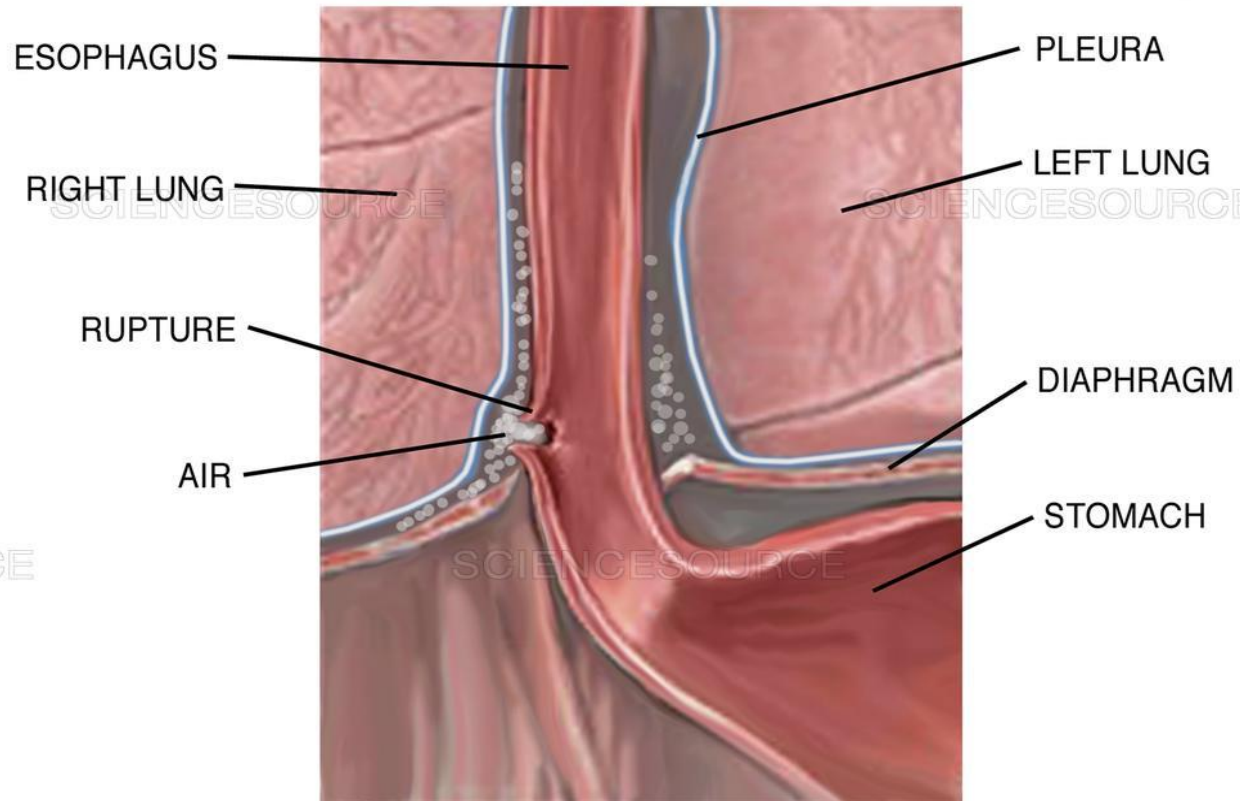
Dissection versus an Aneurysm (AAA)



5. Tension Pneumothorax = Collapsed Lung



6. Esophageal Rupture



Mangiamo's in Hilton Head





So far...

- Learned a lot about me
- Case of chest pain (William Morgan)
- How doctors think
- Dual process theory
- Six immediately life-threatening chest pain
- **Describe the usual work-up of chest pain in the ED**
- **Describe how we diagnose these 6 causes of chest pain**

ED Work Up of the Patient with Chest Pain

- Very common complaint (nearly 6 million ED visits per year)
- There are at least six immediately life threatening causes
- We can order these causes by likelihood
- History and physical exam can help
- Diagnostic work up considers life threats

Chest Pain and Work Up

- Vital Signs
- Cardiac Monitor
- H and P
- EKG (within 10 minutes of arrival)
- CXR
- Troponin

Chest Pain and Work Up

- **Vital Signs**

Blood pressure (systolic over diastolic)

Heart Rate (60 – 100 beats per minute)

Temperature

Respiratory Rate

Pulse Oximetry

Chest Pain and Work Up

- **Cardiac Monitor**

Continuous monitoring of the heart

Too fast or too slow

Irregular

Pauses or asystole

Fibrillation (atrial or ventricular)

Chest Pain and Work Up

- **H and P**

- History**

- Onset – sudden versus gradual**

- Duration – long versus short**

- Exacerbating versus relieving**

- Radiating pattern**

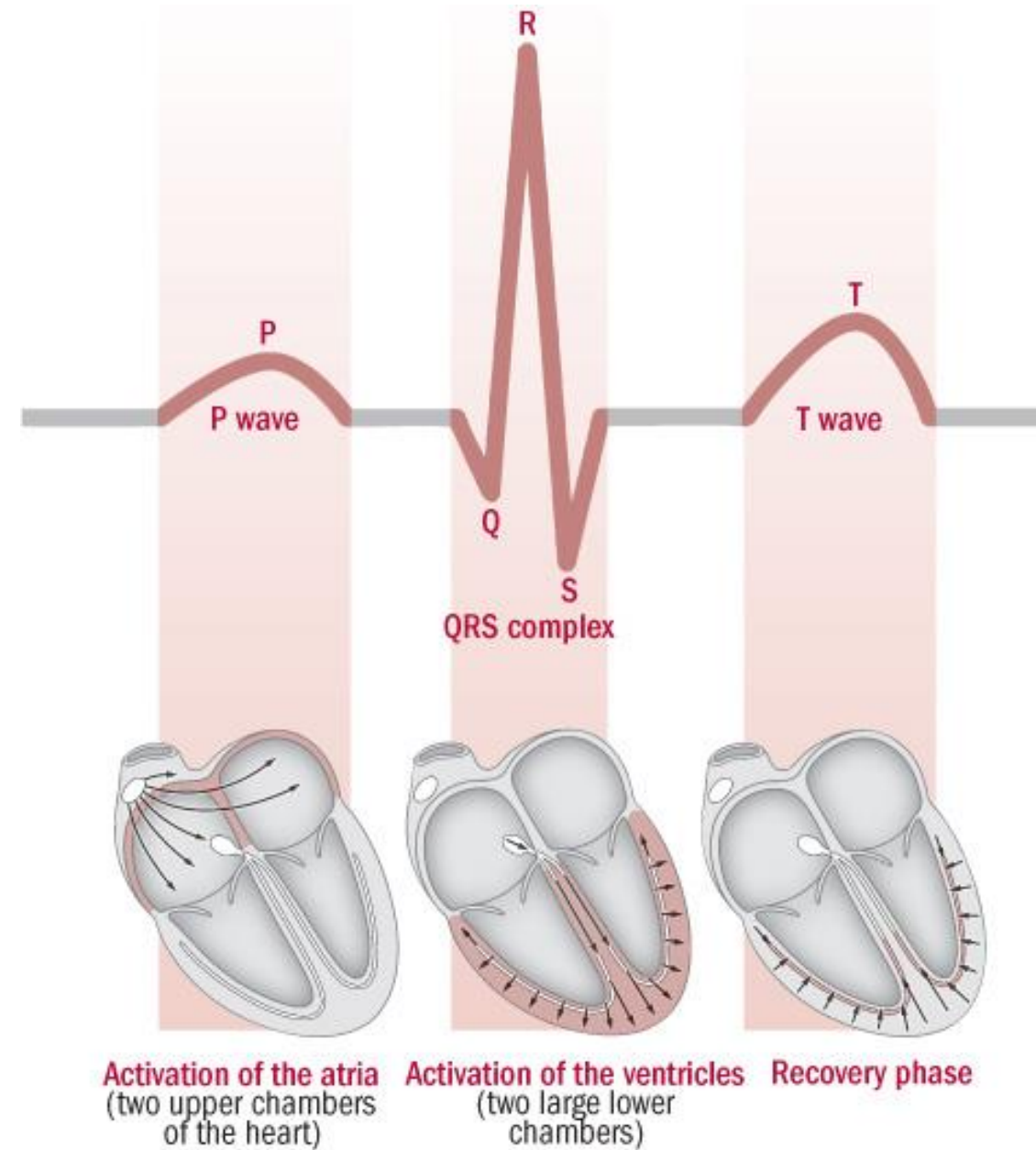
- Associated symptoms**

- Special populations (elderly and diabetics)**

- Physical**

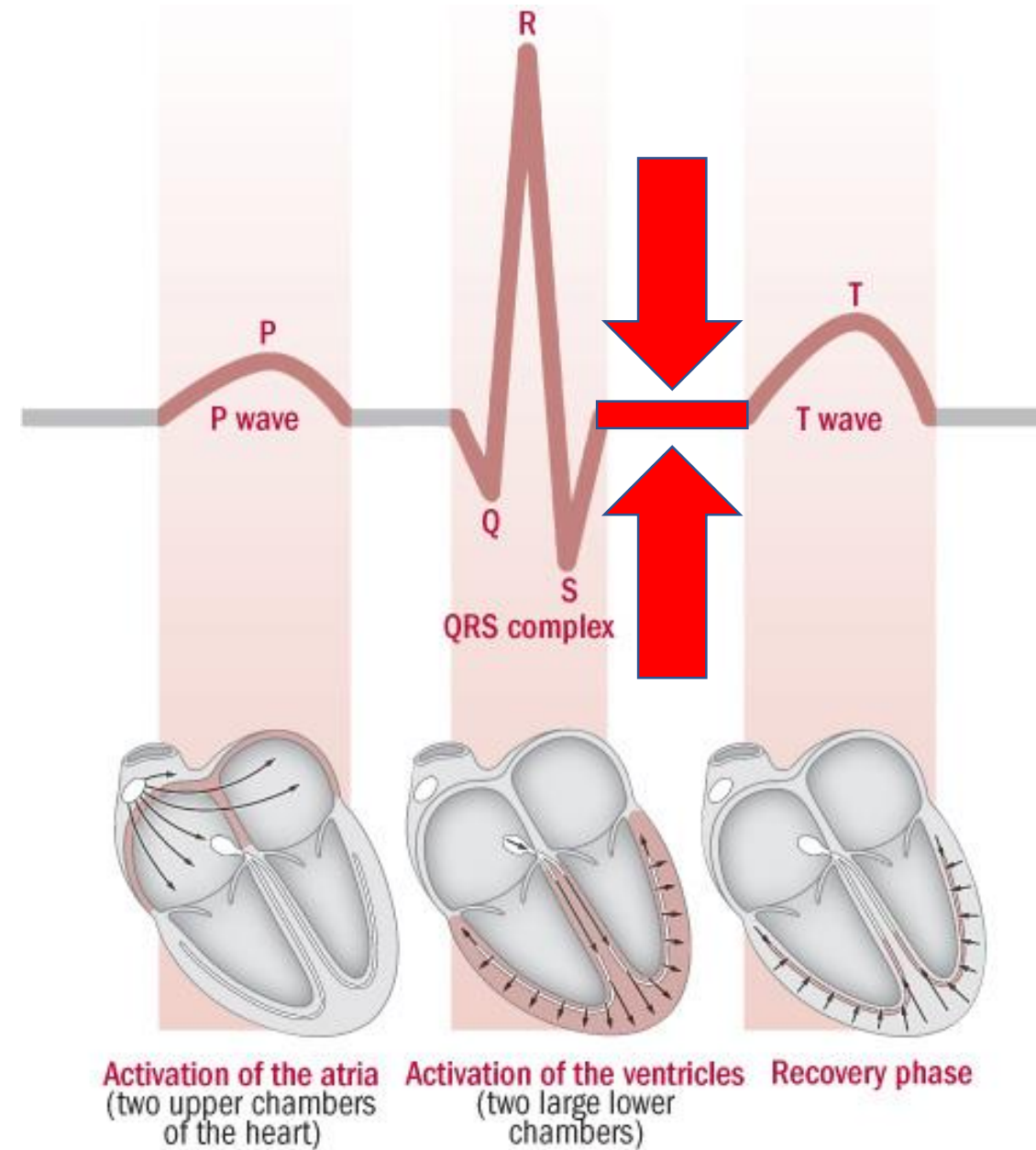
Chest Pain and Work Up

- EKG (within 10 minutes of arrival)



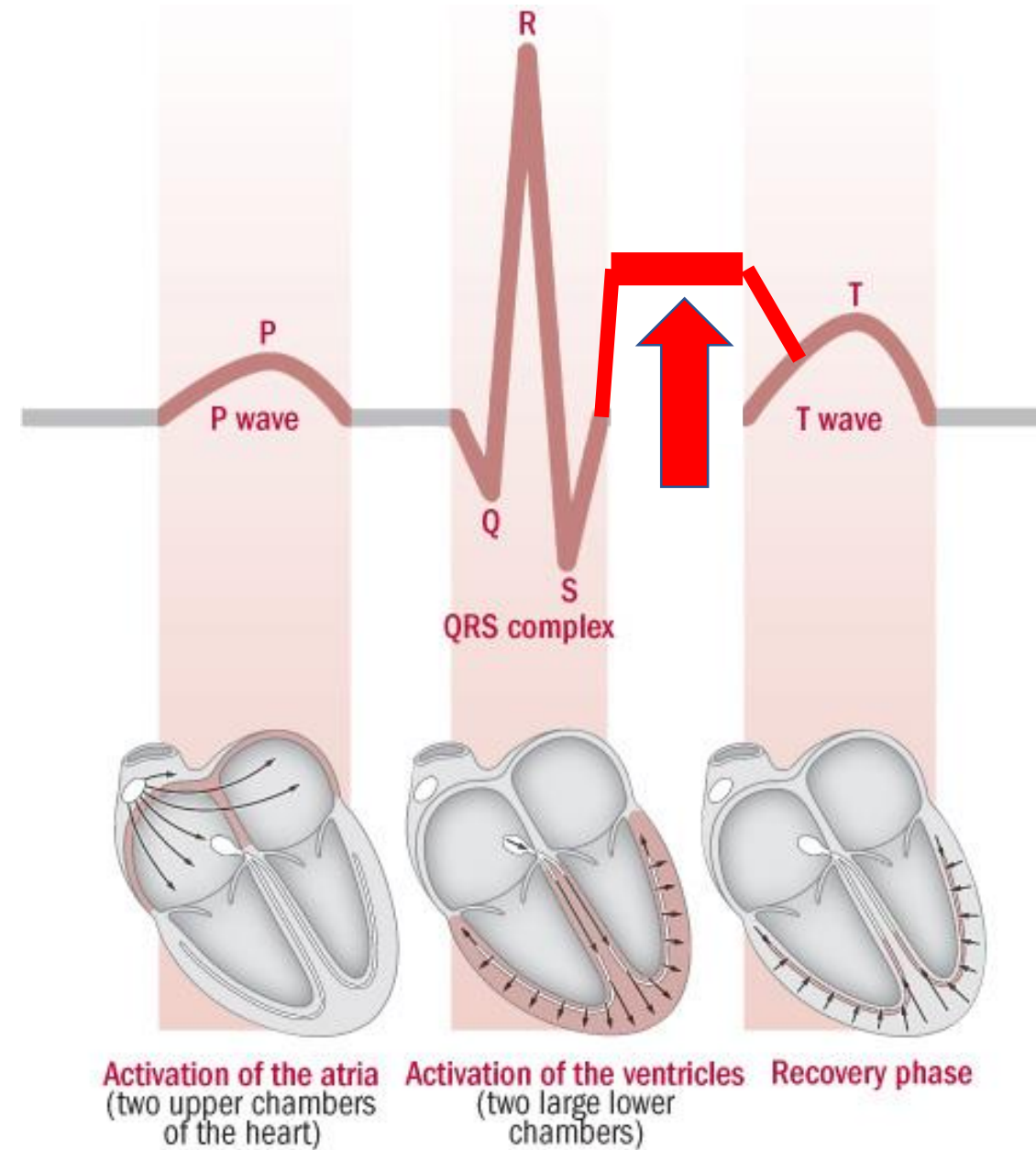
Chest Pain and Work Up

- EKG (within 10 minutes of arrival)



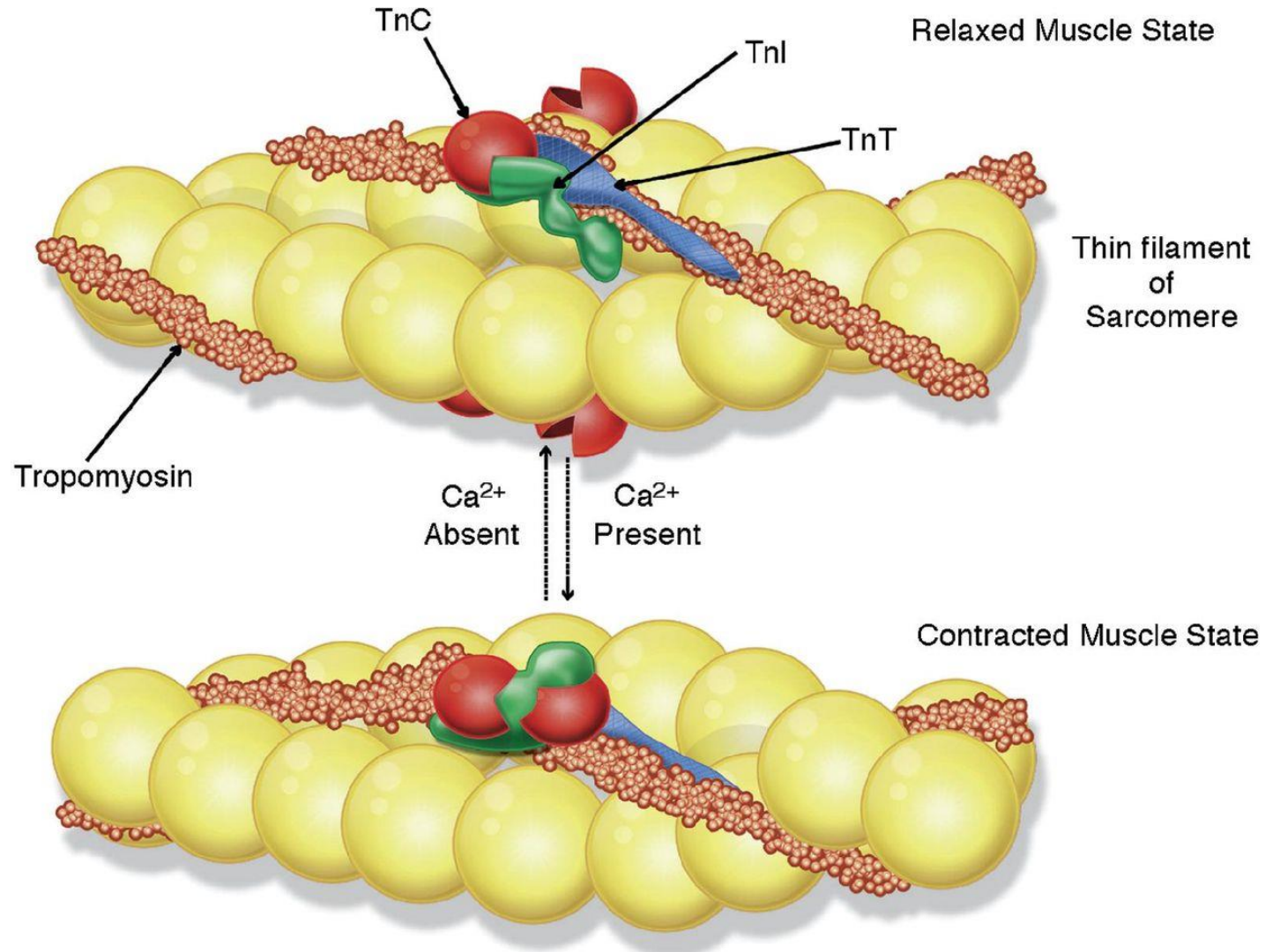
Chest Pain and Work Up

- EKG (within 10 minutes of arrival)



Chest Pain and Work Up

- Troponin and Lab tests



Chest Pain and CAD/ACS Work Up

- Vital Signs
- Cardiac Monitor
- H and P
- EKG
- CXR
- Troponin
- Intravenous line started
- Rapid treatment with aspirin
- Mobilize cardiology

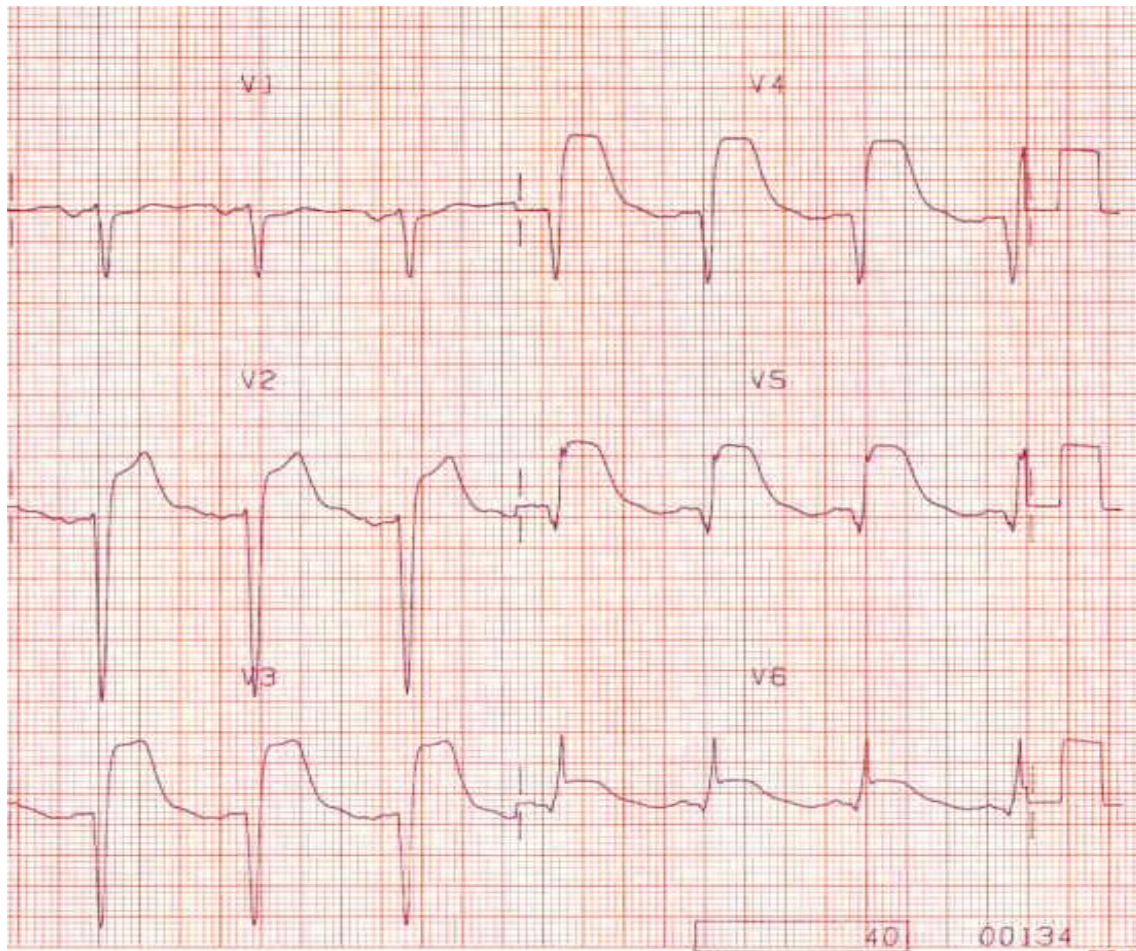


History for ACS

- Pain description
 - Increase likelihood of ACS/CAD:
 - CP radiating to both arms and shoulders
 - Diaphoresis with CP
 - Nausea and vomiting with CP
 - CP with exertion
 - Decreased likelihood of ACS/CAD:
 - Pain made worse by inspiration (pleuritic)
 - Positional
 - Sharp or stabbing
 - Palpable CP



YIKES!



Chest Pain and Work Up for ACS or MI

- Vital Signs – usually normal but variable
- Monitor - usually normal but variable
- H and P - previous slide
- EKG - can be a STEMI or NSTEMI (next slide)
- CXR - usually normal or big heart + wet lungs
- Troponin - elevated

Chest Pain and Work Up for Significant CAD

- **STEMI** = Abnormal EKG and ST elevation
emergent cath to try and restore perfusion
- **NSTEMI** = Elevated troponin but EKG with no ST elevation
may also go to cath
- Most do not have these EKG or troponin changes but need to ask one major question:



Does this person have significant CAD and need some intervention?

Chest Pain and Work Up for Significant CAD

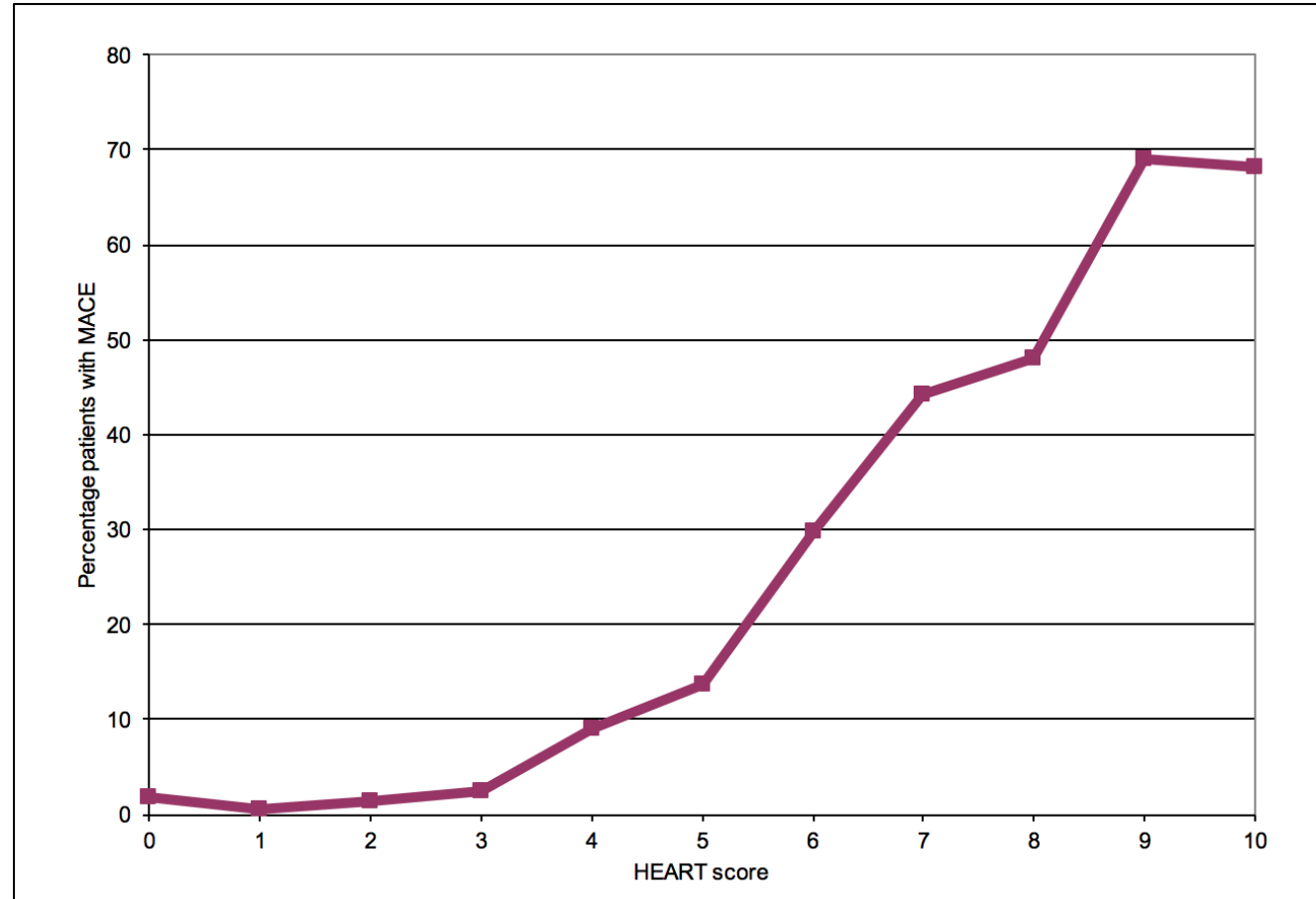
- Can use scoring systems

HEART

TIMI

HEART SCORE and MACE

(Major Adverse Cardiac Events)



HEART

HEART score for chest pain patients

H istory (Anamnesis)	Highly suspicious	2	
	Moderately suspicious	1	
	Slightly suspicious	0	
E CG	Significant ST-deviation	2	
	Non-specific repolarisation disturbance / LBBB / PM	1	
	Normal	0	
A ge	≥ 65 years	2	
	45 – 65 years	1	
	≤ 45 years	0	
R isk factors	≥ 3 risk factors <i>or</i> history of atherosclerotic disease	2	
	1 or 2 risk factors	1	
	No risk factors known	0	
T roponin	≥ 3x normal limit	2	
	1-3x normal limit	1	
	≤ normal limit	0	
Total			

Risk factors for atherosclerotic disease:

Hypercholesterolemia

Cigarette smoking

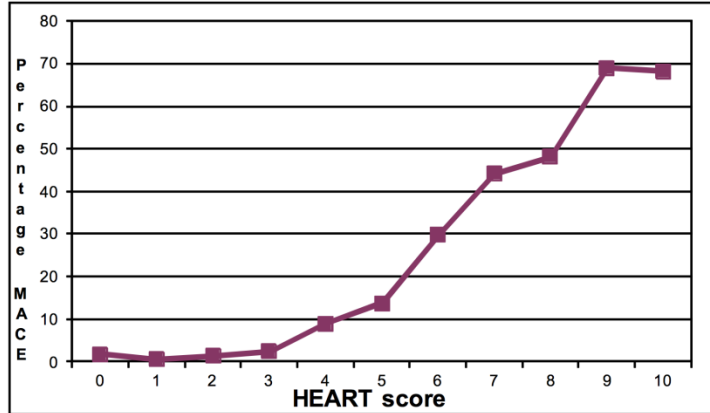
Hypertension

Positive family history

Diabetes Mellitus

Obesity (BMI>30)

HEART score reliably predicts endpoints



HEART	~ % pts	MACE/n	MACE	Death	Proposed Policy
0-3	32%	38/1993	1.9%	0.05%	Discharge
4-6	51%	413/3136	13%	1.3%	Observation, risk management
7-10	17%	518/1045	50%	2.8%	Observation, treatment, CAG

*MACE = Major Adverse Cardiac Event = Myocardial Infarction, PCI/CABG, all-cause death. Based on N=6174

Literature:

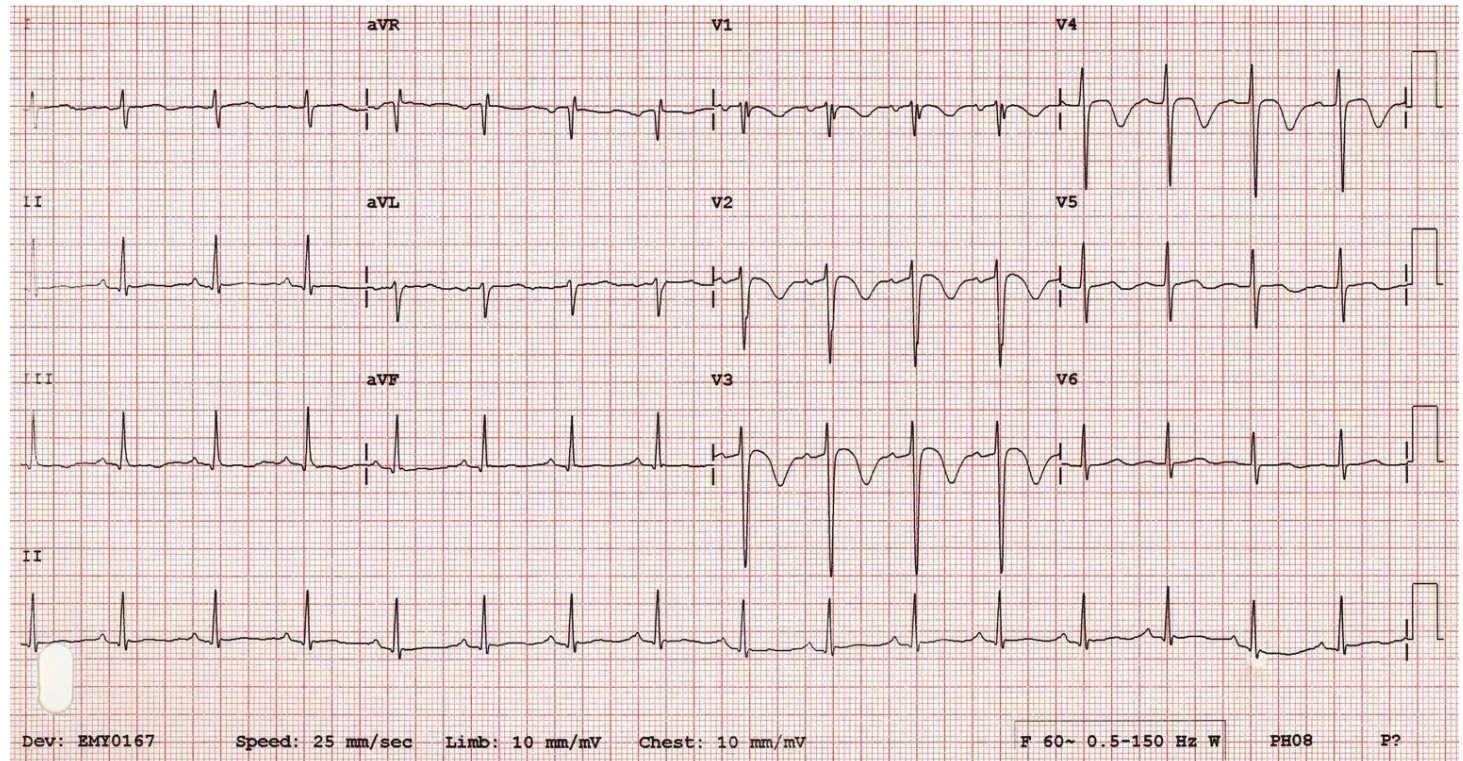
1. Chest pain in the emergency room: value of the HEART score. Six AJ, Backus BE, Kelder JC. *Neth Heart J*. 2008;16:191-6.
2. Chest pain in the emergency room: a multicenter validation of the HEART Score. Backus BE, Six AJ, Kelder JC, et al. *Crit Pathways in Cardiol*. 2010;9:164-9.
3. A prospective validation of the HEART score for chest pain patients at the emergency department. Backus BE, Six AJ, Kelder JC, et al. *Int J Cardiol*. 2013;168:2153-8.
4. The HEART score for the assessment of patients with chest pain in the emergency department Six AJ, Cullen L, Backus BE, et al. *Crit Pathways in Cardiol* 2013;12:121-126.
5. Impact of using the HEART score in chest pain patients at the emergency department: a stepped wedge, cluster randomized trial. Poldervaart JM, et al. *Annals of Internal Medicine*. 2017. Epub ahead of print

Questions and comments:

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 Jacob Six six@heartscore.nl
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www.heartscore.nl

HEART SCORE > 3 = noninvasive or stress testing, ≥ 7 = invasive

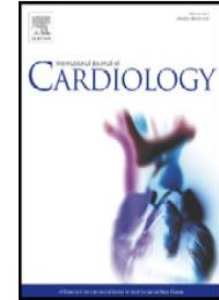




Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard



Comparing HEART, TIMI, and GRACE scores for prediction of 30-day major adverse cardiac events in high acuity chest pain patients in the emergency department☆



Jeffrey Tadashi Sakamoto^a, Nan Liu^{b,c,*}, Zhi Xiong Koh^b, Nicholas Xue Jin Fung^d,
Micah Liam Arthur Heldeweg^e, Janson Cheng Ji Ng^b, Marcus Eng Hock Ong^{b,f}

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^b Department of Emergency Medicine, Singapore General Hospital, Singapore

^c Centre for Quantitative Medicine, Duke-NUS Medical School, Singapore

^d Yong Loo Lin School of Medicine, National University of Singapore, Singapore

^e Faculty of Medical Sciences, University of Groningen, The Netherlands

^f Health Services and Systems Research, Duke-NUS Medical School, Singapore



What about ACS/CAD risk?

- STEMI to the cath lab
- Very low risk CP can be discharged
- **Intermediate risk?**

What about the intermediate risk?

- What are the options?
 - Conventional stress imaging
 - Stress Echo
 - Stress Nuclear Medicine Test (stress mibi)
 - Coronary cat scan (CTA)
 - Cardiac MRI
 - Cardiac Cath

Stress Testing Summary

Test	Sensitivity	Specificity	LR-
Treadmill ECG	30%	93%	0.75
Stress Echo	85%	85%-90%	0.18
Stress Mibi	90%	80%-90%	0.12
Coronary CTA	92%	96%	0.11
CMRI (stress CMR)	90%	94%	0.10

Stress Testing

- Bruce Protocol (1963)
- Increased workload = heart squeezes faster and harder
- Coronaries dilate to increase flow (perfusion)
- IF coronaries unable to help because of blockages (CAD)

Chest Pain

EKG changes

Wall motion or perfusion abnormalities

- A positive stress test is usually followed by a cardiac catheterization to restore blood flow (perfusion)

Stress Testing

Strengths

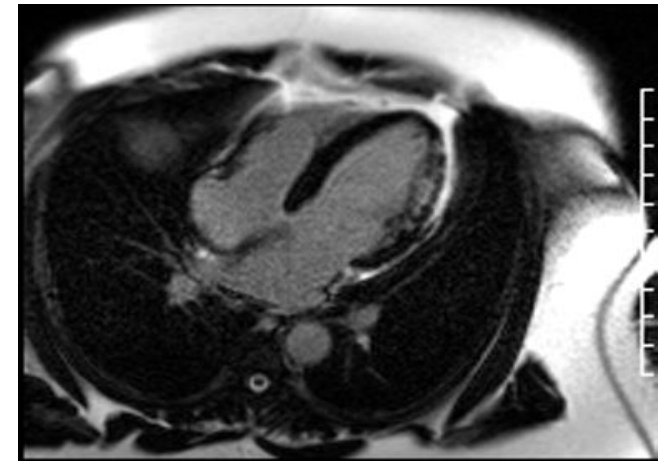
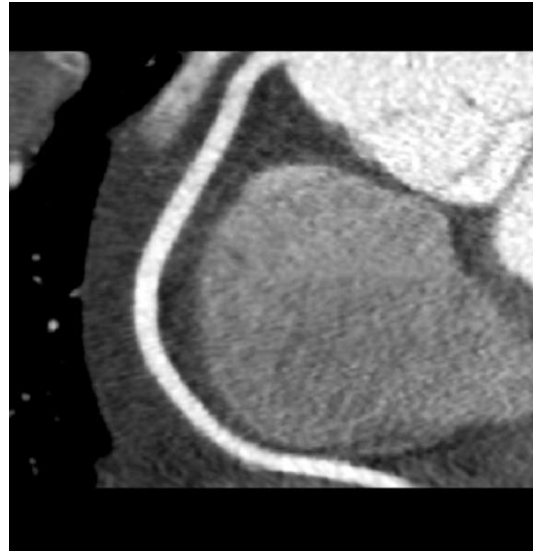
- Great functional test
- Imaging helps
- Don't have to walk
- Monitors rhythm and BP
- Great effort = predictive
- Positivity at low work loads
- Accessible, Inexpensive

Weaknesses

- Limited by effort (need 85%)
- Limited by rhythm
- Accuracy questionable
- Medications can affect results
- Body habitus
- Preexisting illnesses
- Gender differences

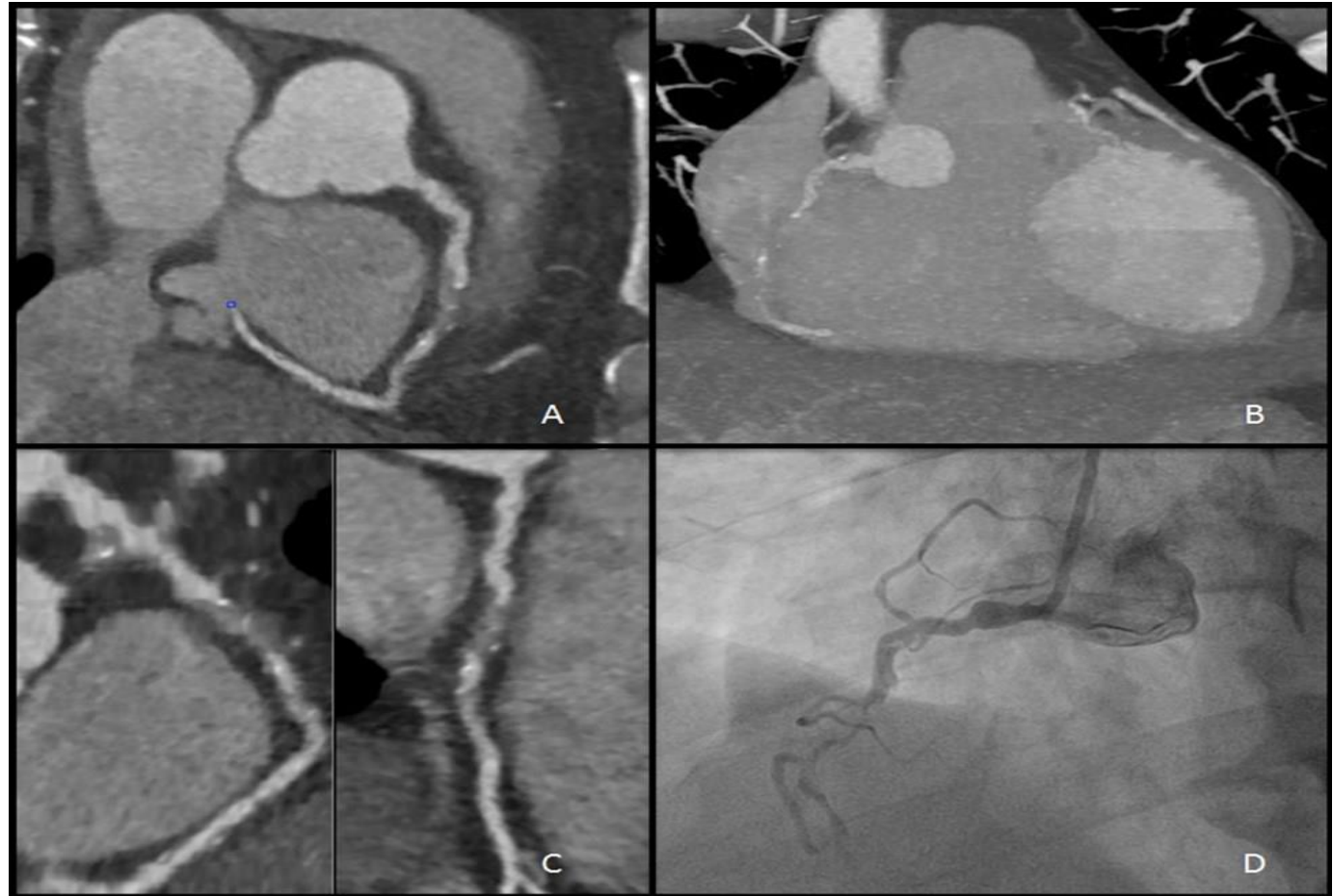
Higher pretest probability or unable to stress?

- Coronary CTA?
- Cardiac MRI?
- Or just admit and cath?



Coronary CTA

- Anatomical test
 - Is there CAD present?
- Does not address likelihood of plaque rupture
- Does not address impact of moderate stenosis
- Can overestimate severity



ROMICAT-II results (NEJM 2012;367:299-308)

- 1000 patients
- Shorter LOS overall with CCTA
- Similar 30 day ED and rehospitalization rates
- No missed ACS in either group
- **Increased rates of cardiac cath in the CCTA group**
- **Increased downstream costs**

Coronary CTA

- **Strengths**

- Rapid acquisition
- Identifies early CAD
 - Risk factor modification
- Alternate causes
 - Triple rule out is getting technically better

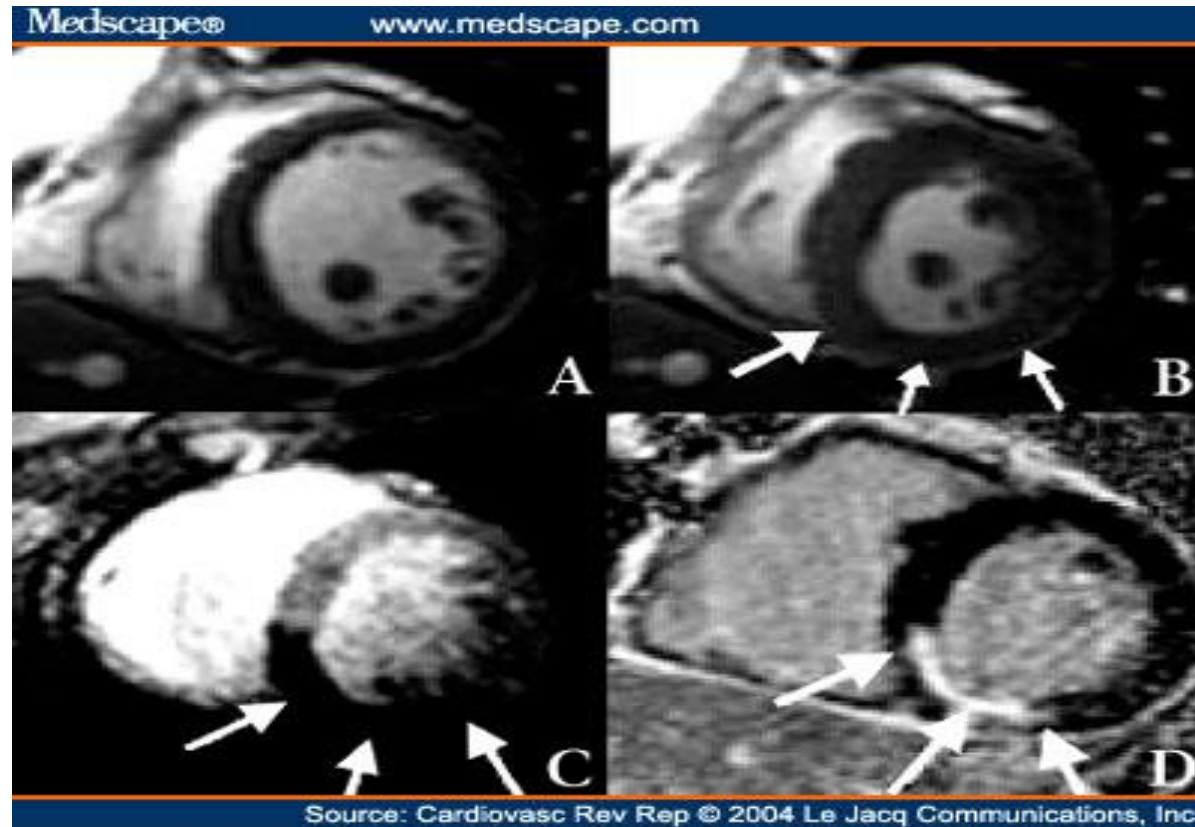
- **Weakness**

- Radiation exposure
- Contrast exposure
- Need slow heart rate
- Can overestimate blockages
- More downstream costs
- Patient selection...
(diabetes, HTN, elderly, high BMI, h/o CAD)

CCTA - summary

- Helpful if negative and safe to DC or look for other causes
- Risk of poor images in patients with the most concern
- Difficult to interpret the intermediate result
- Increases resource utilization downstream

Cardiac MRI



Cardiac MR – Not Yet

Strengths

- Comprehensive assessment
 - Structure
 - Function
- T2-weighted imaging detects edema
- Resting exam can be completed prior to stress exam
- Very high sensitivity and specificity

Weaknesses

- Scan time of 30-60 min
- Need for Gadolinium and Adenosine
- Exclusions
 - Claustrophobia, metal, pregnancy, etc
- Requires infrastructure

Chest Pain and Work Up for ACS or MI

- **Vital Signs** – usually normal but variable
- **Monitor** – usually normal but variable
- **H and P** – previous slide
- **EKG** – can be a STEMI or NSTEMI
- **CXR** – usually normal or big heart + wet lungs
- **Troponin** – elevated, normal then rising or normal times two
- **Scores** – HEART
- **Stress Testing** (echo, perfusion, with meds) – timing?
- **CCT or CMR**
- **Cardiac Cath**





Chest Pain Patient – Pulmonary Embolus (PE)

23 yo female presents 2 weeks after a normal delivery

Called her OB and c/o chest pain, pleuritic, cough and fever

Coughing causes abdominal pain (uterine infection?)

Vital signs: temp to 101.5, HR of 110, RR of 22

OB MD resident says she no uterine infection but pneumonia.

CXR shows left lower lobe pneumonia

Discharged on antibiotics

Returns two days later coughing up blood (hemoptysis)

Chest Pain Patient

- Diagnosis = PE with lung injury (infarction)
- Admitted with long course due to an pulmonary infarct with infection and cavitation

When Should I Consider PE?

Obvious Factors Independently Associated with PE

Symptoms

Unexplained SOB

Hemoptysis

Signs

Unilateral leg swelling

Tachycardia

Hypoxemia ($\text{SaO}_2 < 95\%$)

Risk Factors

Limb/Body Immobility

Recent Surgery (past 4w)

Thrombophilia

Cancer* Age > 50

**Adenocarcinoma and Brain Tumor (GBM)*

Interesting Factors

- Sudden onset?

PE (+) 39% had sudden onset

PE (-) 51% had sudden onset

- Reproducible CP?

19.9% of patients PE (+) had reproducible CP

- Comfortable?

PE (+) 60% Comfortable

PE (+) 27% Mod Discomfort

PE (+) 13% Severe Distress

Risk Factor Clarifications

- Immobilization time that is significant
 - > 6 hours continuously in the bent knee position
 - the clock resets with standing and contracting the calves
- Surgery; how recent?
 - < 4 Weeks
- Medications or hypercoagulable states

Thrombophilic Status	RR of Clot	% Pop	% of VTE*
OCPs	4	-----	-----
Factor V Leiden (Heterozygous)	5-7	5-15	12-40%
Factor V Leiden + OCPs	30-35	-----	-----
Prothrombin Gene Mutation	3	2%	6-18%
Prothrombin Gene Mutation + OCP	16	-----	-----
Protein C Deficiency	7	0.2%	5-15%
Protein S Deficiency	6	Unknown	5-15%
Antithrombin III	5	0.02-1%	4%
Hyper-Homocysteinemia	2-4	Unknown	-----
Antiphospholipid Syndrome		2-4%	5-10%

Risk of Clotting

* Small Number is in unselected patients – Large number is with first events prior to age 50 or with a history of VTE in first-degree relatives

What % of Patients With PE Have No, “as of yet” DX Risk Factors?

33%

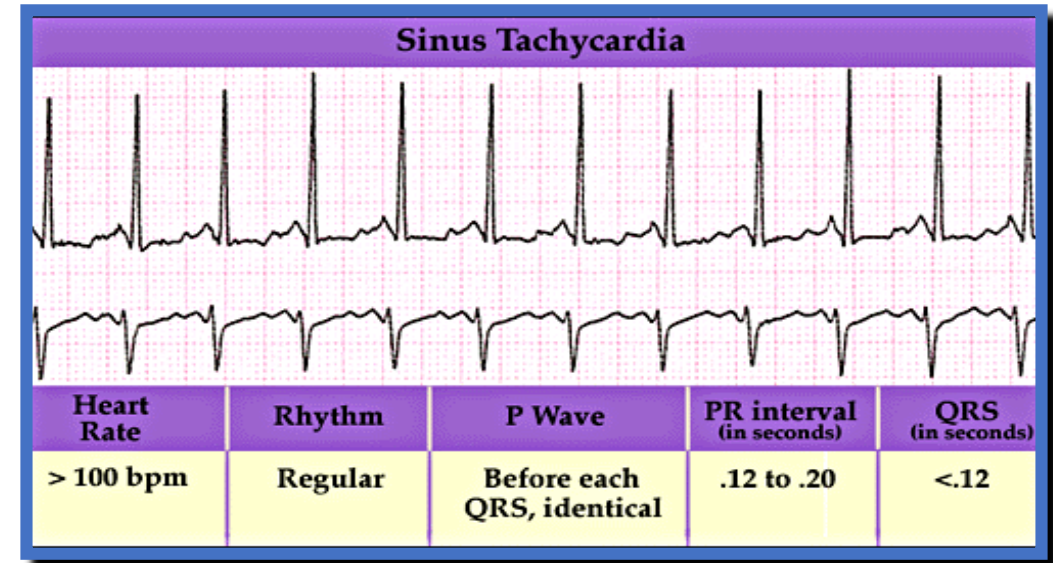
The 2 groups of patients in whom PE is most likely to be missed:

-Young, otherwise healthy, obese, hemodynamically stable women on Estrogen

-Older patients with a good alternative diagnosis
-The most common wrong alternative dx is bronchitis

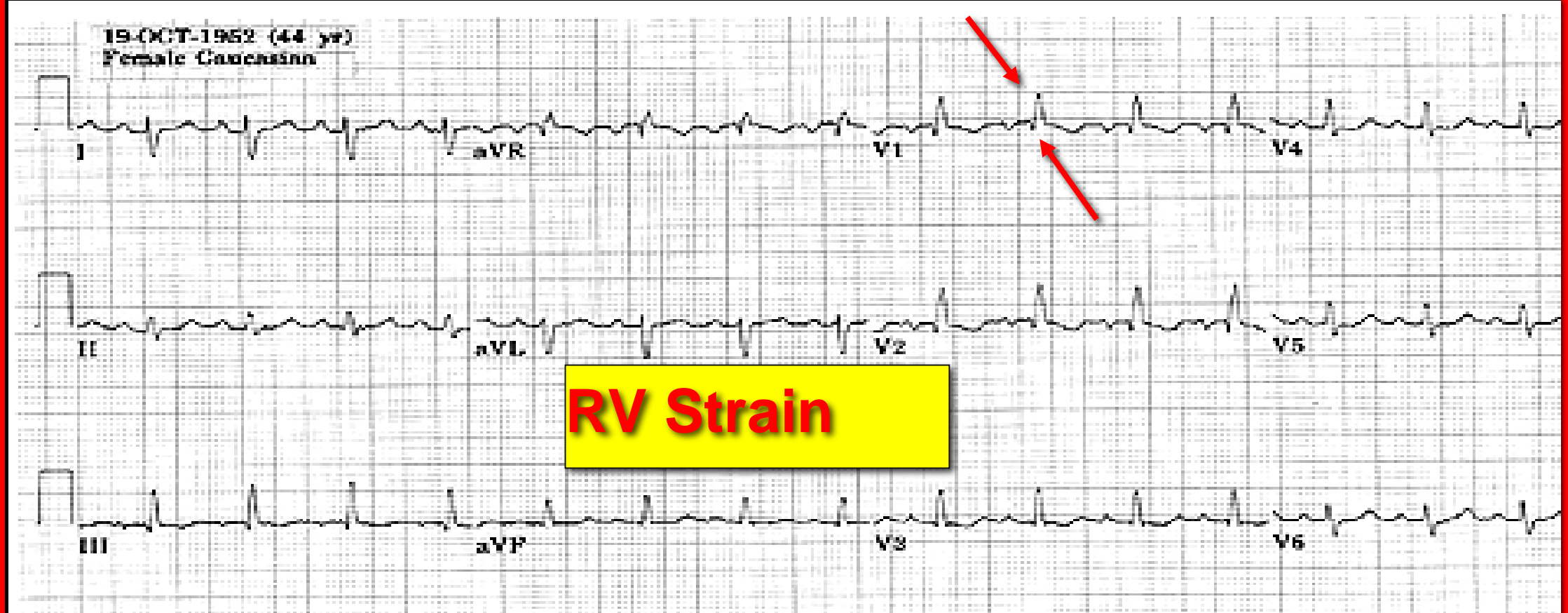
EKGs (most common)

- Sinus tachycardia
- Non-specific ST-T changes



“Classic” findings are rare (up to 20%) and reflect R Heart Strain

Some “Classic” EKGs showing strain on the right heart



Wells Criteria

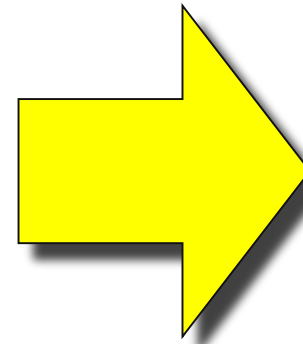
Criteria		Points	
Suspected DVT		3.0	
An alternative diagnosis is less likely than PE		3.0	
Heart rate >100 beats/min		1.5	
Immobilization or surgery in the previous 4 wk		1.5	
Previous DVT/PE		1.5	
Hemoptysis		1.0	
Malignancy (on treatment, treated in the past 6 mo or palliative)		1.0	
Score Range	Mean Probability of PE, %	% With This Score	Interpretation of Risk
<2 points	3.6	40	Low
2–6 points	20.5	53	Moderate
>6 points	66.7	7	High

But Wait...Is There Anyone Who Needs No Evaluation?

Low PTP (< 15%) +

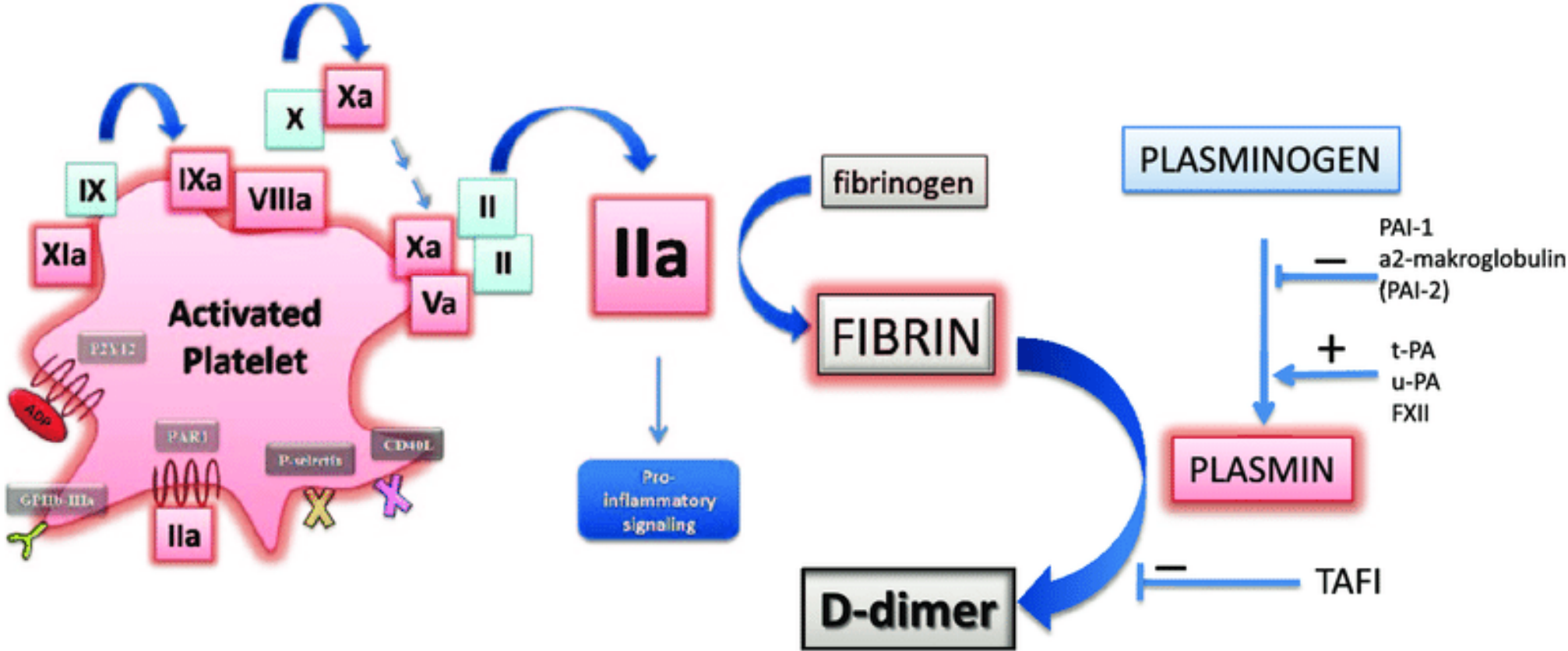
PERC Rule

- Age < 50
- Heart rate <100 (at any time in ED)
- Room air SaO₂ >94%
- No prior PE/DVT
- No recent surgery (< 4w)
- No Hemoptysis
- No exogenous estrogen (Tamoxifen)
- No DVT findings clinically



**Will have a PTP <2%
and therefore will not
benefit from an
evaluation for PE**

(byproduct of the clotting cascade)



Using the D-Dimer

- Most helpful if negative D-dimer (very sensitive)
- Lots of reasons for false positives
- If pre-test probability is very low may not help
- If pre-test probability is high may not help

Why false positive D-Dimers?

- Elevated in ~ 50% of patients with:
 - Active malignancy
 - 1 week post-partum
 - 1 week post-op
 - Age > 80 years
- Elevated in 75% of normal pregnancies
 - 100% by third trimester
- Other: Acute inflammatory conditions

Why false negative D-Dimers

- Thrombus present for 72 hours prior to blood testing for d-dimer with no new interim clots
 - D-dimer $T_{1/2}$ is about 8 hours
- Subsegmental PE
- False positive confirmatory testing

Chest Pain and Work Up for PE

- Vital Signs – BP low or normal, oxygen low or normal
- Monitor - tachycardia but variable
- H and P - chest pain/SOB, risk factors present or leg swelling
- EKG - tachycardia or right heart strain
- CXR - usually normal
- Troponin - can be elevated in a PE
- D-Dimer - usually elevated
- Rules - Wells
- Echo - look for right heart strain
- CTPE or VQ - ?
- Dopplers - ?
- Angiogram - ?

Confirming a pulmonary embolus

- CTPE
- VQ
- MR
- Dopplers
- Angiogram



CT PE or CTPA (CT pulmonary angiography) (thin slice imaging of the lungs)

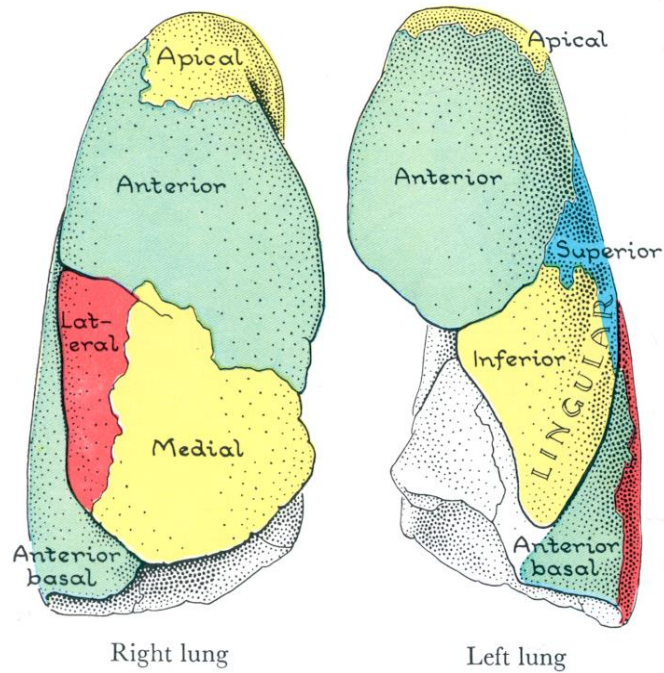
Strengths

- Quick in the ED
- Definitive test for rule in or out
- Shows clot burden and great for main, lobar, segmental
- Can see other pathology
- Over 90% sensitive and specific

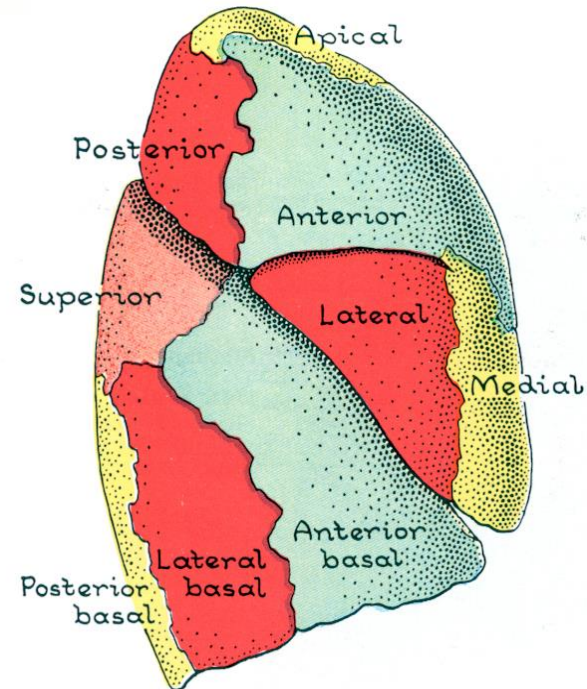
Weaknesses

- Dye cannot be used in renal failure or severe allergy
- Need an IV in place
- Coordinate dye bolus
- Movement and higher BMI

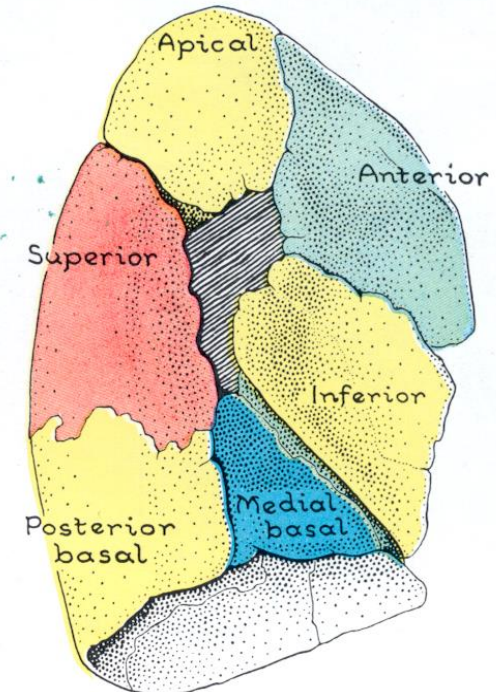
CXR Anatomy



ANTERIOR VIEW

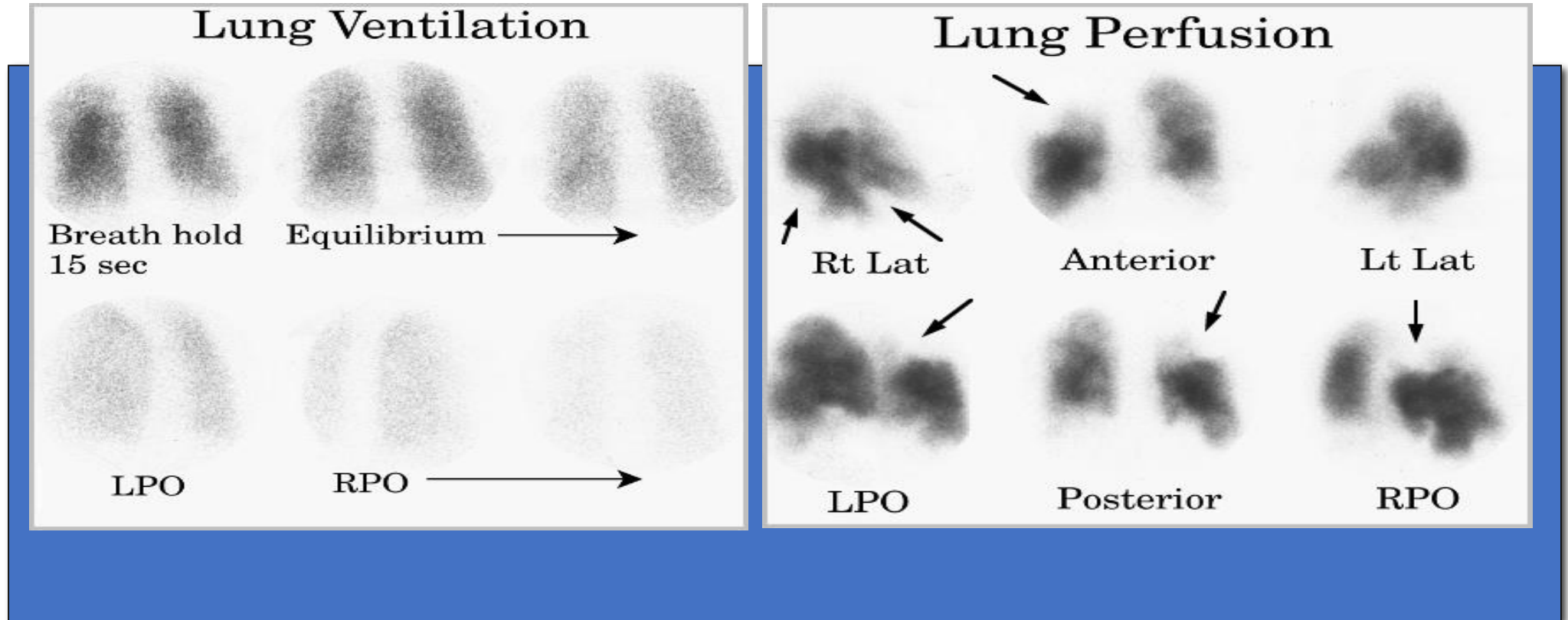


LATERAL VIEW



MEDIAL VIEW

Ventilation-Perfusion Scan (V/Q)



- Nuclear Medicine Scan matches areas of ventilated lung to perfused lung
 - Looks for matched and unmatched “defects”

V/Q is MUCH SAFER in pregnancy than an undiagnosed PE

VQ for PE

Strengths

- Less radiation
- Can use in renal patients
- Can use in allergy to dye
- Can be diagnostic
- Shows lung involved

Weaknesses

- Usually have to leave the ED
- Takes time
- Need an IV in place
- Preexisting lung disease
- **“Indeterminate” or “intermediate probability”**

Conclusions for V/Q

- Order a VQ wisely
- A “Normal” VQ = “No PE”
- High Prob VQ is diagnostic for PE (80%)
- In between low and high less helpful

Ultrasound of Legs

- A positive Duplex-Doppler US is an endpoint for diagnosing PE
 - Can “rescue” some patients with negative other studies
- A negative Duplex-Doppler US can't exclude PE (by itself)

Dopplers for PE or clot in the legs (DVT)

Strengths

- Least invasive test
- No contraindications
- Can be diagnostic
- Shows extent of clot

Weaknesses

- Usually have to leave the ED
- Takes time
- Not offered 24 hours a day
- High BMI
- PE could be coming from somewhere else

Summary: Diagnosing Pulmonary Embolus

- **Labs (including troponin), EKG and CXR are standards**
- **Decision Rules (PERC and Wells) can help**
- **D Dimer for low or moderate probability**
- **CT PE is usually the default or “go to” test**
- **Doppler of lower extremities for indeterminate cases**
- **VQ Scan if unable to perform CT or pregnant**
- **Cardiac Echo to consider RV dysfunction**
- **MRI specificity good but low sensitivity**
- **Angiogram**

Treatment of PE

- Heparin
- Enoxaparin (Lovenox)
- Rivaroxaban (Xarelto), Apixaban (Eliquis), Warfarin
- Thrombolysis
- EKO's / Catheter Directed Lytics
- Surgical Thrombectomy
- IVC Filter



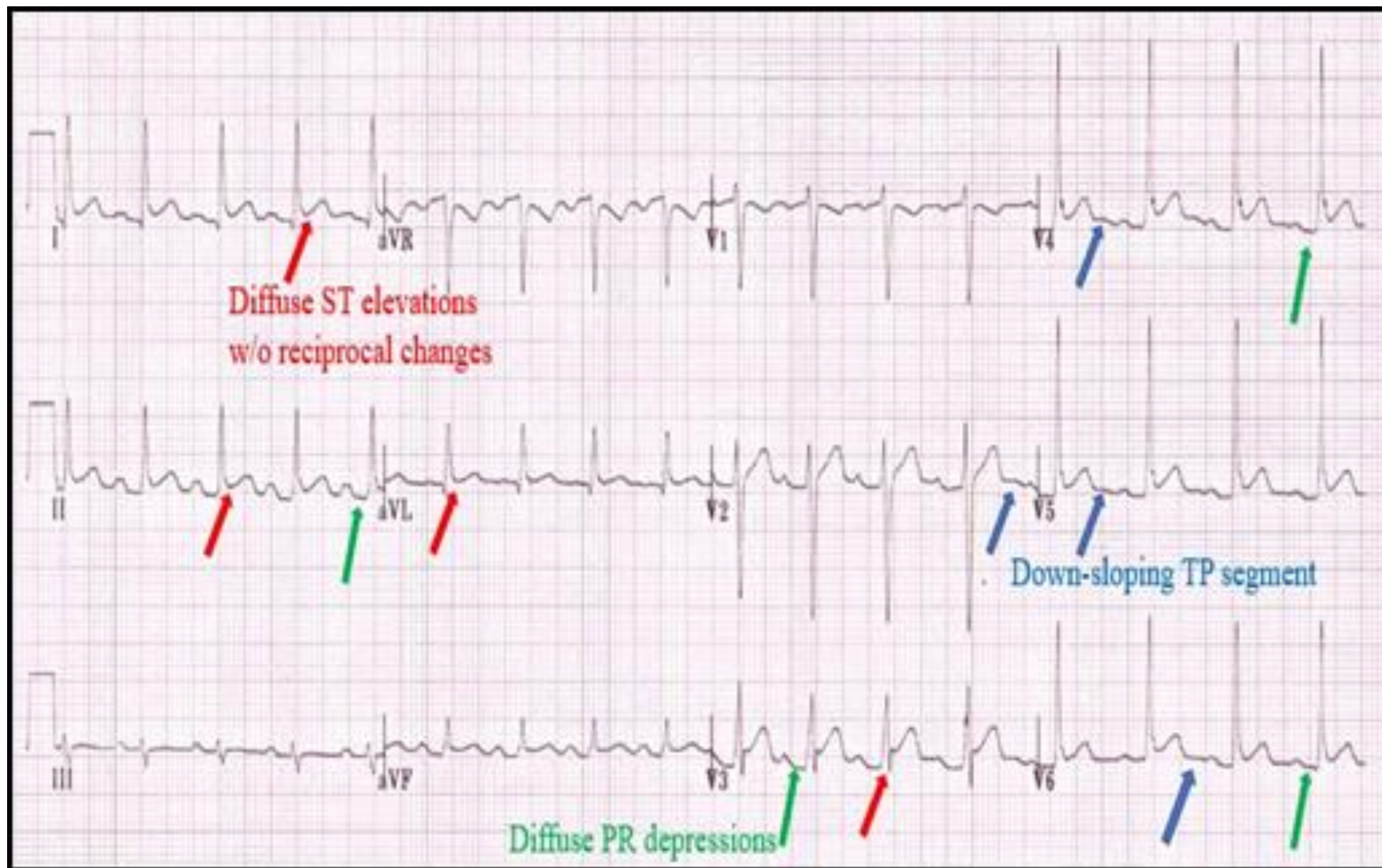
Pericardial Tamponade Symptoms

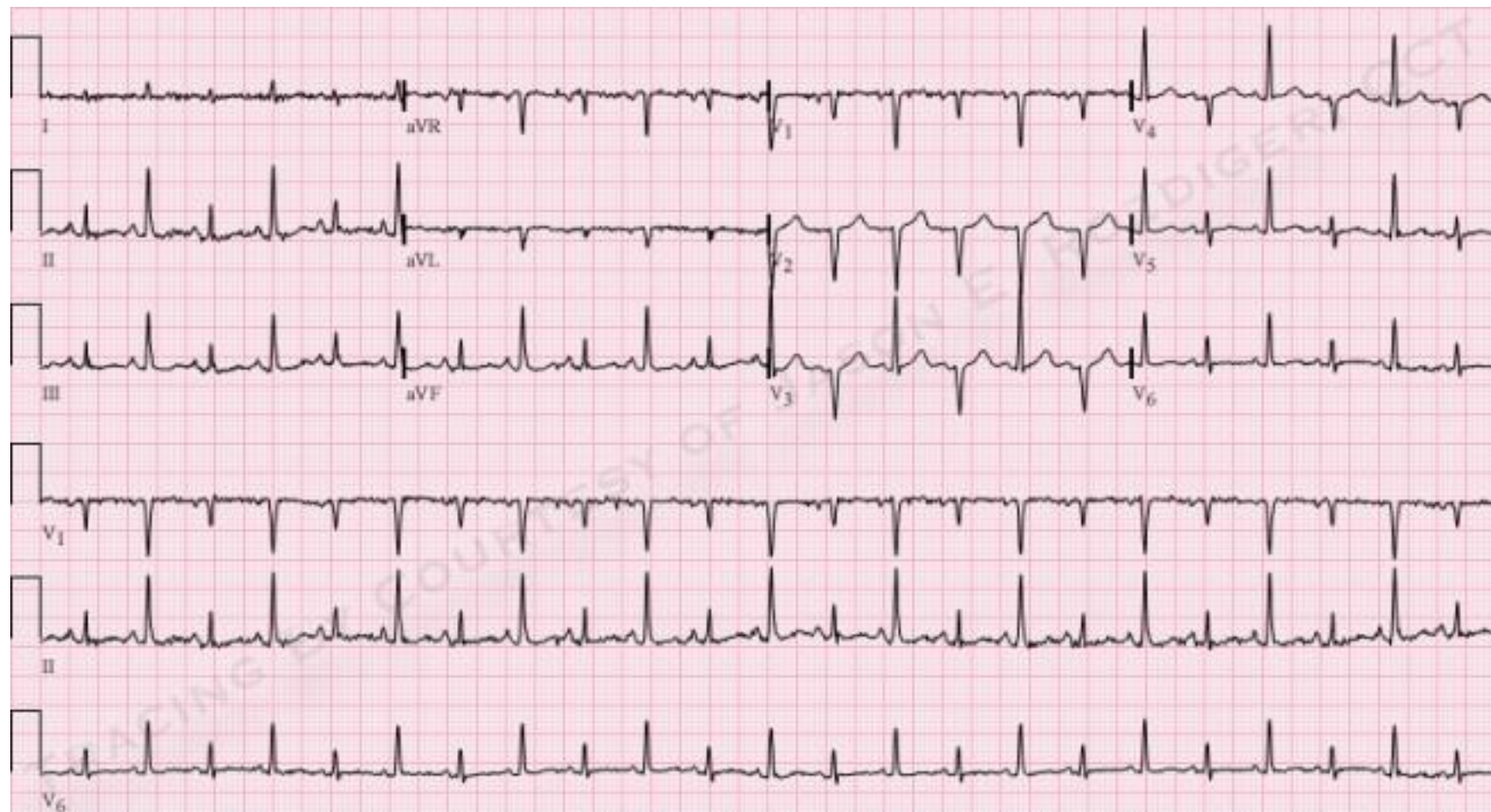
- Causes:
 - infectious, autoimmune, neoplasm, cardiac, metabolic, drugs
- Beck's Triad:
 - Low blood pressure (hypotension)
 - Distended neck veins (JVD)
 - Muffled heart sounds
- Classic symptoms;
 - CP; worse supine better leaning forward
 - CP; worse with swallowing
 - SOB

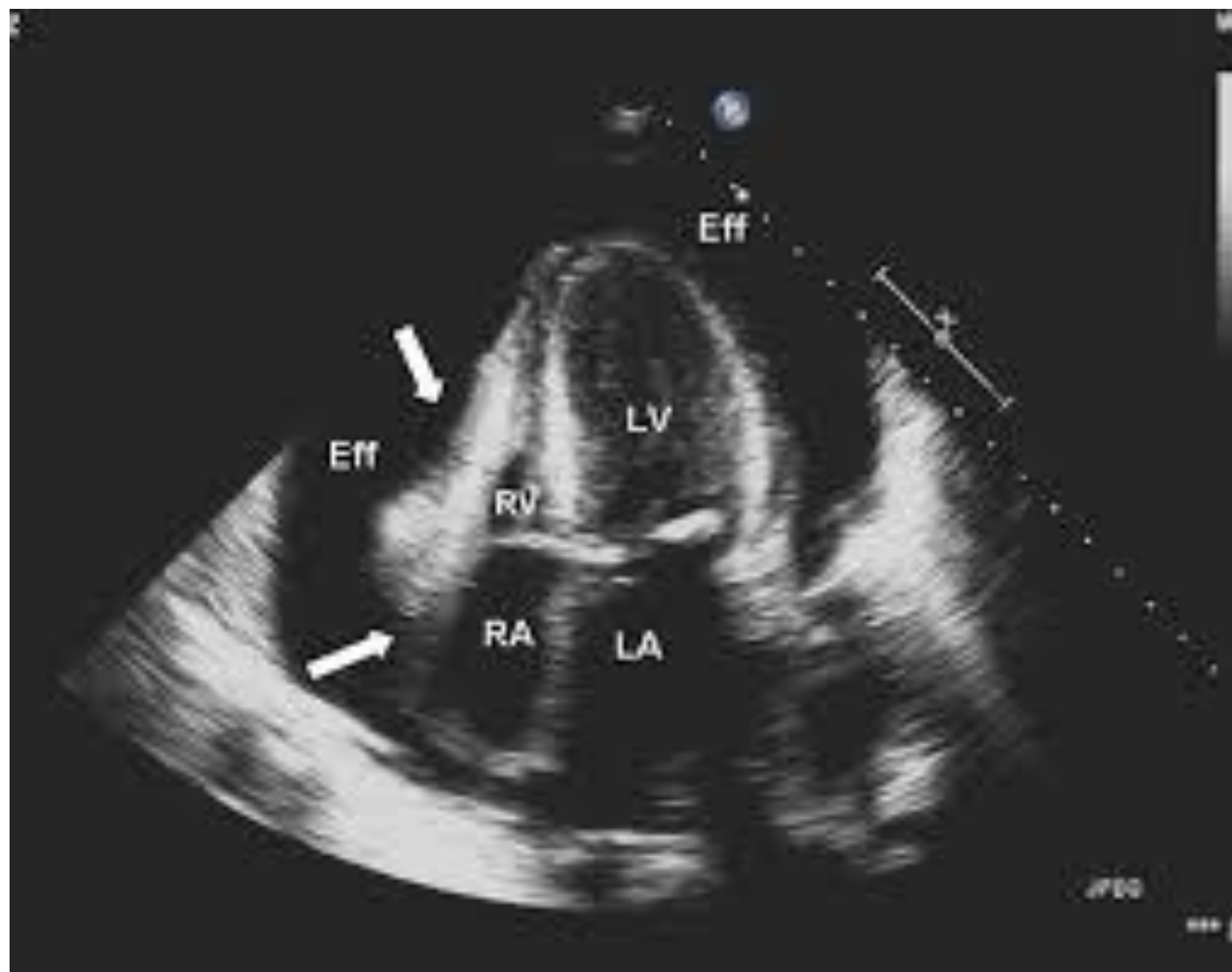


Pericardial Tamponade

- EKG:
 - Tachycardia
 - Low voltage
 - Can look like a STEMI
 - T wave changes
 - Electrical alternans
- CXR: BIG HEART (cardiomegaly)
- Bedside cardiac echo







Pericardial Tamponade Treatment

- Fluid resuscitation
- Percutaneous drainage
- Surgical drainage

Aortic Dissection

Hagan PG, et al.

The International Registry of Acute Aortic Dissection (IRAD)

JAMA 2000; 283:897-903

Diercks DB, et al.

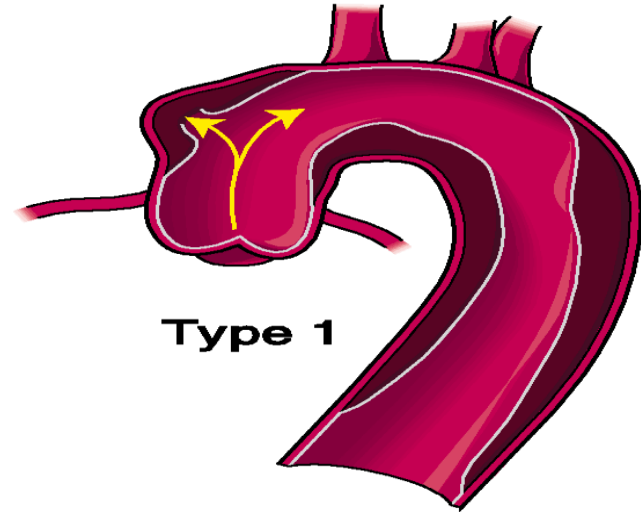
Clinical Policy: Critical Issues in the Evaluation and
Management of Adult Patients With Suspected Acute
Nontraumatic Thoracic Aortic Dissection

Ann Emerg Med 2015;65:32-42

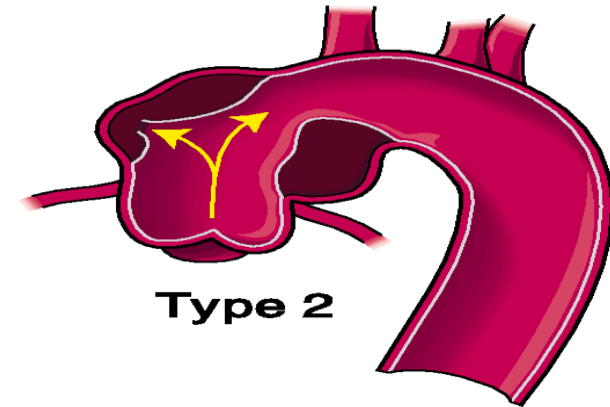
Dissection of the Aorta

- Marfan's is the usual culprit in the young!
- So Marfan's Characteristics...
 - Pectus excavatum
 - Arachnodactyly
 - Arm span > height
 - High-arched palate
 - Kyphosis
 - MVP
 - Myopia
 - Lens Dislocation

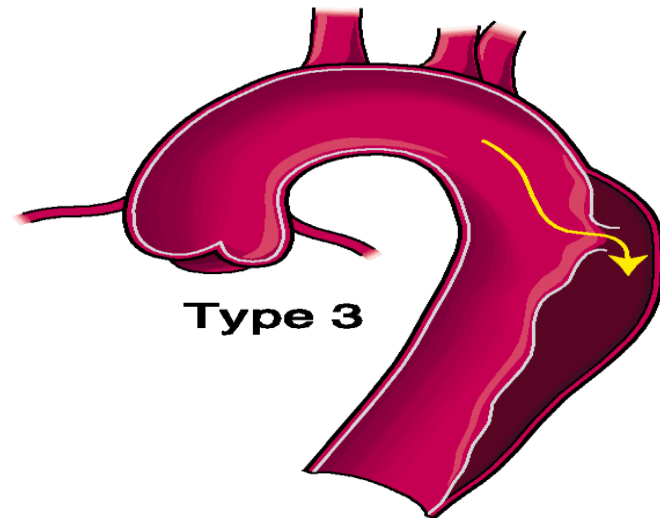
Dissection of the Aorta



Type 1



Type 2



Type 3

Scary Lessons from IRAD!

- International Registry of Aortic Dissection
- 464 patients in the series
- Pain as a Presenting Symptom: **95.5%**
 - **Abrupt onset:** **85%**
 - **Anterior CP:** **61%**
 - **Posterior CP:** **36%**
 - **Back pain:** **53%**
 - **Abd Pain** **30%**

Scary Lessons from IRAD!

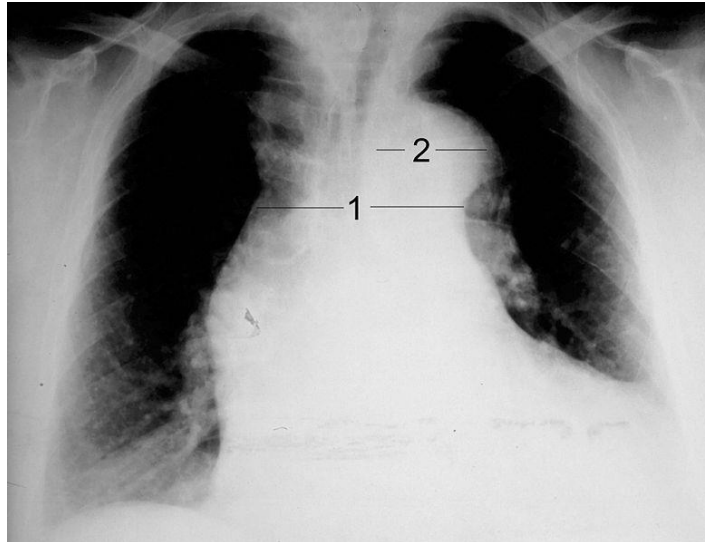
- Quality of Pain
 - Sharp: 64%
 - Tear/rip: 51%
 - Radiating: 28%
 - Migrating: 17%
- Other Signs
 - Elevated BP: 50%
 - Normal BP: 35%
 - New Murmur: 31%
 - Pulse Deficit: 15%

Scary Lessons from IRAD!

- Chest Xray Findings
 - Normal 12%
 - No wide Mediastinum 21%
 - Wide Mediastinum 62%
 - Abnormal Aorta 50%
 - Abnormal Heart 26%
 - Pleural Effusion 19%
- EKG Findings
 - No abnormalities 31%
 - Non specific changes 41%

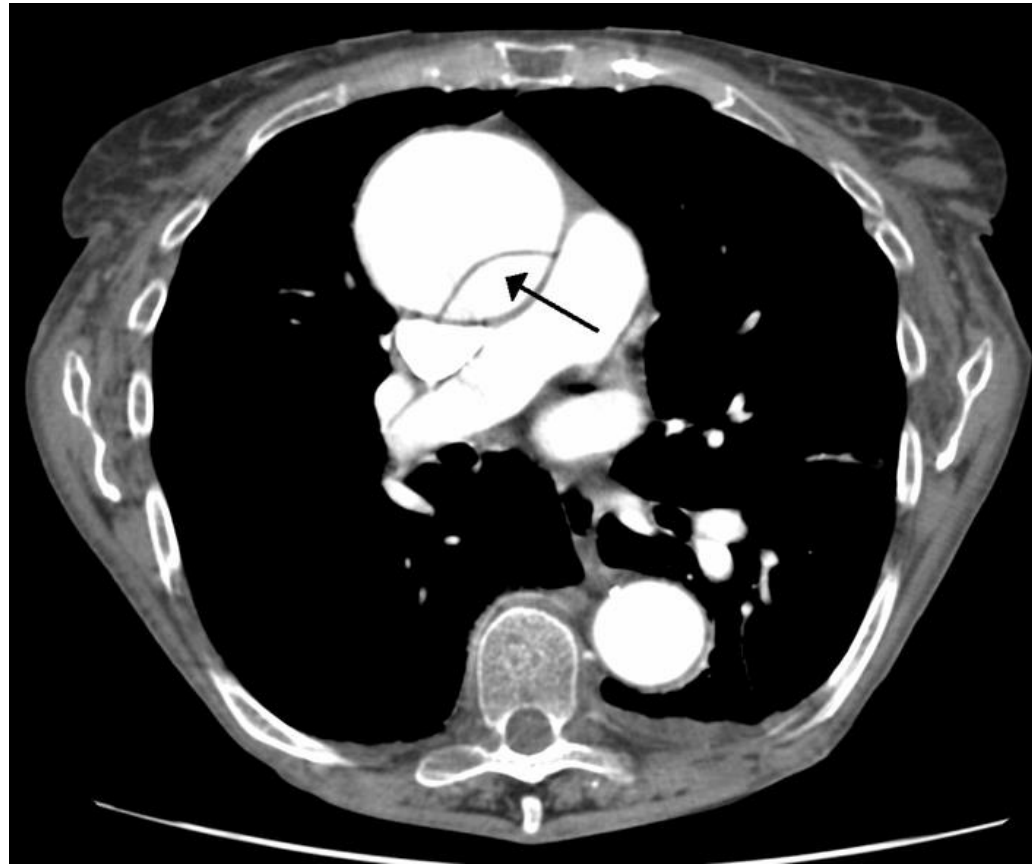
Scary Lessons

- Use Gestalt to help
- Beware of false “normal findings”
- IRAD in-hospital mortality was 27.4%
- Type A mortality not fixed 58% and fixed 26%



Diagnosing Aortic Dissection

- D Dimer
- CTA (gold standard)
- Echo (TEE)
- MRI
- Aortography



Diagnosing Aortic Dissection

Test	Sensitivity	Specificity	LR+	LR-
• D Dimer	95%	60%	2.4	.08
• CTA	93%-100%	98%-100%		
• TEE	88%-98%	95%		
• MRI	98%-100%	98%		
• Aortography	Gold Standard but rarely used			



Tension Pneumothorax

- Risk factors: smoking, family history , Marfan's, endometriosis
- Symptoms: Sudden SOB and CP worse with inspiration (pleuritic)
- Signs:
 - Low oxygen and tachycardia
 - tracheal deviation
 - absent or diminished breath sounds
- CXR or Ultrasound but should diagnose this clinically
- Treatment: needle decompression, chest tube, thoracotomy



FIGURE 1: Subcutaneous emphysema at the base of the neck and dissecting along the pectoralis muscles

Boerhaaves Syndrome – Esophageal Perforation

- Causes: iatrogenic, nausea and vomiting, esophagitis (pill)
- Mortality rate as high as 30%, 100% if untreated
- Macker's Triad; lower CP, vomiting, subcutaneous air
- Symptoms: CP (depends on location), pain with swallowing, SOB,
- Signs:
 - Low blood pressure or oxygen, tachycardia, fever
 - Feel or hear air in the tissues
- Diagnosis

Diagnosis of Esophageal Perforation

- CXR
 - Subcutaneous air (emphysema)
 - Air in the mediastinum (pneumomediastinum)
 - Free air under the diaphragm
- Definitive Diagnosis
 - Gastrografin swallow (like an Upper GI)
 - CT with contrast
 - EGD
- Treatment
 - NPO and resuscitation
 - Antibiotics and meds to decrease acid
 - Drainage and debridement



67 yo Male William Morgan with CP Summary

- Patient with a negative work up (stress, UGI, CXR and labs)
- Then sudden and severe chest pain
- Dr. Burnside heard something on cardiac exam
- Required an emergency lifesaving surgery
- Life was saved

Immediately Life Threatening CPs

What was William Morgan's diagnosis?

1. Acute Coronary Syndrome (ACS)
2. Pulmonary Embolus (PE)
3. Pericarditis with tamponade
4. Aortic Dissection
5. Tension Pneumothorax
6. Esophageal Rupture

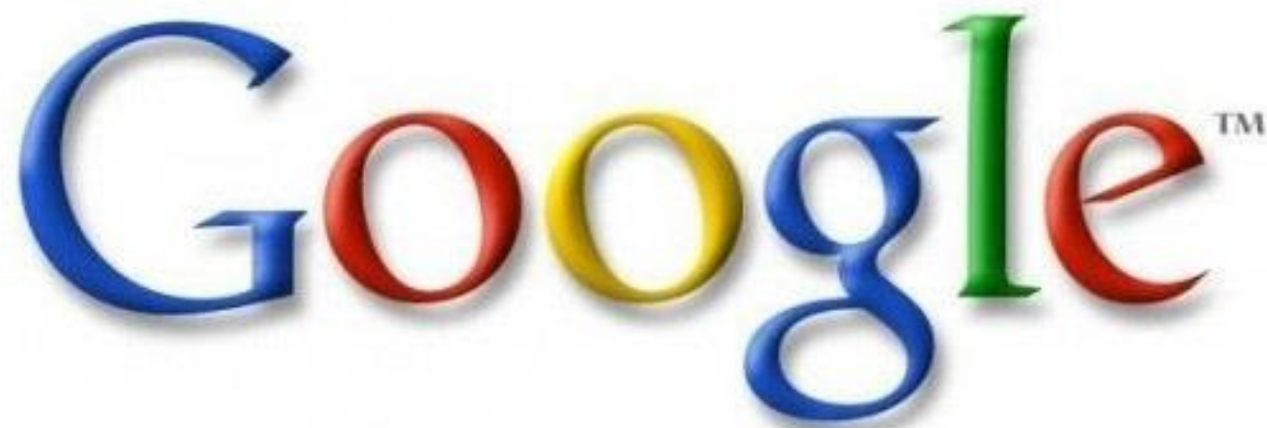
Immediately Life Threatening CPs

What was William Morgan's diagnosis?

1. Acute Coronary Syndrome (ACS)
2. Pulmonary Embolus (PE)
3. Pericarditis with tamponade
- 4. Aortic Dissection**
5. Tension Pneumothorax
6. Esophageal Rupture

Takeaways from Today's Discussion

- We all used dual process forms of thinking/decision making.
- Groopman's 3 questions from his epilogue: What else? Anything that does not fit? More than one diagnosis?
- We learned the 6 immediately life-threatening causes of chest pain how to suspect them and how to diagnosis them.
- We can read EKGs and diagnose a STEMI.
- Scoring systems help but diagnostic testing has limitations
- Finally, we solved a case of chest pain.



I ASK GOOGLE ALL THE QUESTIONS

I'm too embarrassed to ask other people.

