Acute Coronary Syndrome

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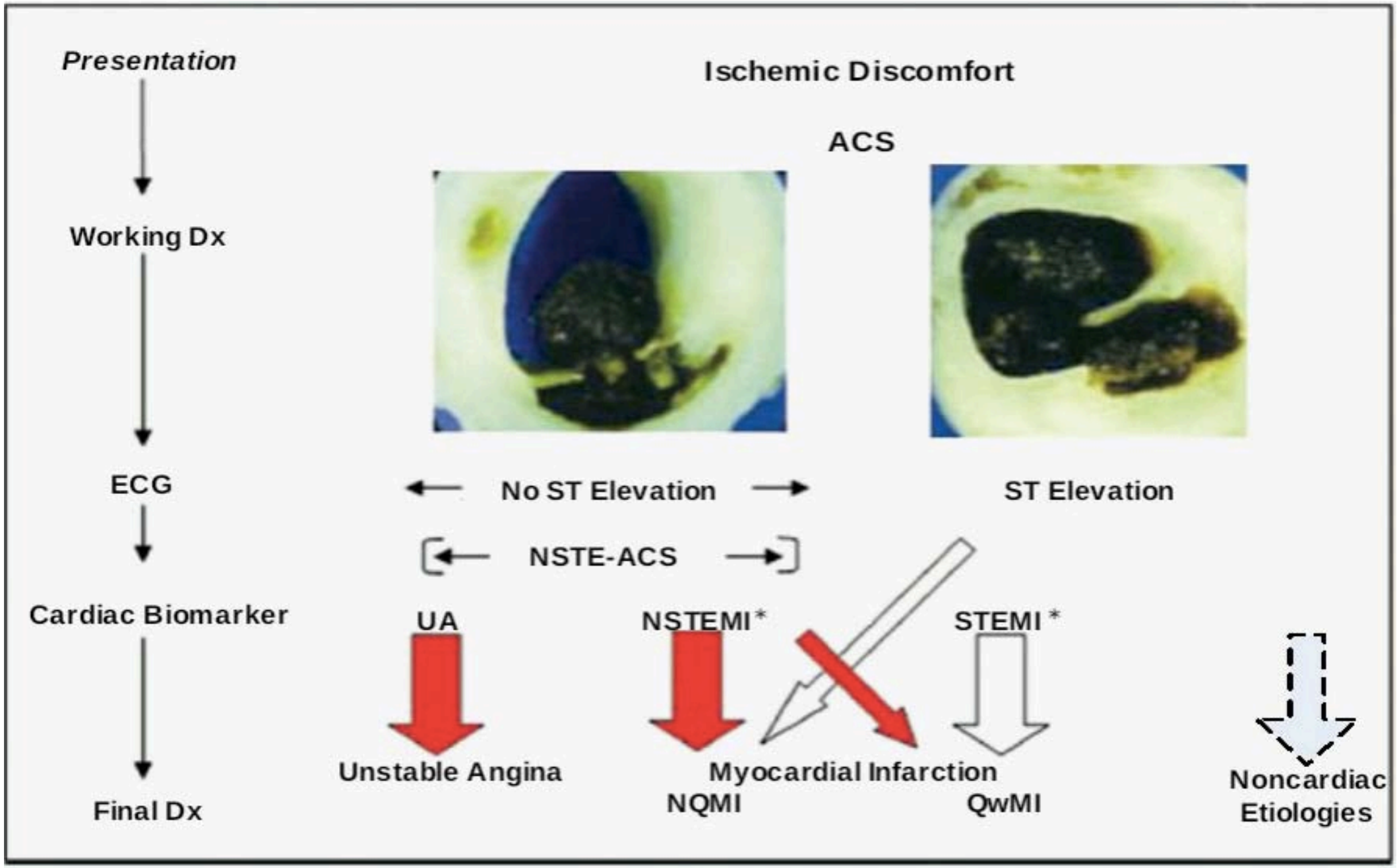
IM Chief Resident

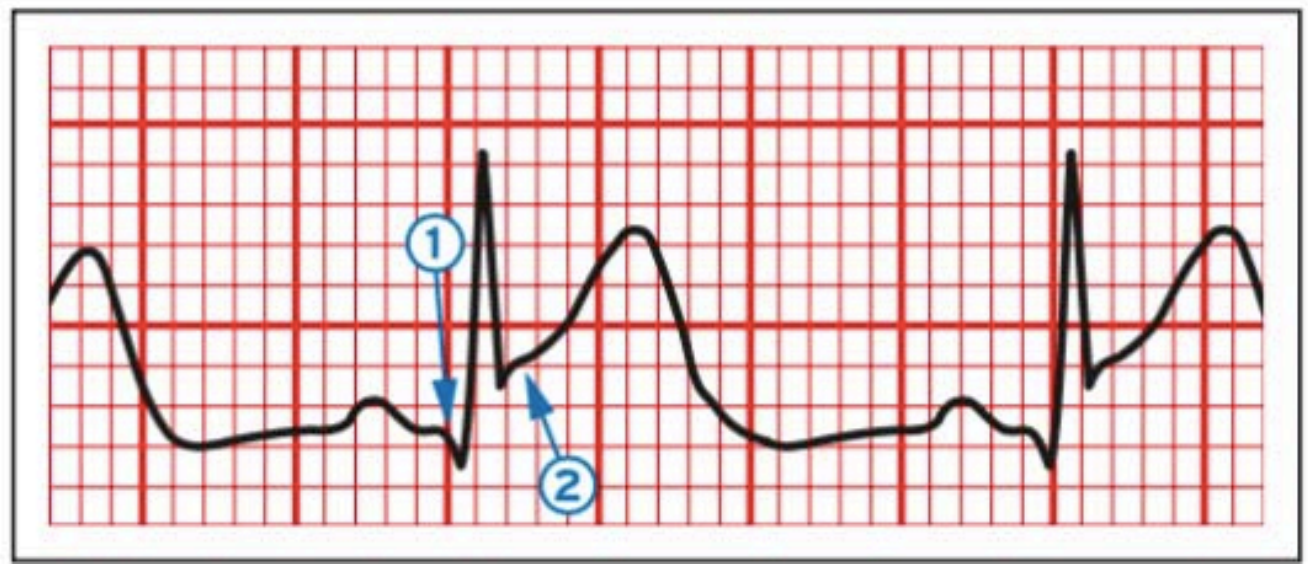
Objectives

- Define STEMI, NSTEMI and unstable angina which are subsets of acute coronary syndrome (ACS). Describe the pathophysiologic difference between type 1 and type 2 MI.
- Understand the importance of risk stratification scores in NSTEMI to determine likelihood of adverse events and optimal management strategy. Describe the TIMI score and know the score that indicates the need for early invasive strategy.
- Know the appropriate management of STEMI and NSTEMI based on ACC/AHA guidelines.
- Describe the abnormal values for high-sensitivity troponin assays, and how to use the high sensitivity assay in the evaluation of a patient with chest pain who rules out, rules in, and is in the indeterminant range for this biomarker.


Presentation
Working Dx
ECG
Cardiac Biomarker
Final Dx
Ischemic Discomfort
ACS
No ST Elevation
ST Elevation
NSTE-ACS
UA
NSTEMI*
STEMI*
Unstable Angina
Myocardial Infarction
NQMI
QwMI
Noncardiac Etiologies

ST Elevation:

ST-elevation
New ST-elevation at the J-point in 2 contiguous leads with the cut-point: ≥1 mm in all leads other than leads V_2–V_3 where the following cut-points apply: ≥2 mm in men ≥40 years; ≥2.5 mm in men <40 years, or ≥1.5 mm in women regardless of age.*
ST-depression and T wave changes
New horizontal or downsloping ST-depression ≥0.5 mm in 2 contiguous leads and/or T inversion >1 mm in 2 contiguous leads with prominent R wave or R/S ratio >1.



STEMI Criteria

- **New ST segment elevations in at least two anatomically contiguous leads:**
  - **Men age ≥40 years:** ≥2 mm in V2-V3 and ≥1 mm in all other leads.
  - **Men age <40 years:** ≥2,5 mm in V2-V3 and ≥1 mm in all other leads.
  - **Women (any age):** ≥1,5 mm in V2-V3 and ≥1 mm in all other leads.

- New LBBB (can be difficult to discern)

Sgarbossa criteria for diagnosis of STEMI in the setting of LBBB

Criteria	Points		Normal LBBB	Ischemic LBBB
ST segment elevation ≥1 mm in any lead with positive QRS (V4, V5, V6, aVL, I) .	5	V4-V6, aVL, I		
ST segment depression ≥1 mm in V1, V2 and/or V3.	3	V1-V3		
ST segment elevation ≥5 mm in any lead with discordant QRS (V1, V2, V3)	2	V1-V3		
			These complexes show the normal (expected) appearance of LBBB.	These complexes show ischemic manifestations in the setting of LBBB.

Case #1 – July 14, 2020 @ 17:00

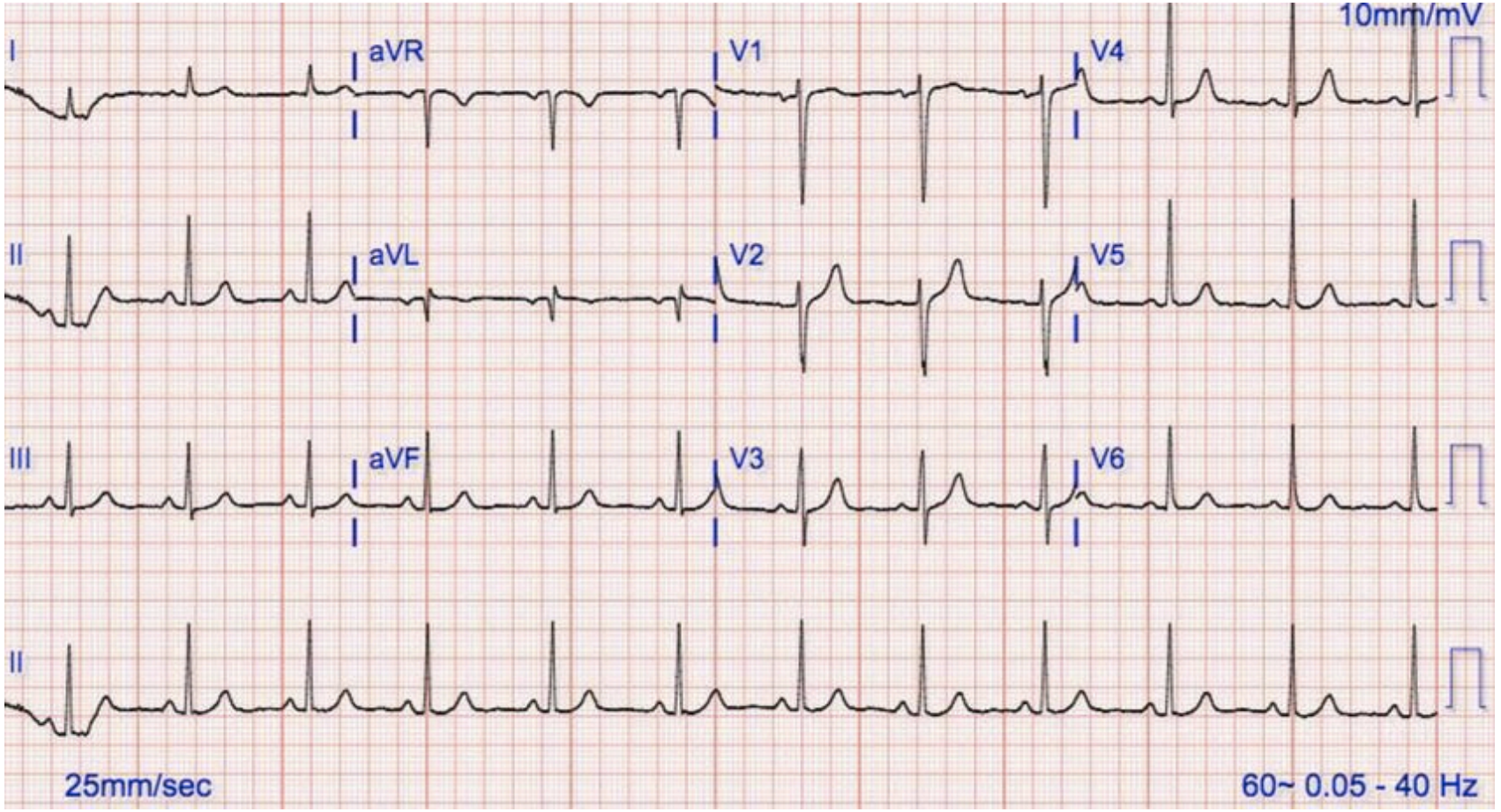
65yo female with PMHx HTN, HLD and tobacco abuse who presented 60 minutes after onset of chest pain. 8/10 chest heaviness with radiation to neck while pruning her cherry trees. Symptoms spontaneously resolved with rest. Associated dizziness, nausea and diaphoresis. Chest pain free in ER.

VS: BP 144/88, HR 60, 97% RA

EKG: to follow

Labs: HS Troponin 44, BNP <10, Cr 0.98, Hb 15.3, Plts 209, INR 1.0

Case #1


10mm/mV
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
25mm/sec
60~ 0.05 - 40 Hz

Called by the ER....

- A. NSTE-ACS – Start ACS protocol, await repeat HS troponin
- B. STEMI – Activate cardiac cath lab
- C. Recommend Observation admission, no ACS protocol
- D. DC home – Chest pain free, troponin indeterminate, EKG normal

Case #1 – July 14, 2020 @ 19:00

Paged by nurse from Obs, repeat HS-T is 220. What orders?

- BP 130/84, HR 64
- Remains chest pain free, wants to know when she can go home to finish pruning trees?

Case #1

- A. NSTE-ACS – ACS protocol with immediate invasive strategy
- B. NSTE-ACS – ACS protocol with early invasive vs ischemia-guided strategy
- C. STEMI – Activate cardiac cath lab
- D. Continue Observation admission, consult cardiology in AM
- E. DC home – Patient has to trim her trees

Case #1

Appropriately started ACS protocol…what is initial ACS protocol?

- A. ASA 81mg , GpIIb/IIIa inhibitor, full dose AC, pravastatin, amlodipine
- B. ASA 324mg, clopidogrel 600mg, full dose AC, HI statin, metoprolol
- C. ASA 324mg, clopidogrel 75mg, DVT prophy dose AC, No statin
- D. ASA 324mg, clopidogrel 600mg, GPIIb/IIIa inhibitor, full dose AC, type and cross with 2u pRBC on hold

NSTE-ACS Therapy

- No more MONA? (MONA-BASH)
- ABCs:
  - Aspirin, Anti-platelet, Anti-thrombotic, Anti-anginal, ACEi/ARB
  - Beta-blocker
  - Cholesterol (statin)

Analgesia

- Morphine- class 2B recommendation
  - Not cornerstone of treatment
  - Associated w/ higher mortality
  - CRUSADE QI Initiative

Meine TJ et al. Association of intravenous morphine use and outcomes in acute coronary syndromes: results from the CRUSADE Quality Improvement Initiative. Am Heart J 2005;149(6):1043-9.

Oxygen

- Free radicals= BAD!
- AVOID trial
  - Supplemental O2
  - Sats >94%
  - Increase risk recurrent MI
- Indicated if sats <90%
- WATCH FOR MONA THE OXYGEN GHOST!

Anti-anginal

- Nitroglycerin
  - No mortality benefit
  - Mechanism: selective coronary vasodilation
  - CAUTION: decrease pre-load
    - Do not use in pre-load dependent RV infarct
    - Careful if severe AS

A's

- ACEI
  - Indicated for anterior wall MI, EF <40%
  - Really unless contraindication should be on it
- Anticoagulation
  - Heparin (UFH)
  - Lovenox (LMWH)
- Anti-platelets
  - Aspirin: 325mg load-->81mg
  - P2Y12 Inhibitors
    - Clopidogrel (Plavix): 300/600mg load--> 75mg daily
    - Ticagrelor (Brilinta): 180mg load--> 90mg BID

B

- Beta blocker
  - Metoprolol 25mg BID
  - Give within 24 hours
  - Caution use if: signs of HF, risk of cardiogenic shock, AV blocks

C=Cholesterol (Statin)

- High intensity statin
  - Atorvastatin 80mg
  - Rosuvastatin 20mg or 40mg
  - Independent of LDL levels

Now what?

- A. Ischemia driven strategy - Order Stress test for in the morning
- B. Early invasive strategy - NPO at midnight for coronary angiogram in the morning
- C. Delayed invasive strategy – Monitor clinically, coronary angiogram within 72hrs
- D. Medical management – continue heparin drip for 48 hours and discharge home on NSTEMI therapy

Factors Associated With Appropriate Selection of Early Invasive Strategy or Ischemia-Guided Strategy in Patients With NSTE-ACS

Immediate invasive (within 2 h)	**Refractory angina**	**"EMERGENT"**
	Signs or symptoms of HF or new or worsening mitral regurgitation	
	Hemodynamic instability	
	Recurrent angina or ischemia at rest or with low-level activities despite intensive medical therapy	
	Sustained VT or VF	
Ischemia-guided strategy	Low-risk score (e.g., TIMI [0 or 1], GRACE [<109])	
	Low-risk Tn-negative	
	Patient or clinician preference in the absence of high-risk features	
Early invasive (within 24 h)	**GRACE risk score >140**	**"URGENT"**
	Temporal change in Tn	
	New or presumably new ST depression	
Delayed invasive (within 25–72 h)	**None of the above but diabetes mellitus**	
	Renal insufficiency (GFR <60 mL/min/1.73 m²)	
	Reduced LV systolic function (EF <0.40)	
	Early postinfarction angina	
	PCI within 6 mo	
	Prior CABG	
	GRACE risk score 109–140; TIMI score ≥2	

Diagnosis/Workup

- Clinical story/ symptoms
- Risk factors
- Exam
- Biomarkers
- ECG
- ECHO/imaging

Story/Symptoms

- "Typical" chest pain = meets 3/3
  - Substernal
  - Brought on by exertion or stress
  - Relieved by rest
- Other "classic" symptoms
  - Lasts>10 min
  - Diffuse
  - Not positional
- Rigid definition has fallen out of favor...

HERMES STUDY

Table 1: Distribution and Univariate Analysis of Symptoms According to Sex					
Symptoms	**Total Women**		**Total Men**		**Women vs. Men**
	N	**%**	**N**	**%**	**P-value**
Chest pain/ sensation	231	89.9	330	86.8	0.80
Breathing affected	171	66.5	241	63.4	0.42
Faint/ dizzy/ lightheaded	103	40.1	124	32.6	0.05
Pressure	96	37.4	126	33.2	0.95
Fatigue	93	36.2	111	29.2	0.06
Arms	90	35.0	118	31.1	0.30
Tightness	88	34.2	109	28.7	0.33
Hot/ sweating	86	33.5	109	28.7	0.20
Nausea/ vomiting	82	31.9	54	14.2	<0.01
Heaviness	72	28.0	70	18.4	0.04
Burning/ GI sensation	64	24.9	100	26.3	0.33
Discomfort	63	24.5	104	27.4	0.06
Shoulders	71	27.6	65	17.1	<0.01
Back	65	25.3	39	10.3	<0.01
Neck	57	22.2	43	11.3	<0.01
Jaw	49	19.1	30	7.9	<0.01
Ache	11	4.3	25	6.6	0.24
Sitting on chest	21	8.2	18	4.7	0.30
Sharp pain	45	17.2	52	13.7	0.59

Risk Factors

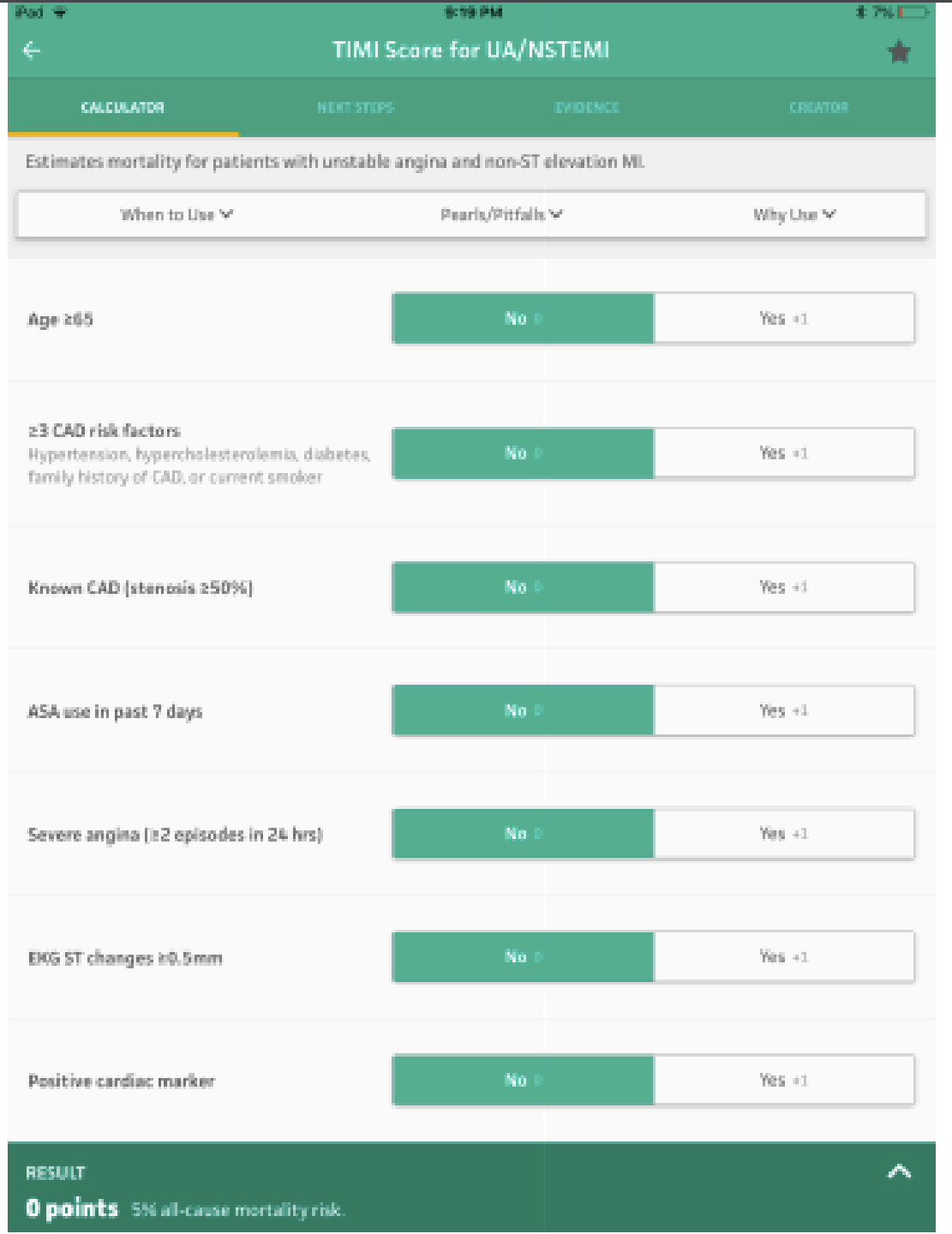
- Hypertension
- Diabetes Mellitus
- Hyperlipidemia
- Tobacco abuse
- Obesity
- Family Hx premature CAD
- Personal Hx CAD
- Age
- **RA, Lupus, IBD consider

Risk Stratification

- Risk scores must be applied to correct patient – do not use on patient without ACS!
  - Used to predict adverse events based on observational data
  - TIMI
  - GRACE
  - HEART

TIMI Risk Score – NSTEMI/UA

Risk Category	TIMI Risk Score	All-Cause Mortality, New or Recurrent MI, or Severe Recurrent Ischemia Through 14 d After Randomization, %
Low	0–1	4.7
	2	8.3
Intermediate	3	13.2
	4	19.9
High	5	26.2
	6–7	40.9



GRACE™

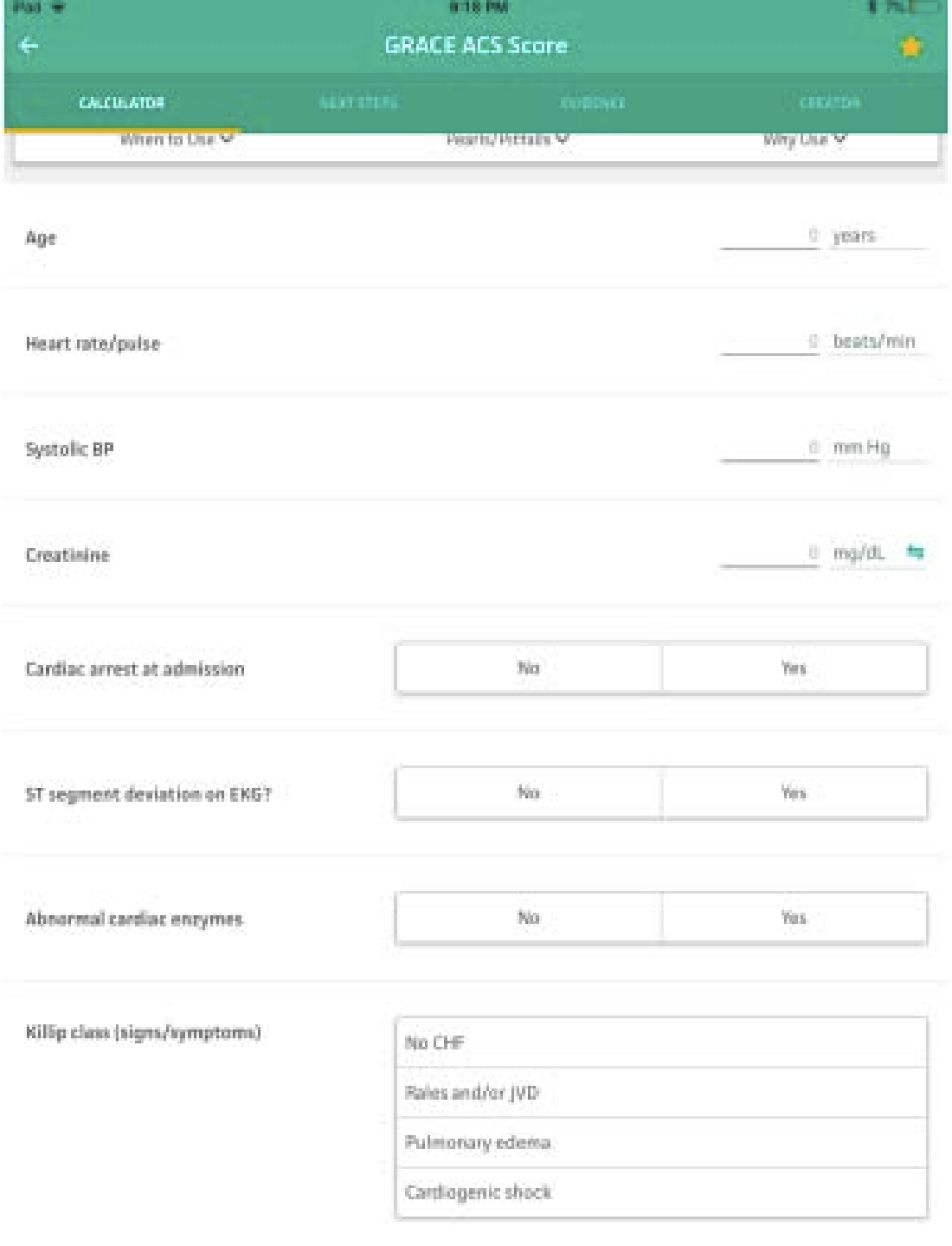
GLOBAL REGISTRY OF ACUTE CORONARY EVENTS

Non STE-ACS: In-hospital Mortality

Risk Category (tertiles)	GRACE Risk Score	Probability of Death In-hospital (%)
Low	1-108	<1
Intermediate	109-140	1-3
High	141-372	>3

Non STE-ACS: 6 Month Post-discharge Mortality

Risk Category (tertiles)	GRACE Risk Score	Probability of Death Post-discharge to 6 Months (%)
Low	1-88	<3
Intermediate	89-118	3-8
High	119-263	>8



Revisit Case #1

65yo M PMH HTN, HLD, tobacco use presented with chest pain after pruning trees. SBP 144, HR 60, Cr 0.98. No ischemia on EKG. + troponins.

- How would you risk stratify this patient?
  - TIMI Risk
  - GRACE Score

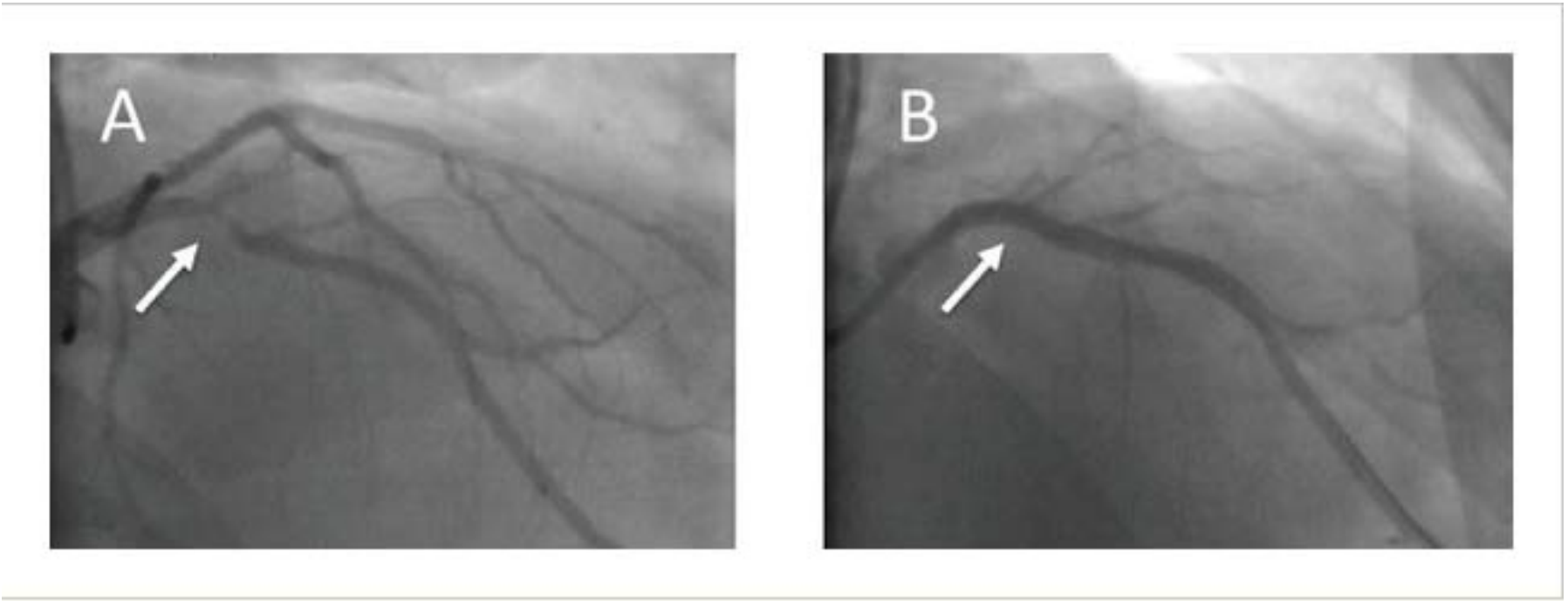
Revisit Case #1

65yo M PMH HTN, HLD, tobacco use presented with chest pain after pruning trees. SBP 144, HR 60, Cr 0.98. No ischemia on EKG. + troponins.

- How would you risk stratify this patient?
  - TIMI Risk= 3-4
  - GRACE Score= 92

Case #1- Next day

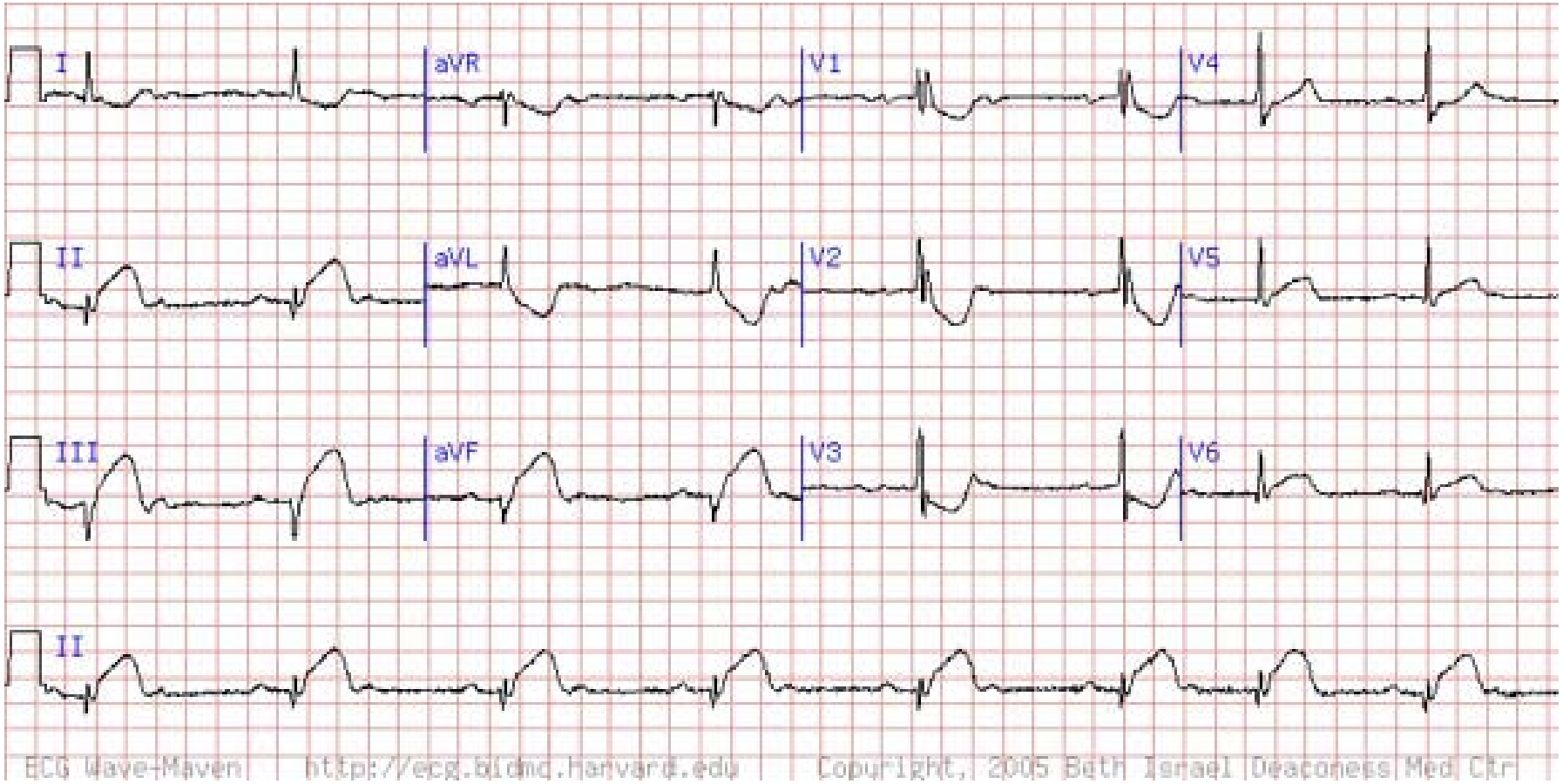
- HS-T now >1000
- Cardiology consulted
- Taken to the cath lab (early invasive strategy)



Case #2 NF at the VA

- Paged by 4C nurse that patient has sudden onset substernal chest pain and appears uncomfortable
- 70yo male with PMH DM2, HTN admitted to VA with substernal chest pressure.
- VS: BP 130/80, HR 70, 96% on RA--> BP 90/60, HR 110
- Initial EKG: nonspecific T-wave changes. Normal troponin

Repeat EKG shows....



Case #2: What do you do?

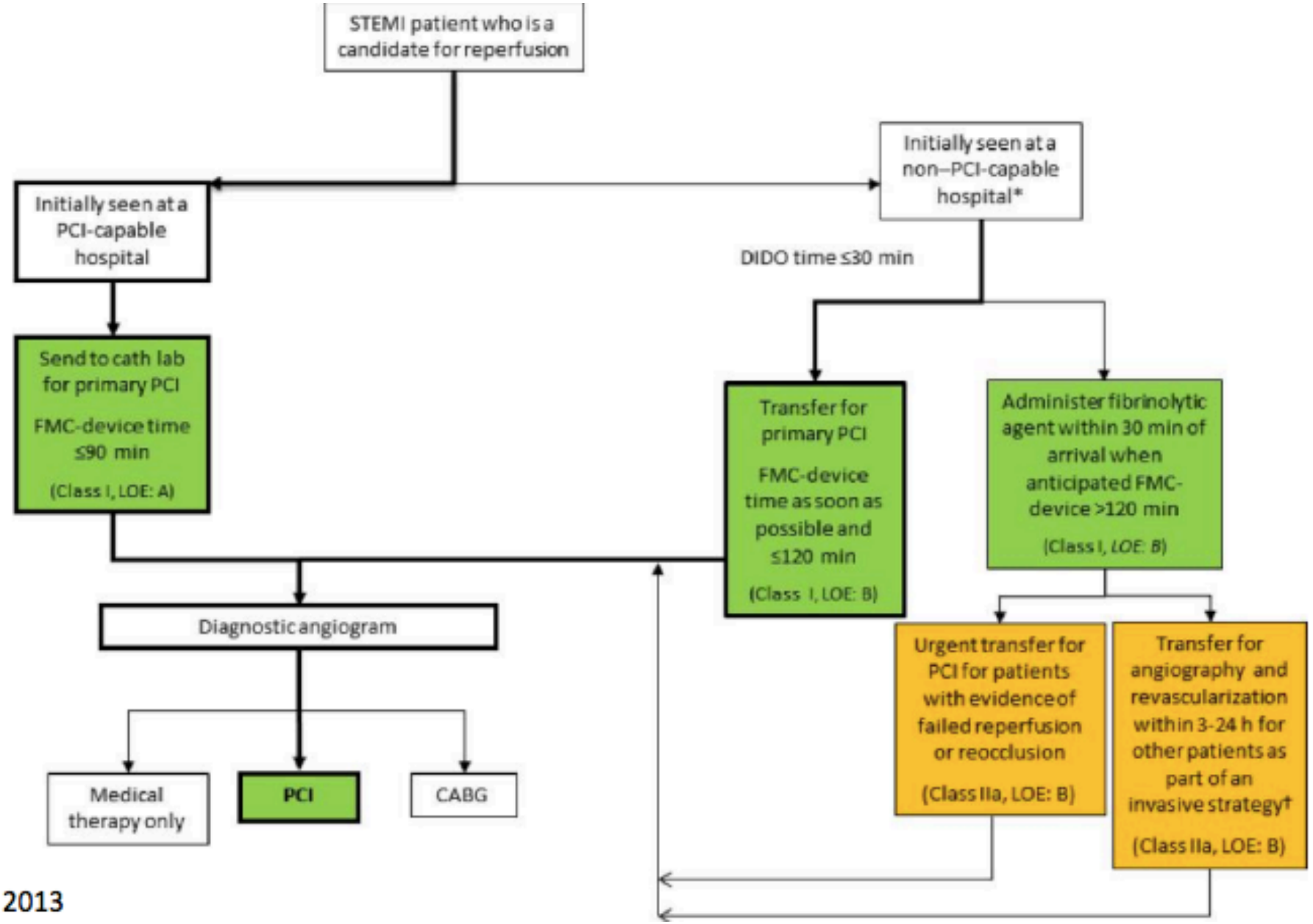
A. ACS protocol- This is an NSTEMI

B. STEMI- Activate cath lab (but it is sunday at the VA...)

C. STEMI- Transfer to PCI capable facility

D. STEMI- give fibrinolytics

E. Call cardiology- they should know the answer


STEMI patient who is a candidate for reperfusion
Initially seen at a PCI-capable hospital
Initially seen at a non–PCI-capable hospital*
DIDO time ≤30 min
Send to cath lab for primary PCI
FMC-device time ≤90 min
(Class I, LOE: A)
Transfer for primary PCI
FMC-device time as soon as possible and ≤120 min
(Class I, LOE: B)
Administer fibrinolytic agent within 30 min of arrival when anticipated FMC-device >120 min
(Class I, LOE: B)
Diagnostic angiogram
Medical therapy only
PCI
CABG
Urgent transfer for PCI for patients with evidence of failed reperfusion or reocclusion
(Class IIa, LOE: B)
Transfer for angiography and revascularization within 3-24 h for other patients as part of an invasive strategy†
(Class IIa, LOE: B)

ACC/AHA 2013

Case #3

50yo male with known HFrEF 25%, meth use, HTN, presents with DOE, swollen legs.

VS: BP 95/55, HR 130, O2 94% on RA

Labs: Hgb 9, Cr 3.5, lactic 3, HS-T 200

EKG: afib RVR

Case #3: what do you do?

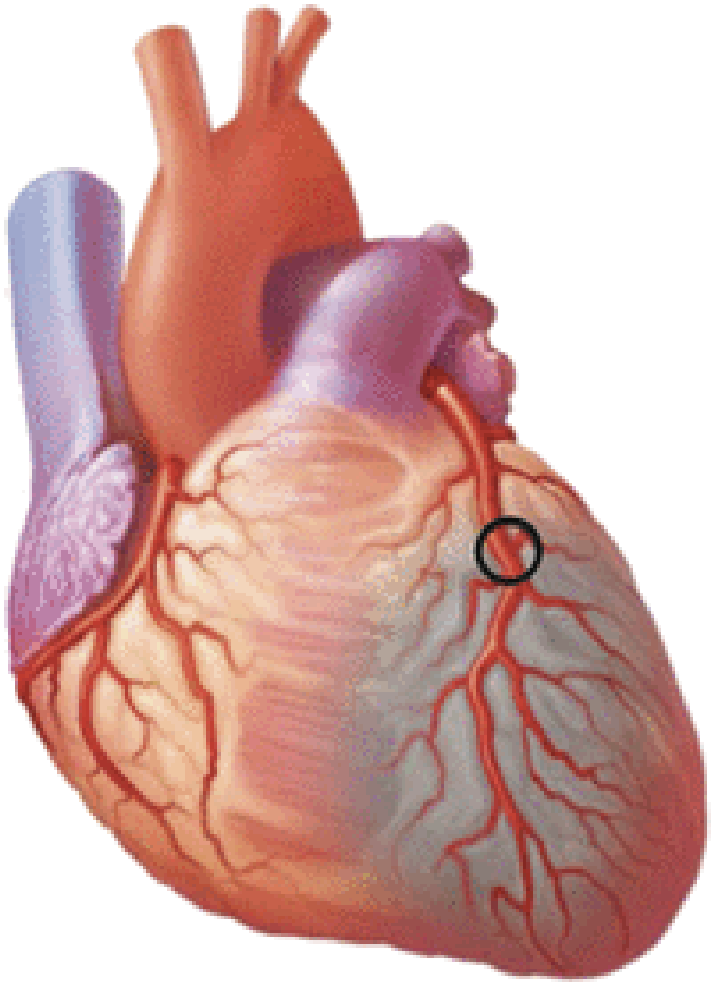
A. STEMI- Activate cath lab

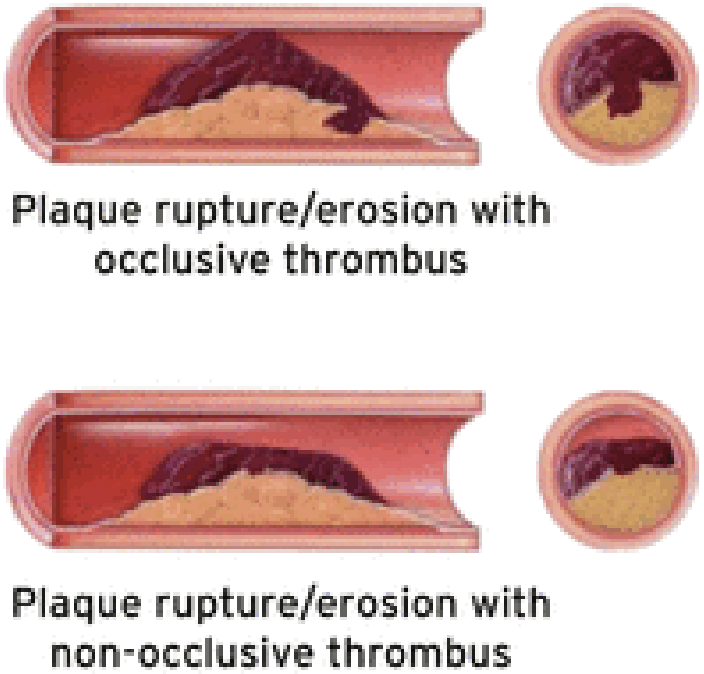
B. Type 2 MI- No ACS protocol, troponin elevation likely demand ischemia from afib RVR, AKI, poor perfusion from low EF

C. NSTEMI- Start ACS protocol

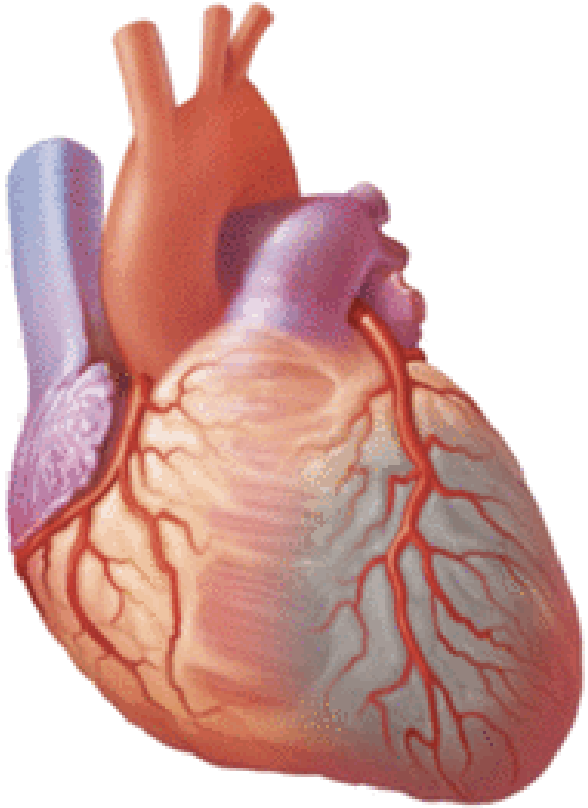
D. Consult cardiology

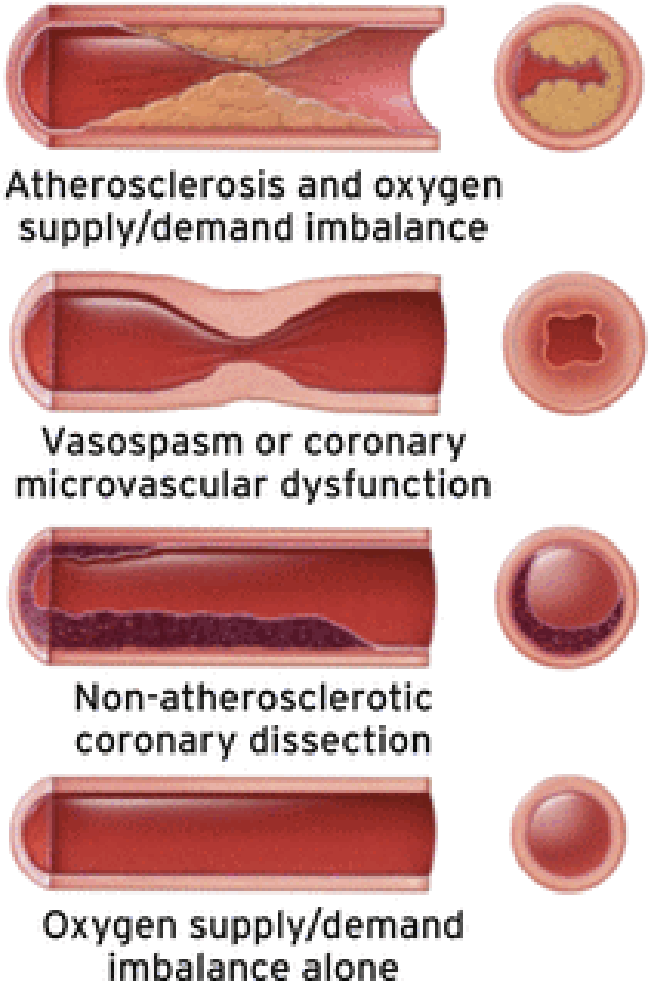
Type 1 MI

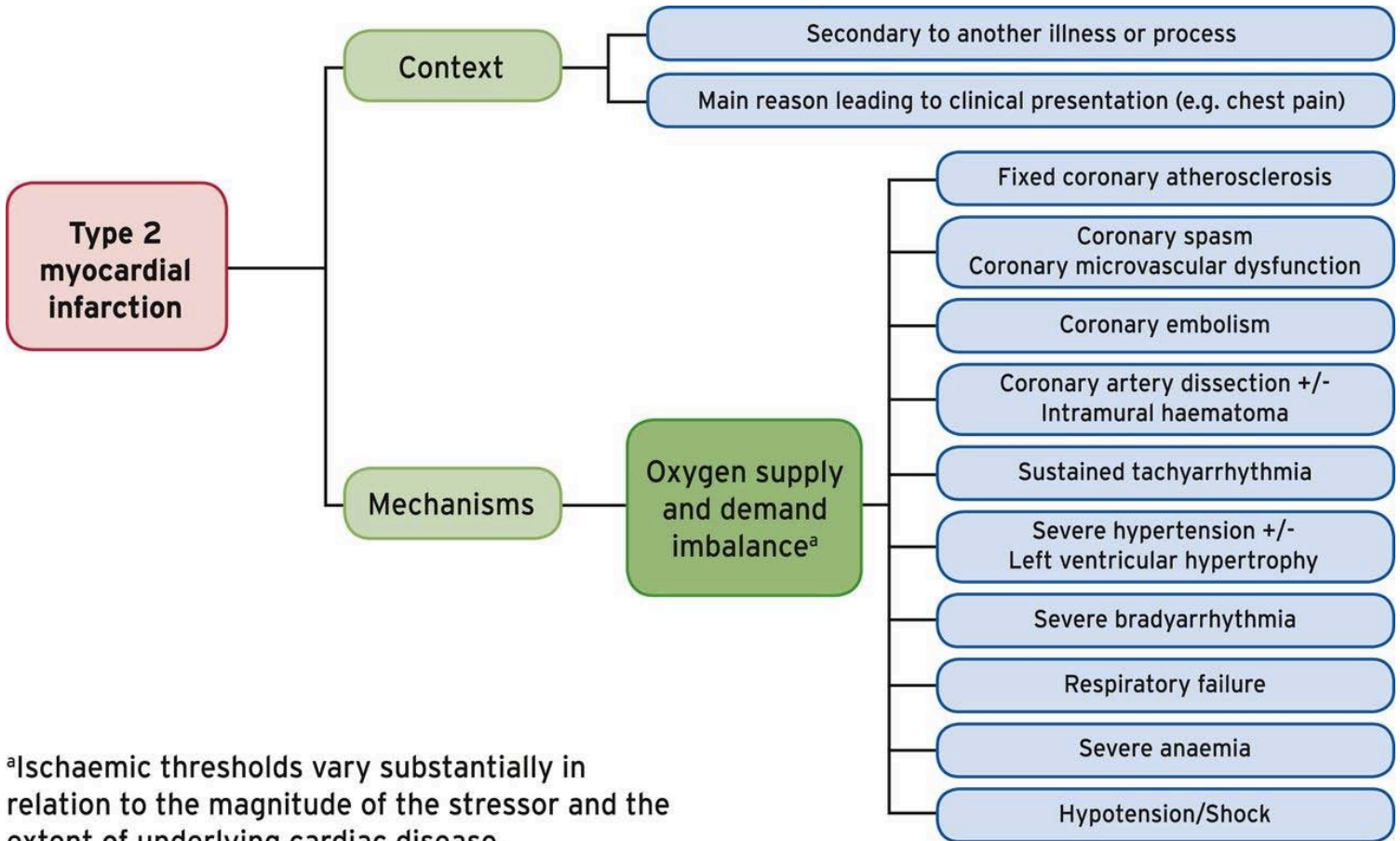



Plaque rupture/erosion with occlusive thrombus
Plaque rupture/erosion with non-occlusive thrombus

Type 2 MI



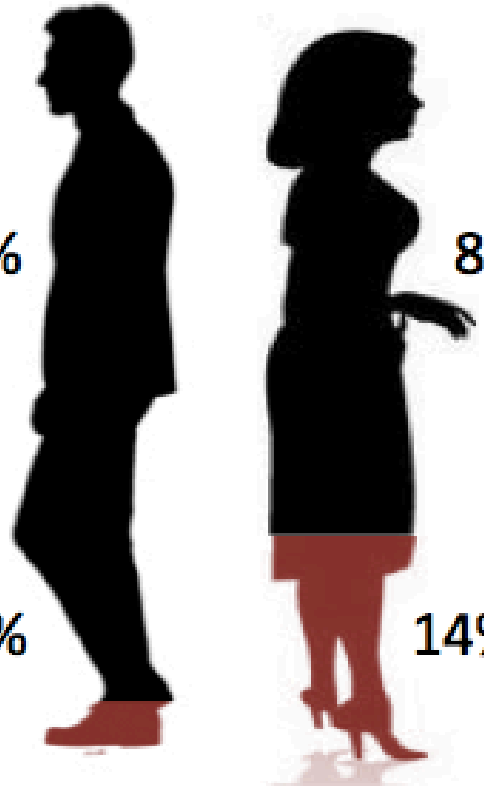

Atherosclerosis and oxygen supply/demand imbalance
Vasospasm or coronary microvascular dysfunction
Non-atherosclerotic coronary dissection
Oxygen supply/demand imbalance alone



[a]Ischaemic thresholds vary substantially in relation to the magnitude of the stressor and the extent of underlying cardiac disease.

Obstructive CAD 93-97%

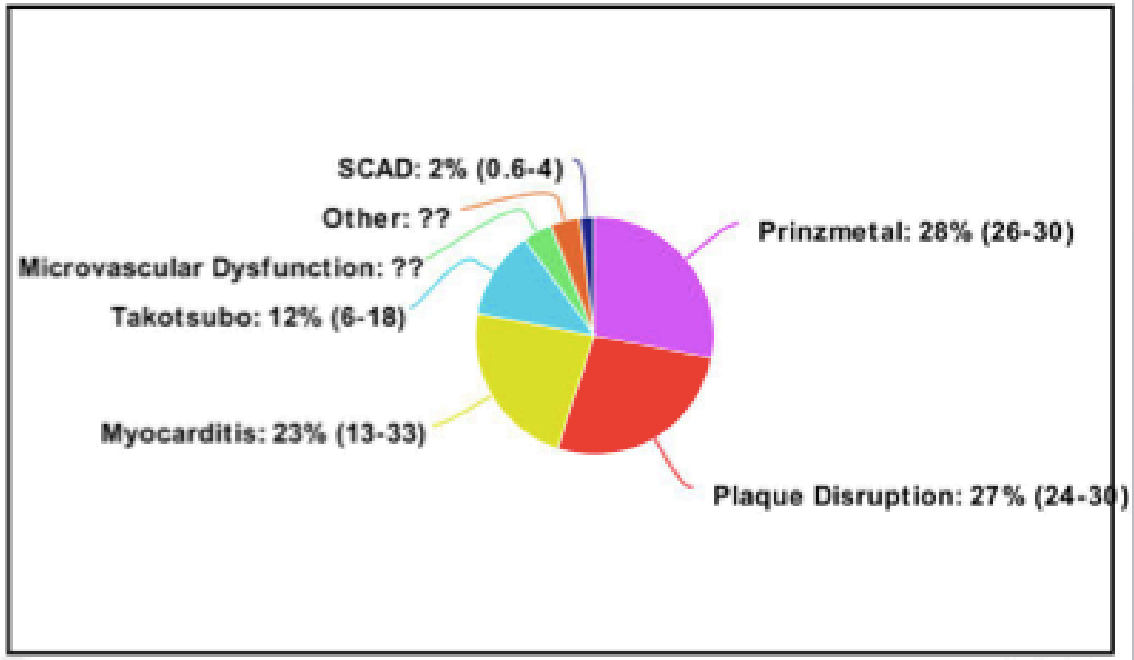
Non-obstructive CAD 3-7%



86%

14%

MINOCA



Case #4

A 35yo female with RA and Crohns Disease presents with progressive dyspnea, shoulder and back pain x4 hours.

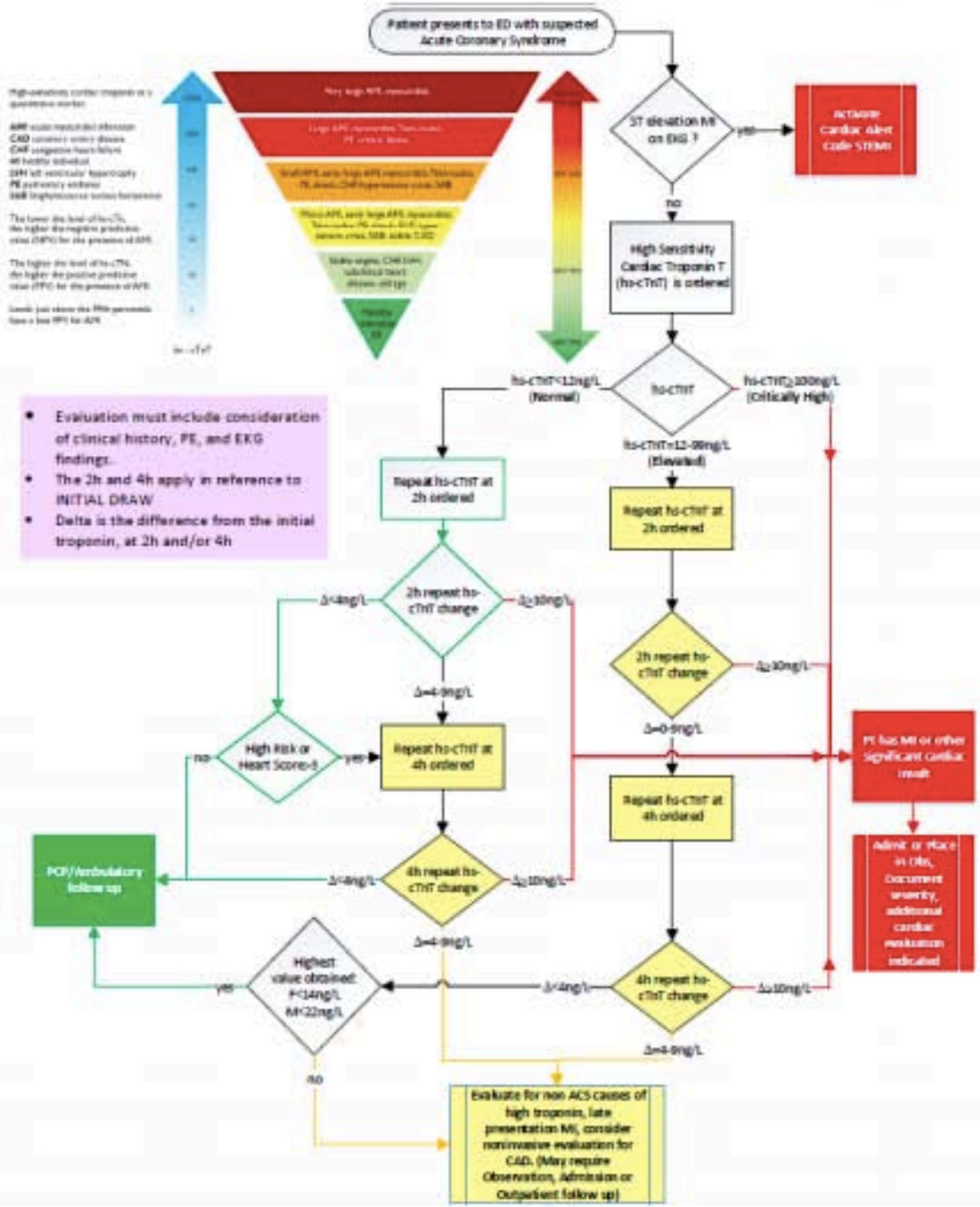
Nurse asks you if you want to initiate ACS workup and order a HS-T?

A. Yes

B. No

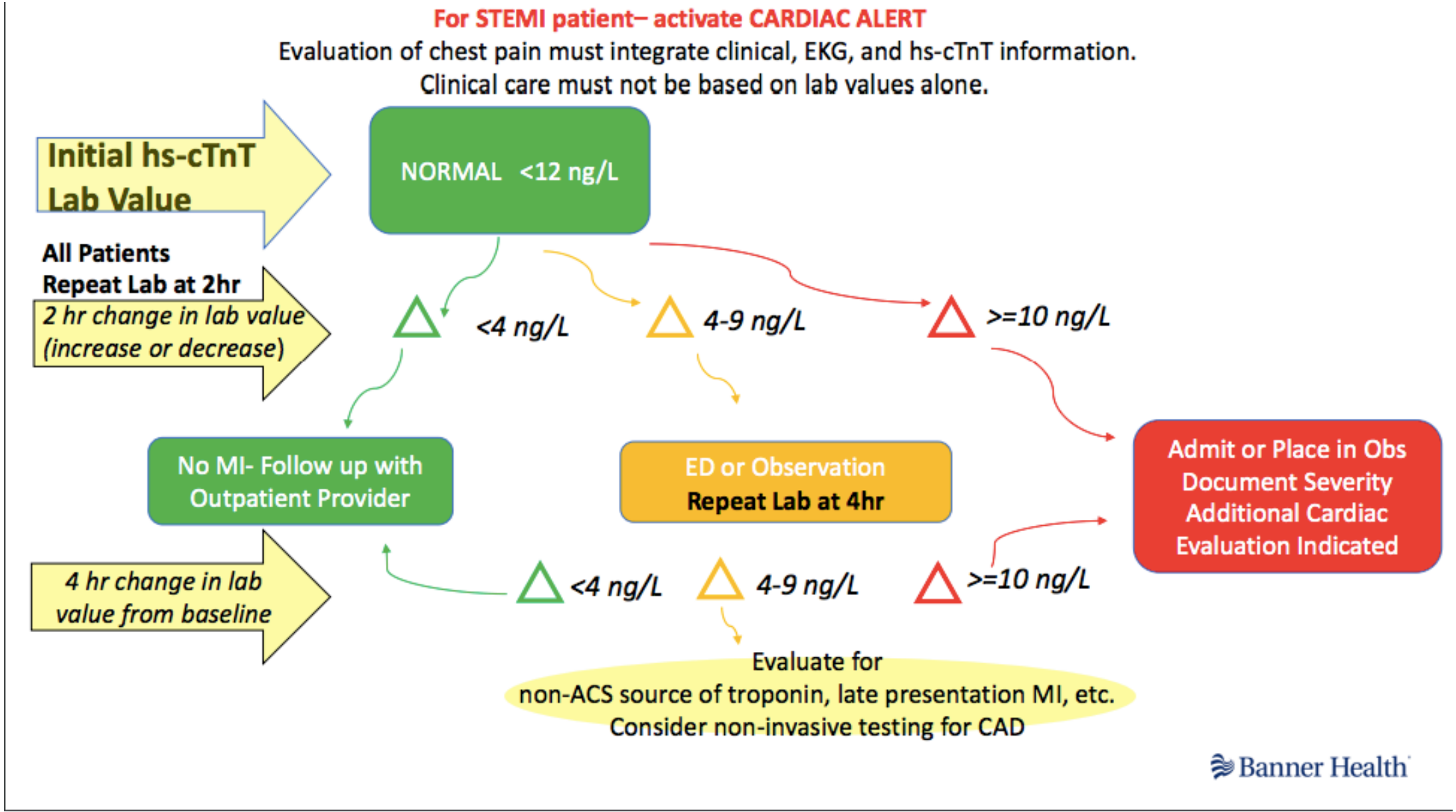
Case #4 YES!

- Risk factors: RA and arguably IBD
- Symptoms convincing
- Results:
  - HST initial = 50
  - Repeat 2 hour=65

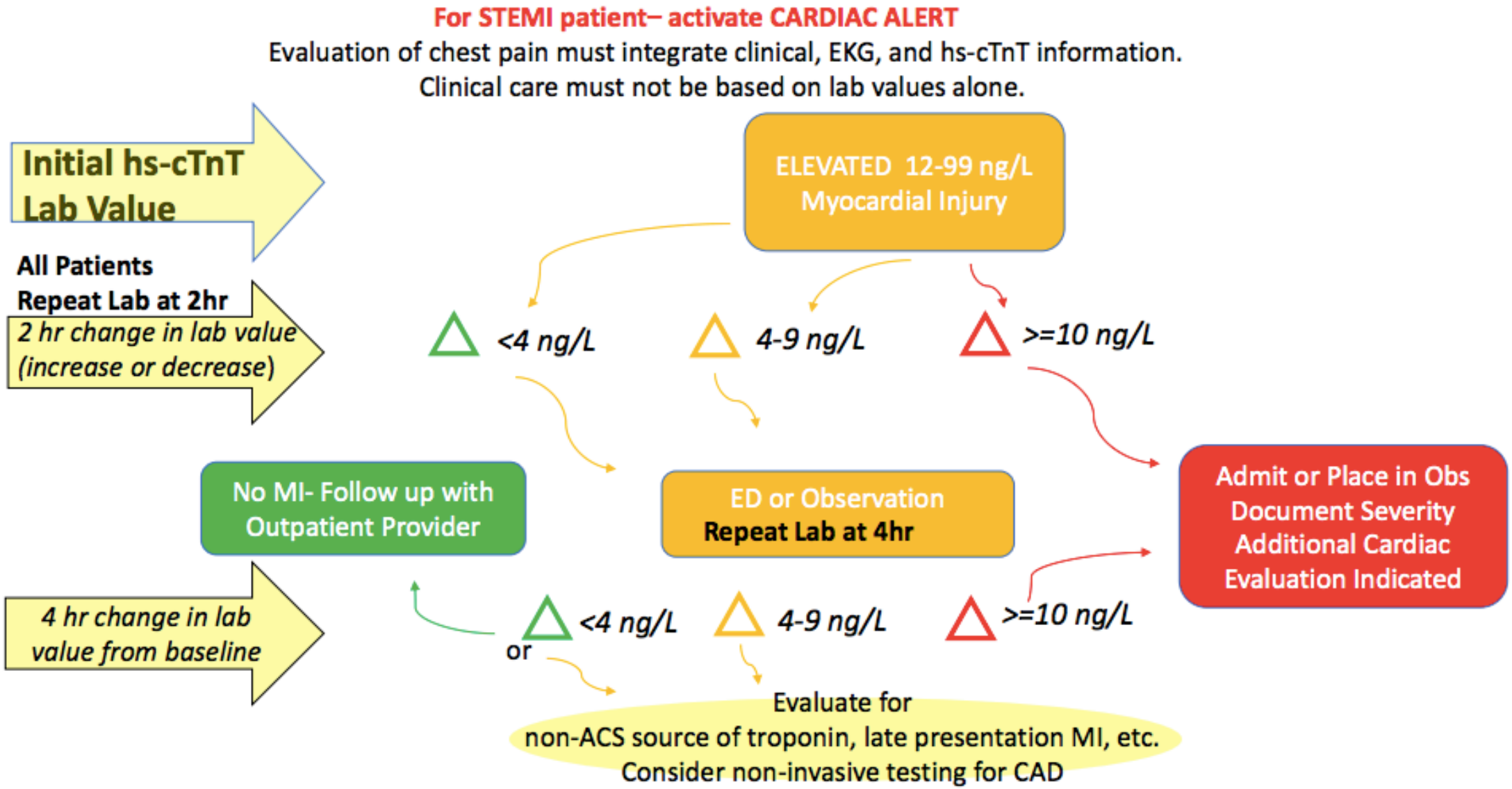


Banner Health

T0= 11
T 2hr = 16
T 4hr = 19



T0= 50
T 2hr = 65



Banner Health

Tips For Consults

1. Know the acuity
2. Know your question
3. Know your patient
4. Know your resources