Positive troponin / Type 1 and Type 2 Myocardial Infarction

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Positive troponin / Type 1 and Type 2 Myocardial Infarction

- Case
- Troponin
- 4th Universal Definition of Myocardial Infarction (2018)
- Approach to elevated troponin / type 2 MI
- Documenting type 2 MI - I21.A1

BT – 52 y. o. male

- 2 days of cough and progressive shortness of breath
- Wife called EMS
- Transported by fire / BLS

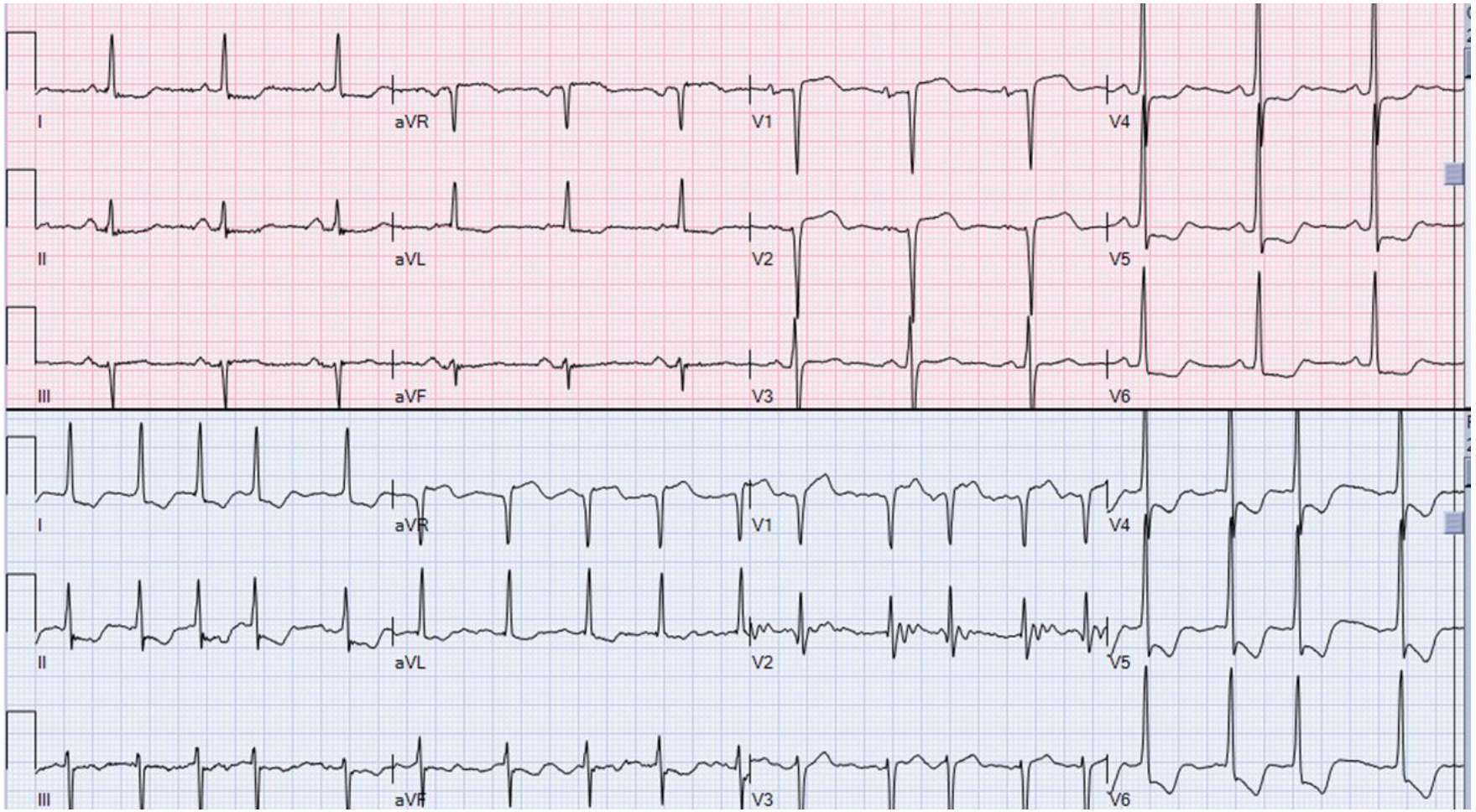
BT – 52 y. o. male

- Temperature 103 F
- Pulse 116 - 160, irregular
- BP 80 systolic
- Respiratory rate 24
- O2 saturation 88%

BT – 52 y. o. male

ECG
after cardioversion

Initial ECG



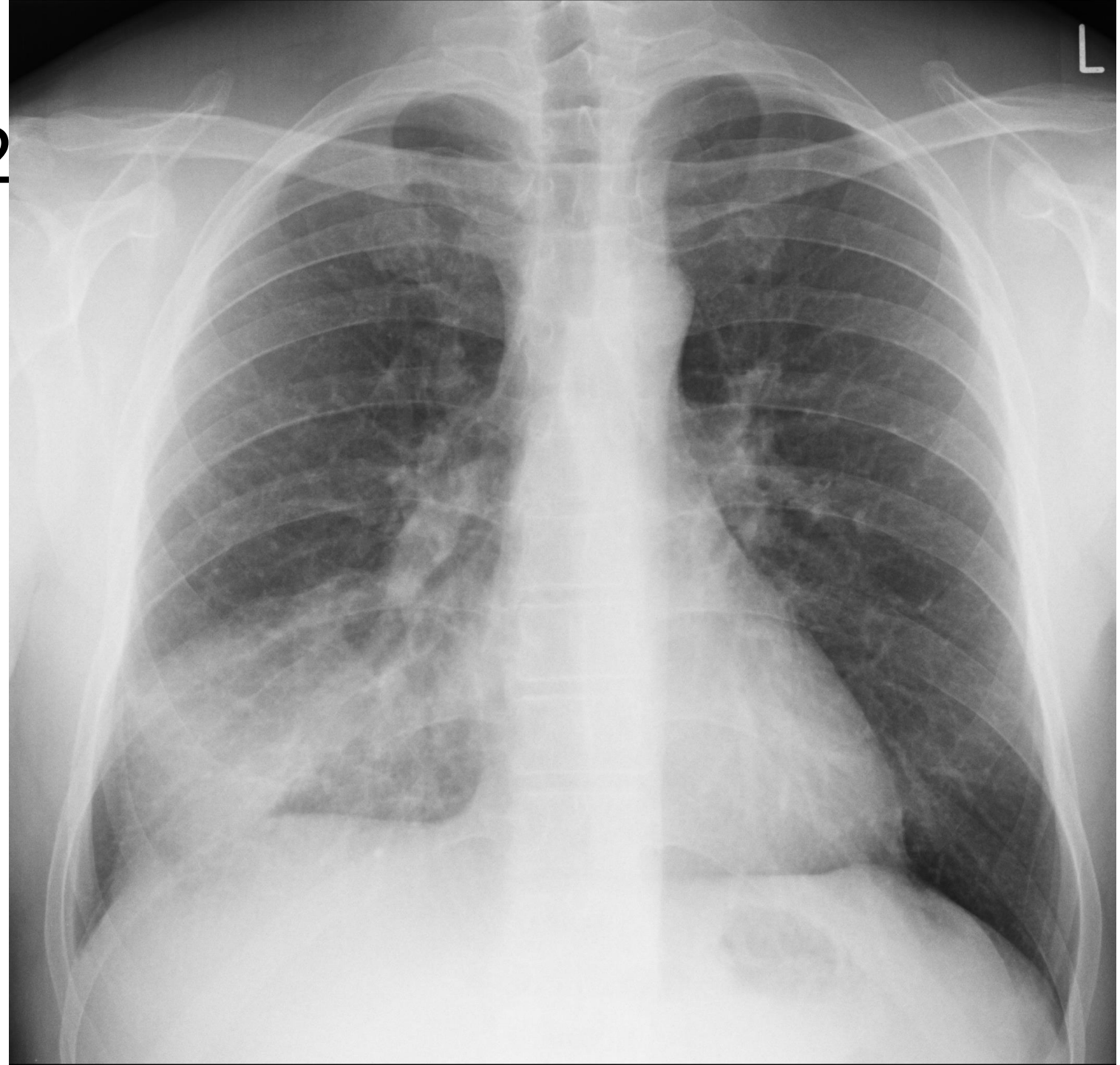
BT – 52 y. o. male

- Saline wide open
- Norepi drip
- High flow 02
- Cardioversion to sinus

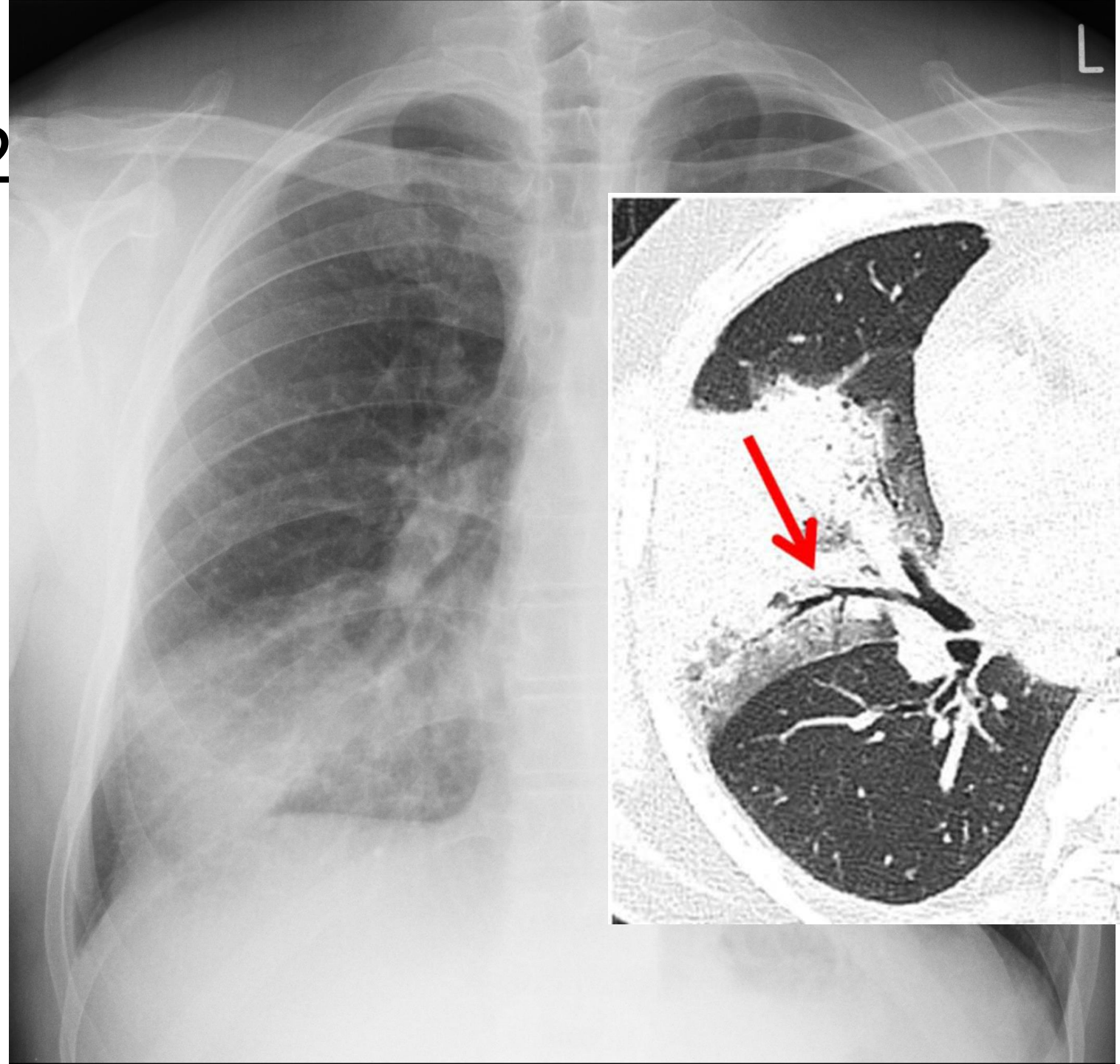
BT – 52 y. o. male

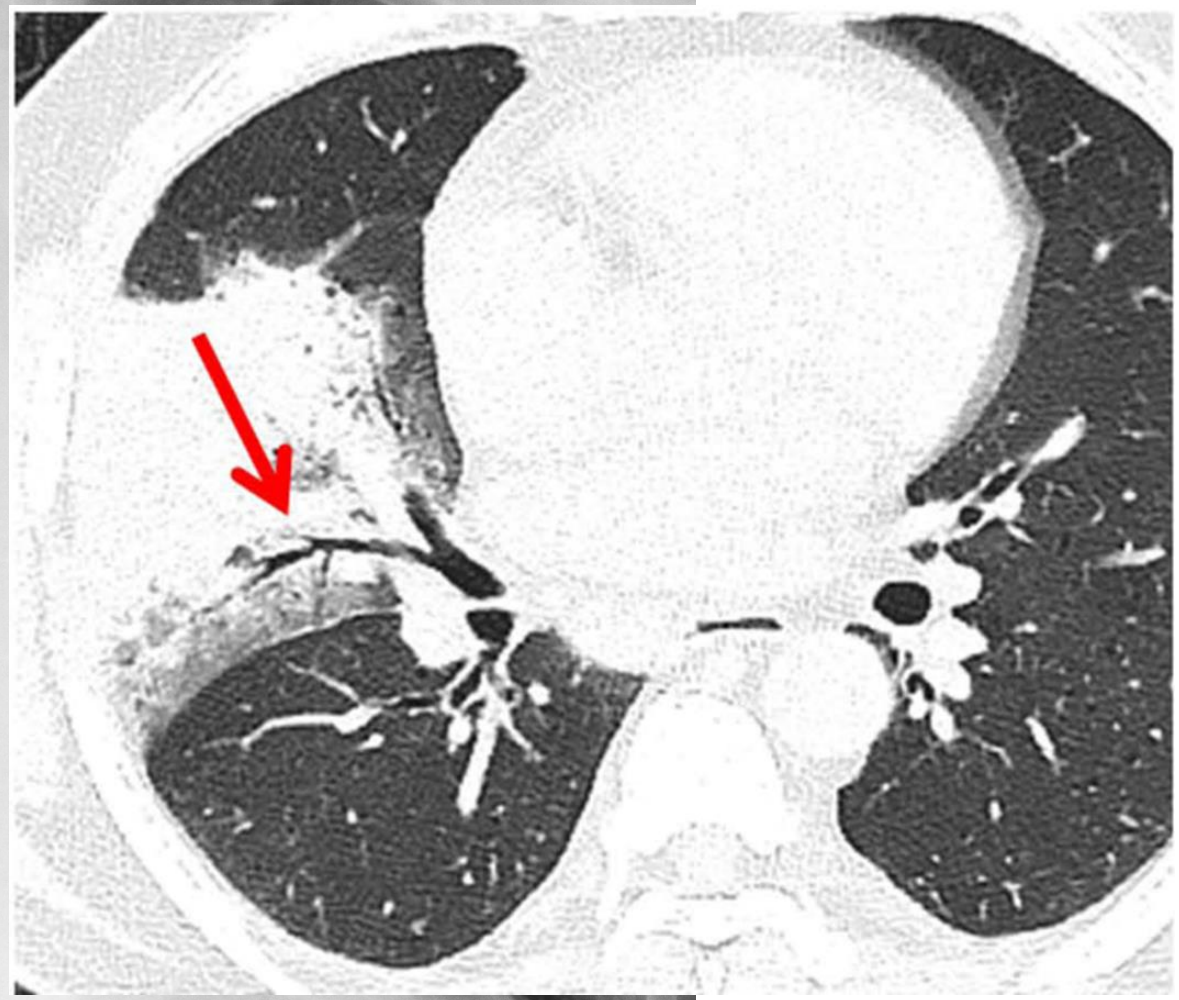
- WBC 14 K
- Creatinine 1.6 mg/dL (baseline 0.8)
- hs-cTNT 72 ng/l 85 ng/l (rule in >52 ng/l)

BT – 52



BT – 52





BT – 52 y. o. male

- Right middle lobe pneumonia
- Sputum and blood cultures
- Course of i.v ampicillin/sulbactam 3 g q6h and doxycycline 100 mg q12 h

BT – 52 y. o. male

- Cardiology consulted for positive hs Troponin

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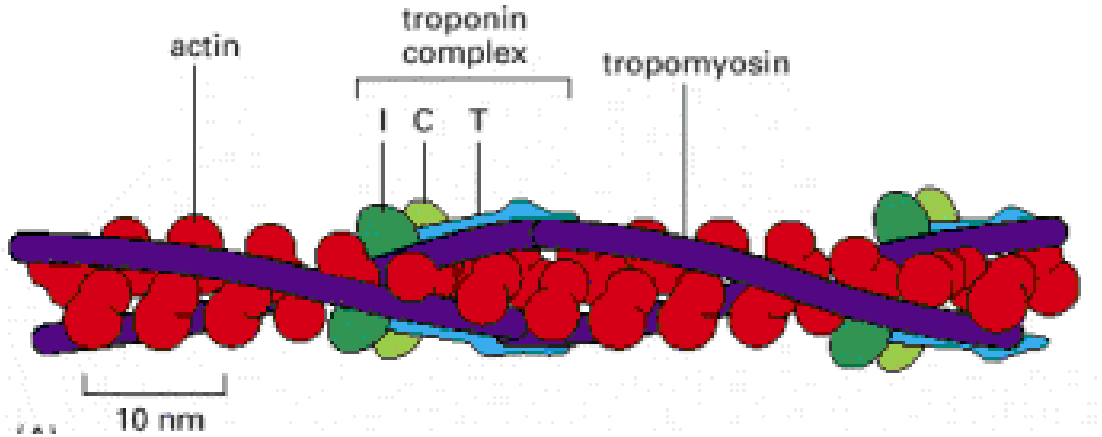
Troponin

– element of cardiac muscle that when detected in blood implies worse prognosis

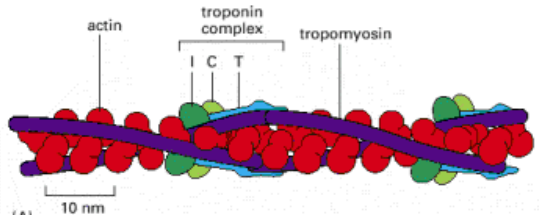
Troponin

- Associated with tropomyosin, which forms a continuous chain along each actin thin filament
- A complex of the three subunits:
  - TN-T: tropomyosin binding subunit

  TN-I: myosin ATPase inhibiting subunit
  - TN-C: calcium binding subunit



Troponin isoforms



- Troponin I and T are highly specific for myocardial injury
  - Levels in a healthy person are negligible
- cTnI indicates only cardiac troponin
- cTnT may cross-react with troponin found in other muscles
  - non-cardiac injury such as skeletal myopathies and with renal failure

High Sensitivity Troponin Assay

Limits of detection 10-20 fold lower than conventional assays.

0.01 ng/mL versus 0.003 ng/mL (3pg/mL)

Analytically precise

coefficient of variation < 10%.

Hammerer-Lercher et al. Journal of the American Heart Association 2013;113:1-11.

Cardiac troponin T by high sensitivity assay

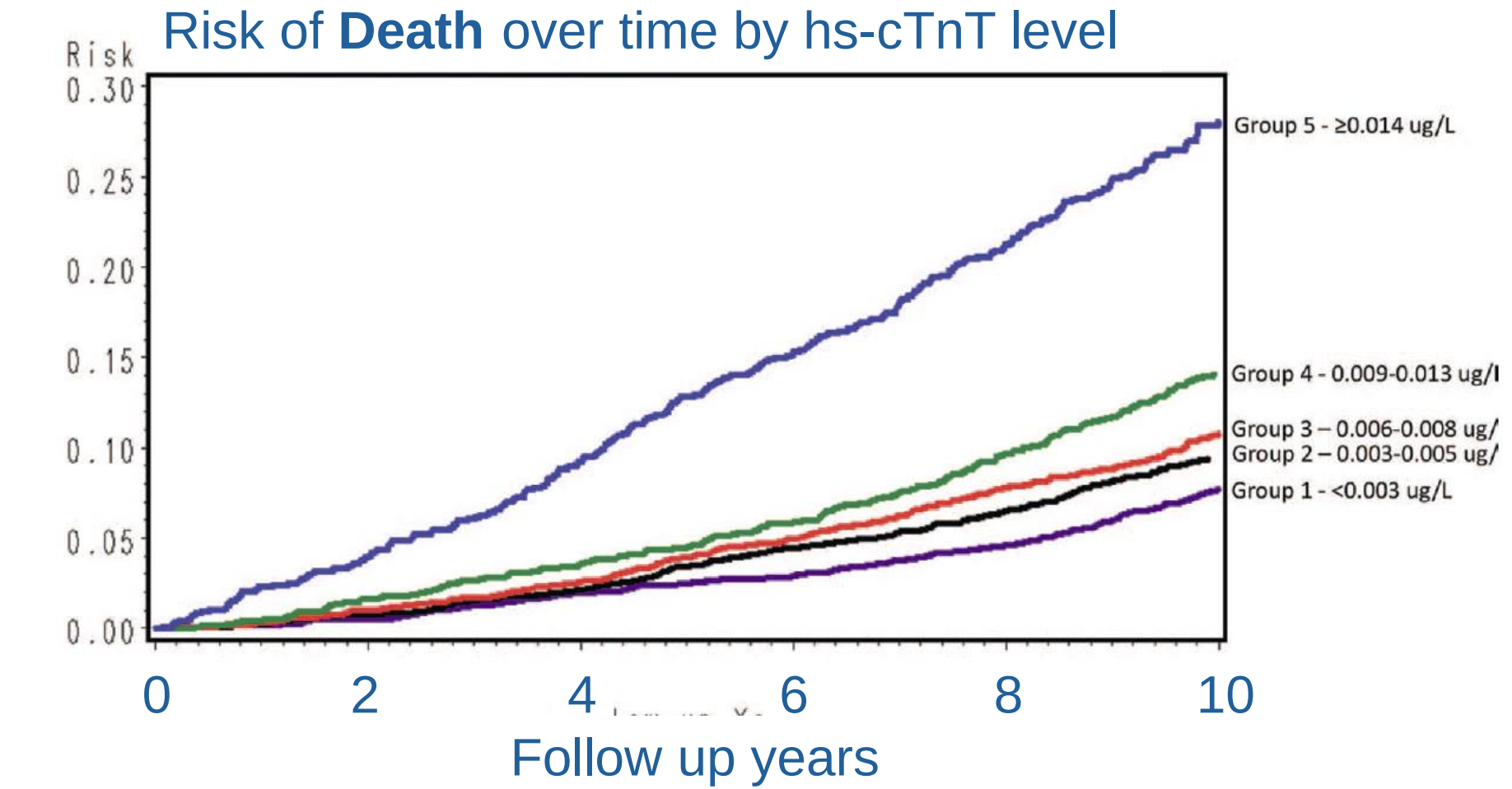
High sensitivity cardiac TnT >= 0.014 mcg/L

90^{th} percentile

99^{th} percentile specified by the manufacturer >= 0.052 mcg/L

HS- Troponin T Predicts Risk in ARIC Saunders. Circ 2011;123:1367-1376

Cardiac troponin T by high sensitivity assay ARIC study



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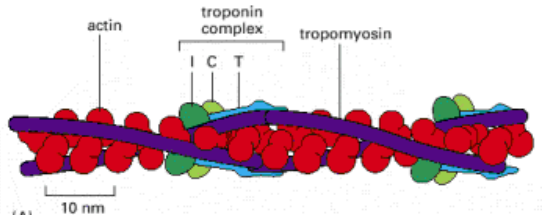
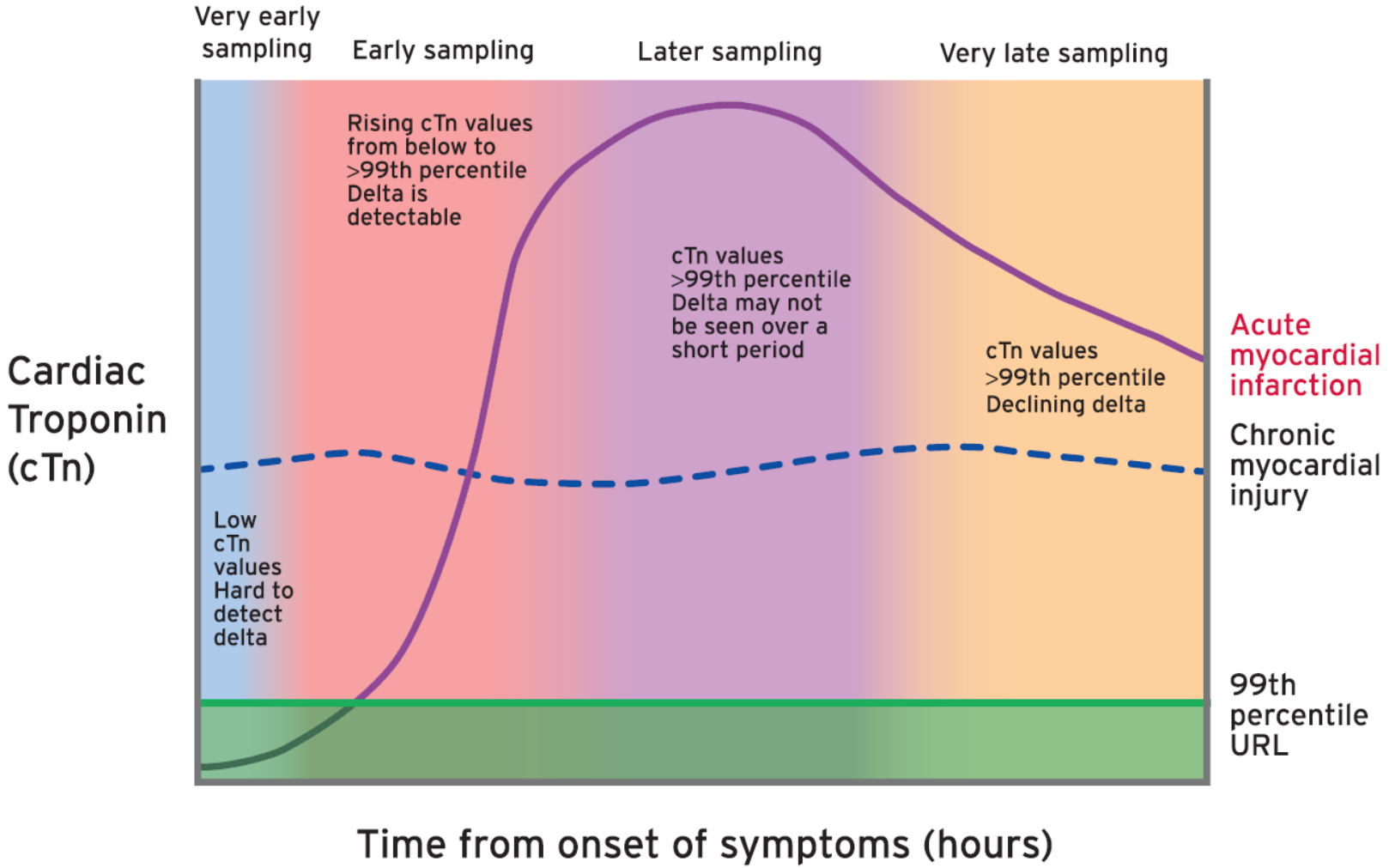
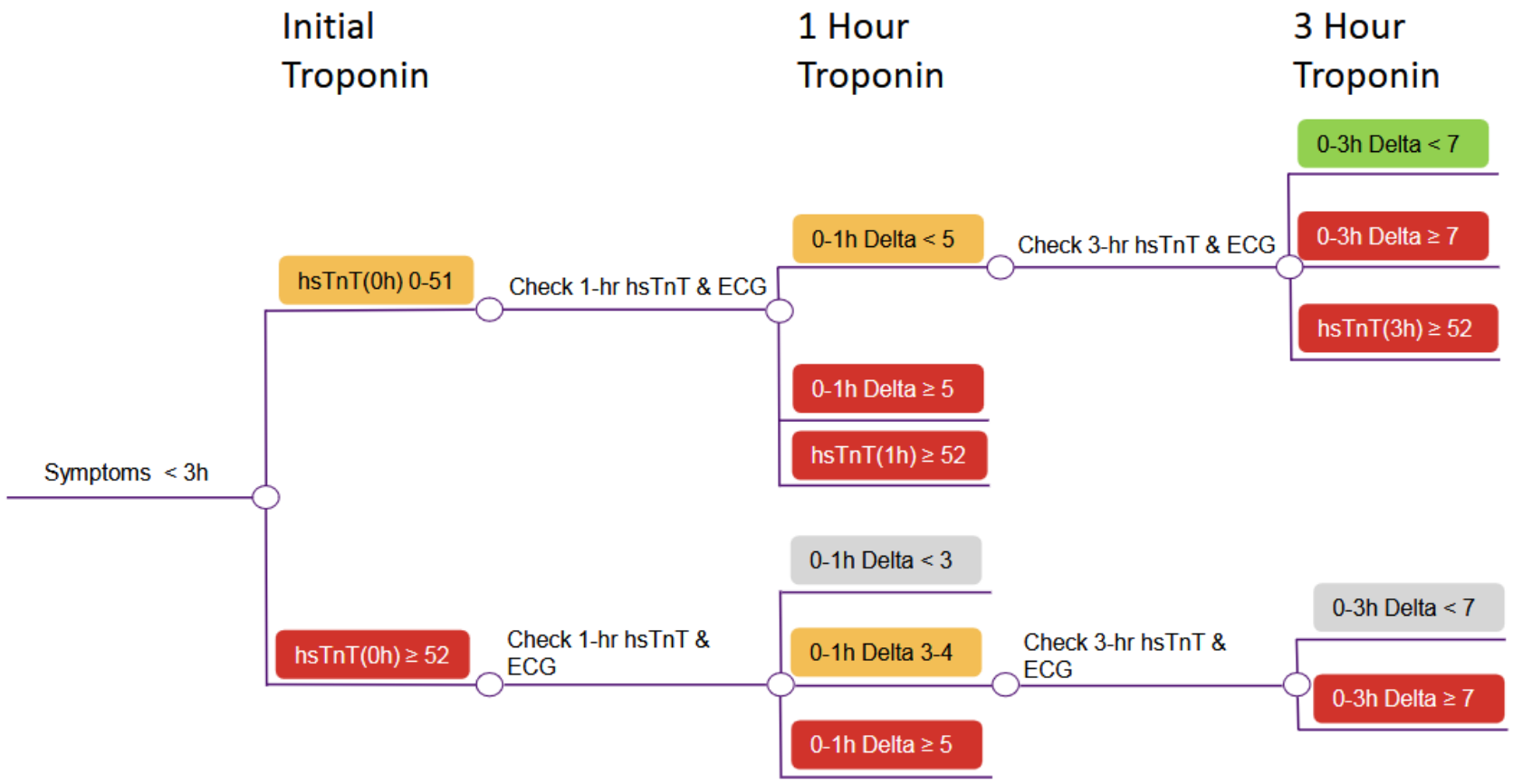
Troponin isoforms



Suspected acute coronary syndrome



ED Evaluation Using hs-TnT: Symptoms < 3 hours



hsTnT(0h) ≥ 52

0-1h Delta ≥ 5

Abnormal

Indeterminate

Ruled Out

No Acute Injury/MI

Duke Cardiology Algorithm

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EXPERT CONSENSUS DOCUMENT

Fourth Universal Definition of Myocardial Infarction (2018)

Kristian Thygesen,* *Denmark*
Joseph S. Alpert,* *USA*
Allan S. Jaffe, *USA*
Bernard R. Chaitman, *USA*
Jeroen J. Bax, *the Netherlands*
David A. Morrow, *USA*
Harvey D. White,* *New Zealand*

The Executive Group on behalf of the Joint European Society of Cardiology (ESC)/American College of Cardiology (ACC)/American Heart Association (AHA)/ World Heart Federation (WHF) Task Force for the Universal Definition of Myocardial Infarction

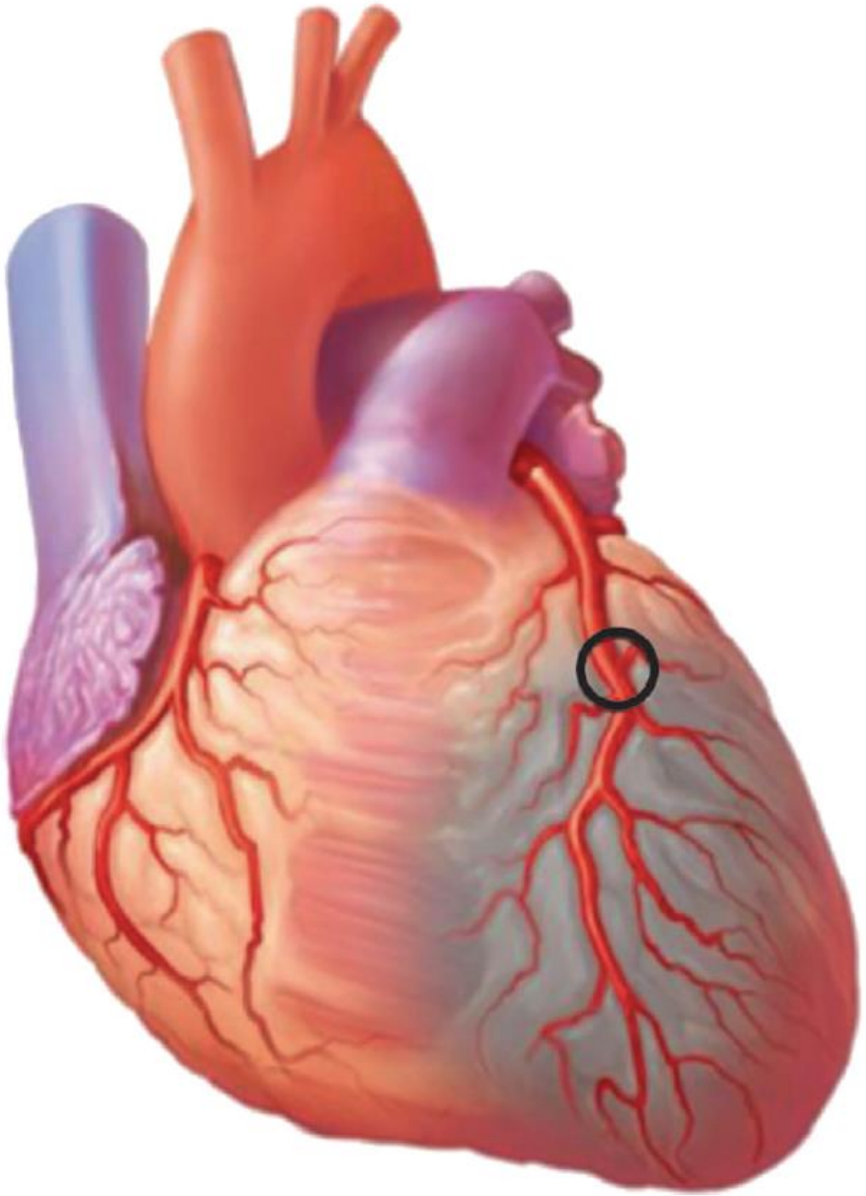
Circulation 2018;138:e618-e651

Types of MI

Type of MI	Characterization
 Type 1	Spontaneous plaque rupture, ulceration, fissuring, erosion, or dissection with resultant intraluminal thrombus, cessation of myocardial blood flow, and acute myocyte necrosis
 Type 2	Ischemic myocardial necrosis resulting from a marked increase in myocardial oxygen demand or a marked decrease in myocardial blood flow, occurring in the absence of acute plaque rupture or coronary thrombosis
Type 3	Sudden cardiac death related to coronary arterial thrombosis
Type 4	MI secondary to percutaneous coronary intervention • Myocardial infarction associated with percutaneous coronary intervention (type 4a) • Stent/scaffold thrombosis associated with percutaneous coronary intervention (type 4b) • Restenosis associated with percutaneous coronary intervention (type 4c)
Type 5	MI secondary to coronary artery bypass grafting

Circulation 2018;138:e618-e651

Criteria for Type 1 Myocardial Infarction



Plaque rupture/erosion with occlusive thrombus

Plaque rupture/erosion with non-occlusive thrombus

Circulation 2018;138:e618-e651

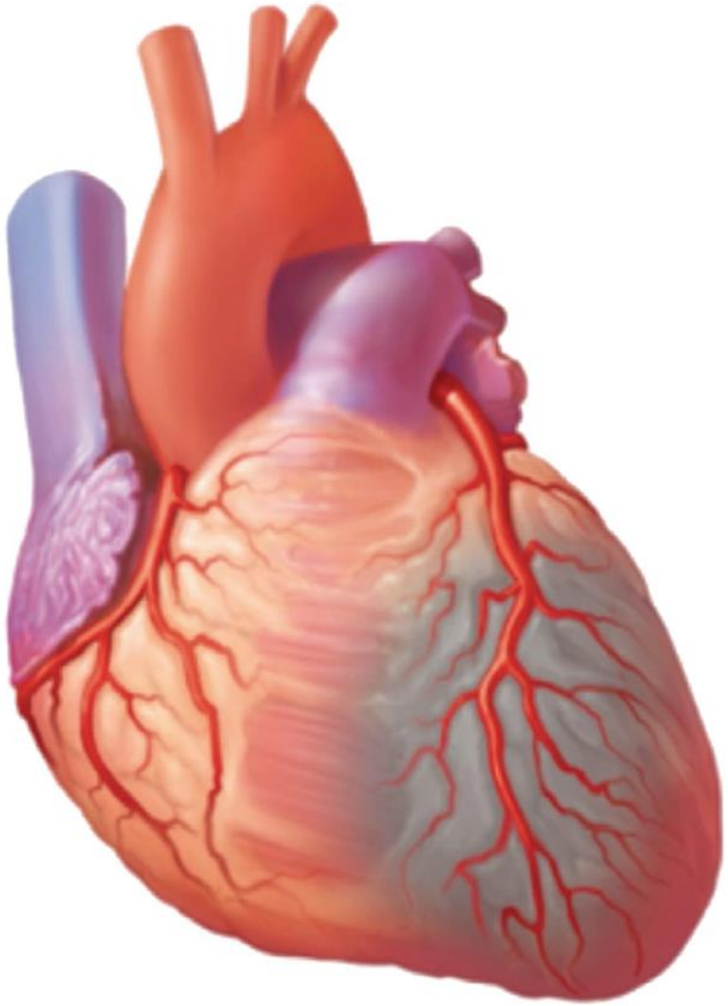
Criteria for Type 1 Myocardial Infarction

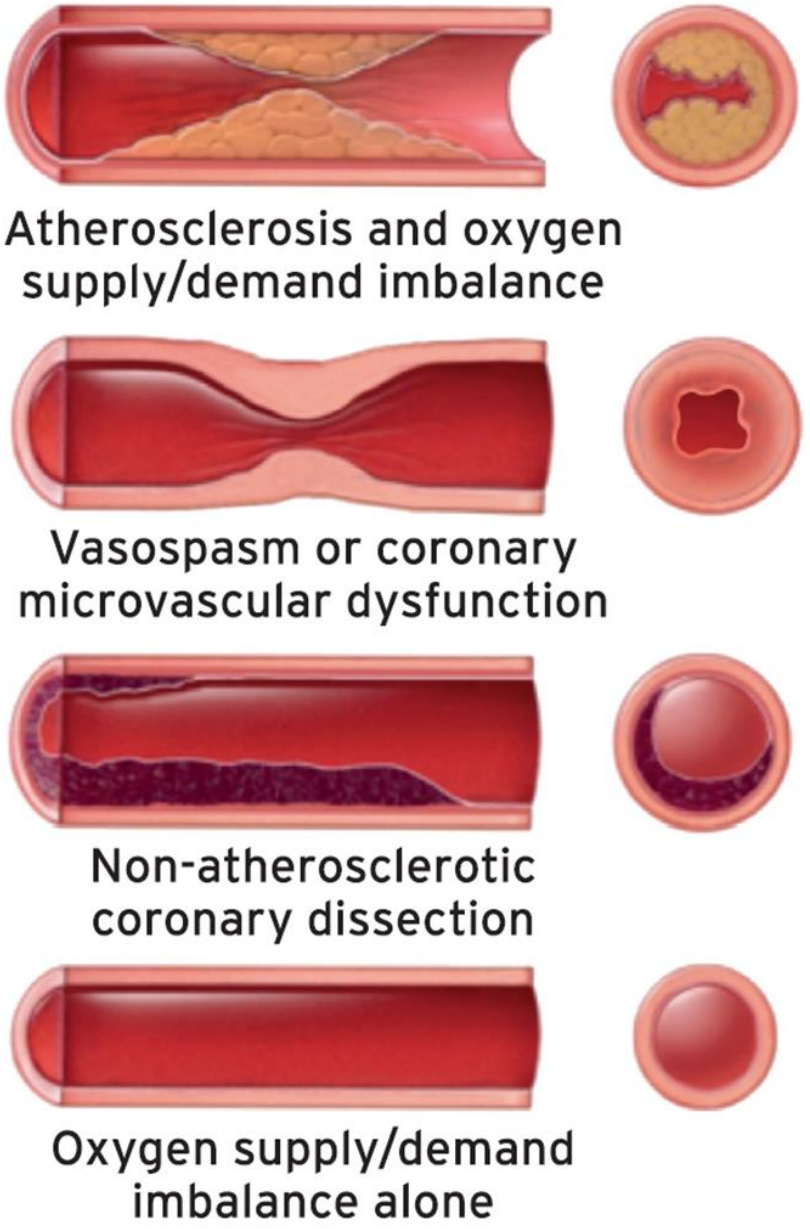
Detection of a rise and/or fall of cTn values with at least 1 value above the 99th percentile URL and with at least 1 of the following:

- Symptoms of acute myocardial ischemia;
- New ischemic ECG changes;
- Development of pathological Q waves;
- Imaging evidence of new loss of viable myocardium or new regional wall motion abnormality in a pattern consistent with an ischemic etiology;
- Identification of a coronary thrombus by angiography including intracoronary imaging or by autopsy.

Circulation 2018;138:e618-e651

Criteria for Type 2 Myocardial Infarction





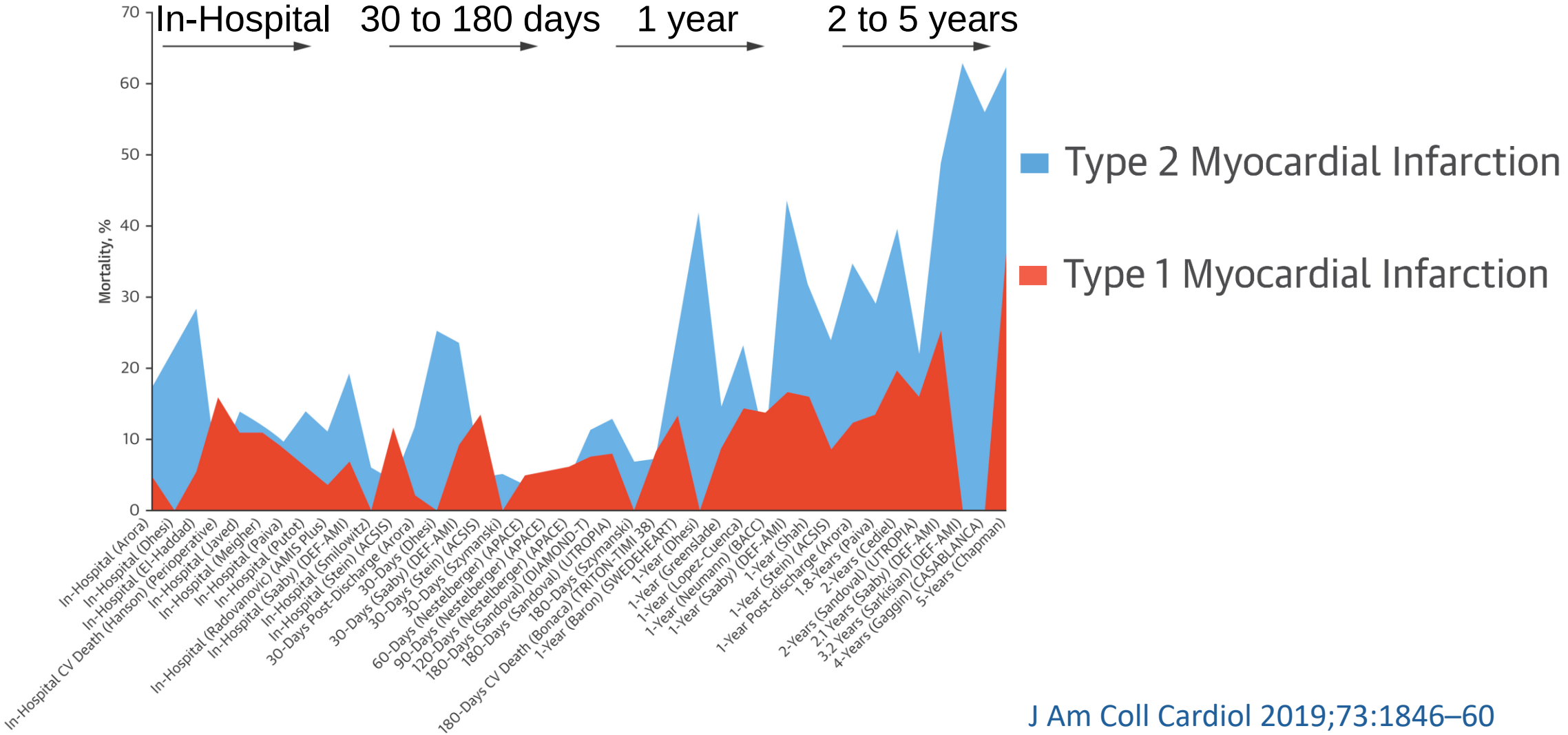
Criteria for Type 2 Myocardial Infarction

Detection of a rise and/or fall of cTn values with at least 1 value above the 99th percentile URL, and evidence of an imbalance between myocardial oxygen supply and demand **unrelated to acute coronary atherothrombosis**, requiring at least 1 of the following:

- Symptoms of acute myocardial ischemia;
- New ischemic ECG changes;
- Development of pathological Q waves;
- Imaging evidence of new loss of viable myocardium or new regional wall motion abnormality in a pattern consistent with an ischemic etiology

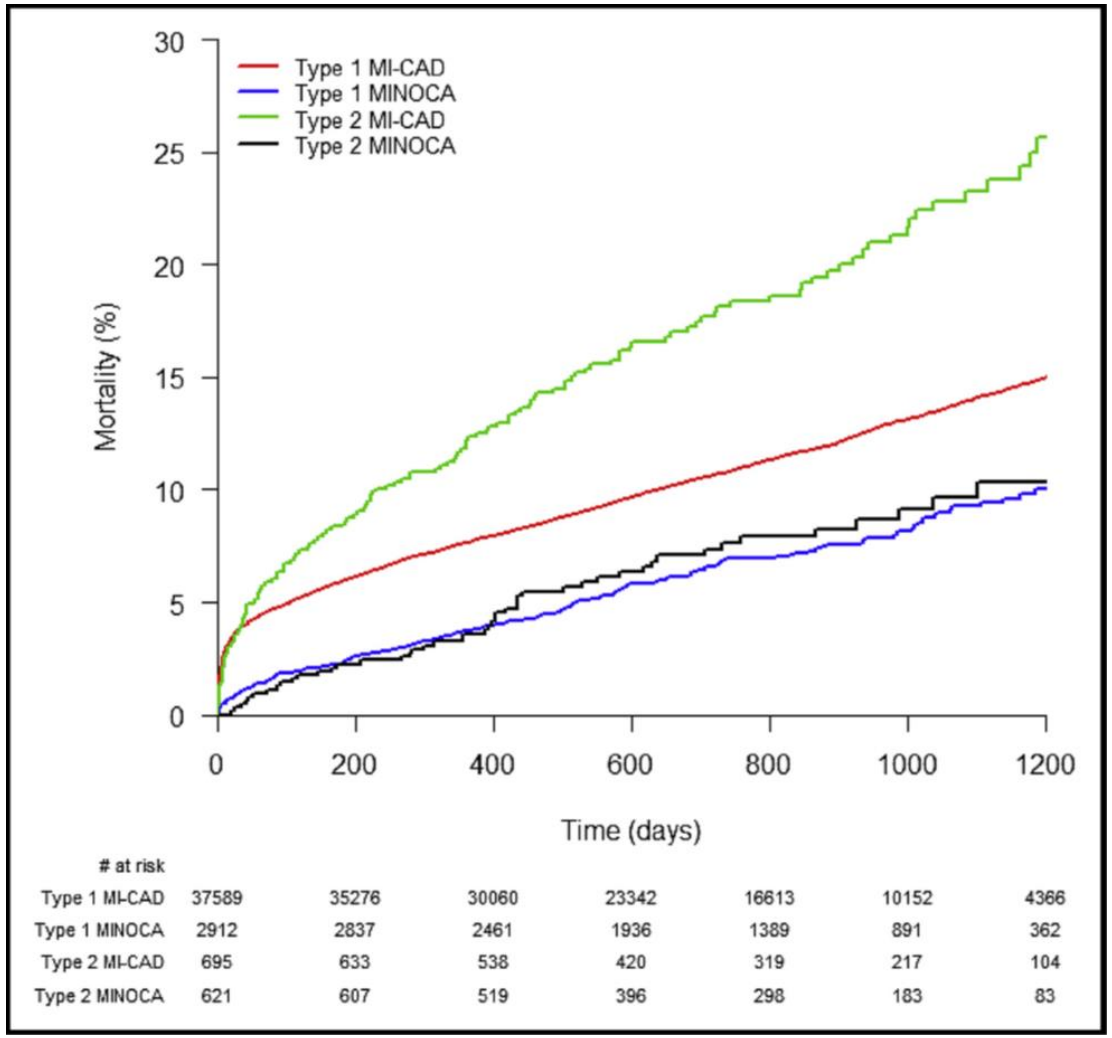
Circulation 2018;138:e618-e651

Risk of death by Type 1 (red) or Type 2 (blue) Myocardial Infarction



J Am Coll Cardiol 2019;73:1846–60

Risk of death by Type 1 or Type 2 Myocardial Infarction With or without coronary artery disease



Type 2 CAD

Type 1 CAD

Type 1 No CAD
Type 2 No CAD

SWEDEHEART, American J Med (2016) 129, 398-406

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Type 1 myocardial infarction

- Spontaneous *plaque rupture* with resultant thrombus and cessation of blood flow leading to myocardial necrosis
- *Timely* mechanical and pharmacological *interventions* lower mortality and complications

Type 2 myocardial infarction

- Myocardial necrosis from marked increase in oxygen demand or decrease in oxygen delivery, in the *absence of plaque rupture* / coronary thrombosis

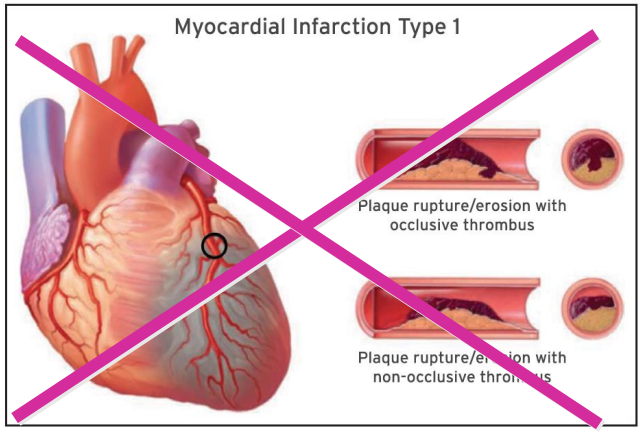
Elevated troponin approach

Confirm that the patient is not having myocardial ischemia related to coronary artery plaque rupture (Type 1)

Myocardial infarction symptoms

Concerning ECG findings

- ST segment elevation
- Dynamic ST or T wave changes



New focal wall motion abnormalities by echocardiography

Clinical setting for demand supply mismatch and not acute coronary syndrome

Type 2 MI / elevated troponin approach

Recognize that the patient may be sicker and at higher risk

Optimize therapies to improve tissue perfusion and decrease oxygen demand

O2 sat >=90%

Blood pressure mean above 60

Hematocrit >=25

Other treatments like beta blockers and pain or anxiety medications when indicated

Treat underlying illness

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Accurate coding for Type 2 Myocardial Infarction (I21.A1) Why does it matter

Incorrectly coding nonischemic myocardial injury as a NSTEMI results in penalization for outcomes that cannot be altered by evidence-based interventions

Hospital Readmissions Reduction Program penalizes hospitals for AMI diagnosis readmissions

- T2MI excluded in FY2023.
- Must code diagnosis as 121.Al instead of other NSTEMI codes to avoid penalization

Hospital Value-Based Purchasing Program includes Mortality domain that includes AMI diagnosis

- T2MI has not been included in the codes for AMI mortality since 2020.
- Must code diagnosis as 121.A1 instead of other NSTEMI codes to avoid penalization.

Accurate coding for Type 2 Myocardial Infarction (I21.A1) Why does it matter

- Must specify cause

  Type 2 MI (I21.A1) due to _____.

- May never be a principal diagnosis
- Requires clinical evidence of ischemia (at least 1)

  Symptoms of myocardial ischemia

  New EKG evidence of ischemia

  New pathologic Q waves

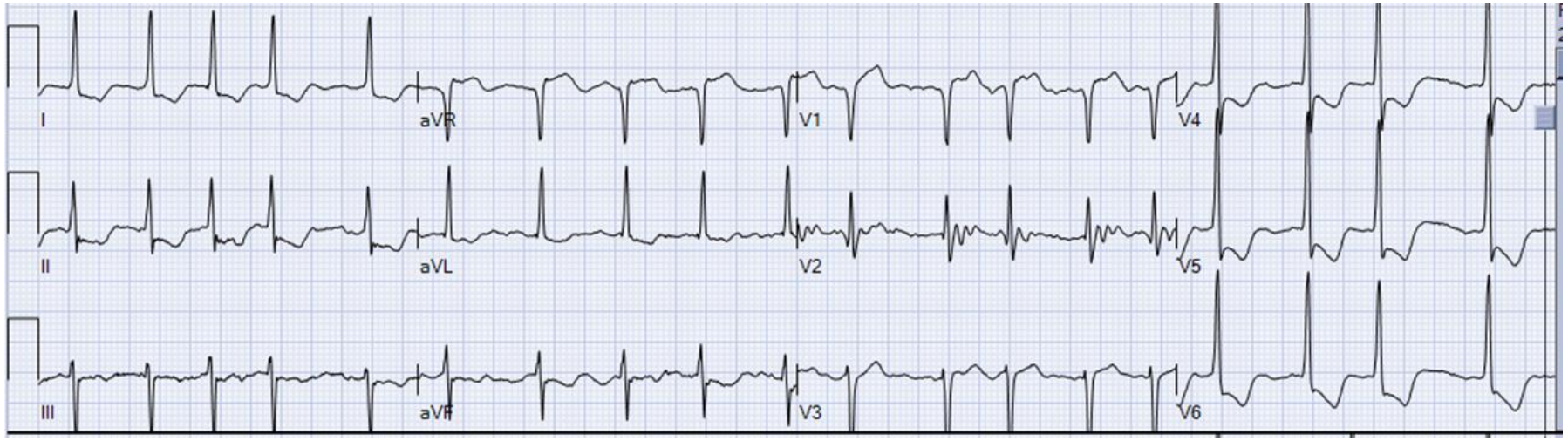
  New imaging evidence (e.g. regional wall motion abnormality)

BT – 52 y. o. male

- Cardiology consulted for positive hs Troponin
- By presentation, clinical findings, and imaging, Cardiologist did not believe the patient met criteria for acute coronary thrombosis / acute coronary syndrome treatment
- Elevated troponin attributed to myocardial necrosis from marked increase in oxygen demand or decrease in oxygen delivery with pneumonia, hypotension, hypoxia

BT – 52 y. o. male

Initial ECG

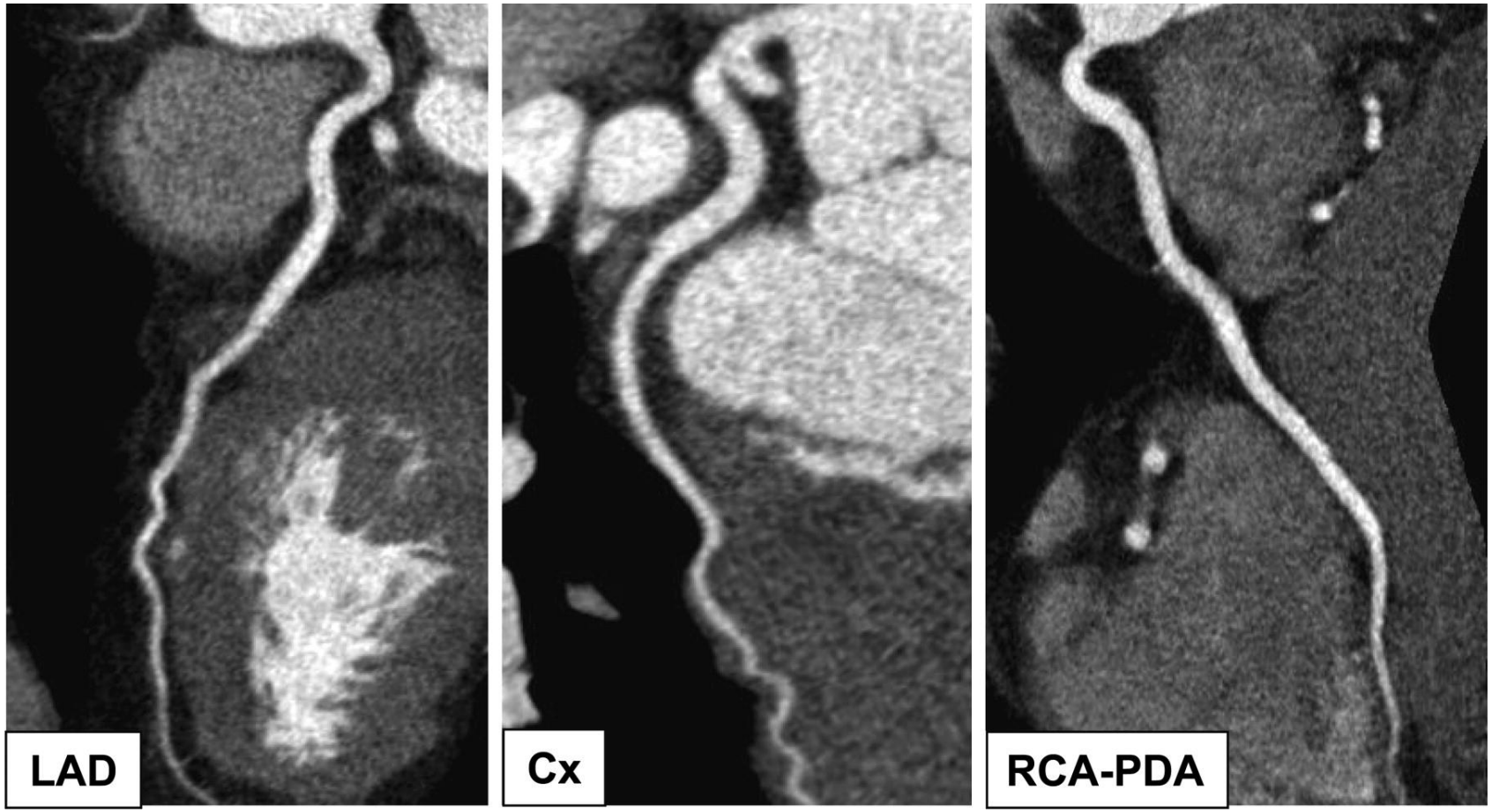


Third ECG

BT – 52 y. o. male

- Cardiology consulted for positive hs Troponin
- By presentation, clinical findings, and imaging, Cardiologist did not believe the patient met criteria for acute coronary thrombosis / acute coronary syndrome treatment
- Elevated troponin attributed to myocardial necrosis from marked increase in oxygen demand or decrease in oxygen delivery with pneumonia, hypotension, hypoxia
- Coronary artery CT obtained as outpatient negative for coronary disease

BT – 52 y. o. male



BT – 52 y. o. male

Coded as

Type 2 MI (I21.A1) due to Pneumonia due to other specified bacteria (J15.8)

Type 1 and Type 2 Myocardial Infarction Conclusions

Troponin is an element of cardiac muscle

when detected in blood implies worse prognosis.

Type 1 and Type 2 Myocardial Infarction Conclusions

Type 1 myocardial infarction

- Spontaneous *plaque rupture* with resultant thrombus and cessation of blood flow leading to myocardial necrosis
- *Timely* mechanical and pharmacological *interventions* lower mortality and complications

Type 1 and Type 2 Myocardial Infarction Conclusions

Type 2 myocardial infarction

- Myocardial necrosis from marked increase in oxygen demand or decrease in oxygen delivery, in the *absence of plaque rupture* / coronary thrombosis
- Treatment involves supportive therapy and treating the underlying cause

Type 1 and Type 2 Myocardial Infarction Conclusions

In documenting Type 2 myocardial infarction

There must be clinical evidence of ischemia, and the cause must be specified.

Properly specifying Type 2 myocardial infarction excludes patients from AMI mortality calculations

and from readmission penalties.

Troponin

– element of cardiac muscle that when detected in blood implies worse prognosis

Type 1 myocardial infarction

- Spontaneous *plaque rupture* with resultant thrombus and cessation of blood flow leading to myocardial necrosis
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Type 2 myocardial infarction

- Myocardial necrosis from marked increase in oxygen demand or decrease in oxygen delivery, in the *absence of plaque rupture* / coronary thrombosis