Chest Pain and Troponin Evaluation

Niteen Milak, MD
Upper Chesapeake Cardiology
Learning Objectives

- Case Study in chest pain
- How to interpret troponin values
- False positive, False negative Troponin
- Review DDx of troponin elevation
Case

- Chief complaint: Chest pain
- 76yo M with no prior cardiac history
- Presents with substernal chest pain: it is nonexertional, radiates to left arm
- Risk factors are dyslipidemia
- Told wife who brought to HMH
- Pain resolves with NTG and pain meds
Case #1, continued

- PMH: cholesterol, GERD, anxiety, TIA, BPH, esophageal dilatation
- PSH: Inguinal hernia, age 22
- Medication: Zocor, Celexa, ASA
- NKDA
- SH: No smoking, No alcohol, married
- FH: No premature CAD
Case #1, continued

- 136/72 P84 R24 SpO2=99%RA
- Pleasant, conversant, NAD
- JVP<8cm H2O, no bruits
- CTA, no crackles
- RRR, no murmurs gallops or rubs
- Warm extremities without edema
Case #1, continued

- CXR: wnl
- EKG: normal sinus rhythm, normal ekg
- Labs: Hg12, Trop neg x3, K+ 3.7, LDL 78
- Echo 2013 EF 60%
Case #1, summarized

- This is a 76 yo patient with a good story of chest pain, however also has anxiety, Ge reflux, esophageal dilatation, and poor historian
- Ekg and 3 Troponins normal
Case #1: What do you do?

1) Discharge home with same day cardiac clinic follow-up
2) Admit to telemetry; rule out for MI with troponin; if rules out, obtain stress test in AM
3) Stat cardiac catheterization, overnight PA's recommendation
4) Wheel pt to personally owned outpatient stress nuclear facility in afternoon (health insurance dependant)
Hospital Course

- At 8 AM, prior to nuclear stress test injection, pt develops 10/10 c pain.
- Nurse notes transient st elevation and NSVT on monitor and calls cardiologist
- EKG and am stat troponin still normal
Date/Time

Cardiology

10/13/16

Distal 056461 11/12

8AM

76yo 10 wks. Paid 6cm L Anxiety 7AM 03

11 8AM

0Cardiac 40 Angina

Revision
STEMI Protocol Activated

Pt helicoptered to UMMS cath lab
Evidence-Based, Outcome-Effective Management of Acute Coronary Syndrome

Management of ST-Elevation Myocardial Infarction

Patient Presents with Chest Pain or Potential Chest Pain Equivalent
(Jaw, shoulder, arm, back or epigastric pain; unexplained dyspnea; syncope; or palpitations, etc.)

Inpatient UCMC

Chest Pain Assessment
Alert STEMI Rapid Response Team

Prompt 12-lead ECG
Within 5 minutes of onsite/arrival

ST-Segment Elevation or New LBBB or Evidence of Acute Posterior MI
Intensivist notifies Interventional Cardiologist (IC) @ 1-800-985-4367 and page on-call IC
STEMI confirmed by IC, ICU Charge Nurse notifies Cath Team via pager 410-434-3454
ICU Charge Nurse notifies Bed Coordinator/AC at 4099

Assessment & Stabilization

- Intravenous access times 2
- Oxygen and pulse oximetry
- Continuous ECG monitoring
- Send identified labs per order set

Pharmacologic Intervention

- Aspirin three (3) 81 mg p.o. now, if not contraindicated
- Aspirin 81 mg p.o. now – preferred dose if on Plavix
- Nitroglycerin SL/IV for ischemic pain
- Beta-blocker if not contraindicated
- Heparin Bolus and continuous infusion
- Integrim
- Morphine sulfate for immediate relief of pain

Cath Lab and Personnel available to meet Door to Wire time of less than 90 Minutes

STEMI Rapid Response Team:
ICU Nurse,
Intensivist, or NP/PA,
IV Therapy,
EKG Tech 7A-11P
OR
ICU Tech 11P-7A
UM Upper Chesapeake Health
STEMI Initial Treatment

Page 1 of 3

Date: ____________ Time: ____________

STEMI Protocol Initiation Order & Times
- Communication order: Initiate STEMI protocol: page STEMI team at 410-588-0133;
- time of page: ____________ time interventionalist called: ____________; time to cath lab: ____________

Contrast Allergy Question
- CONTRAST ALLERGY
  - NO
  - YES (If "YES" contrast allergy medication required - see the Medications section)

Admission
- ED Provider notify intensivist, x4034
- Communication order ED RN: Notify admitting at x2300 to change to IP status
- Status
  - Admit as Inpatient
- Bed Type
  - ICU
- Attending: ____________

Cardiac Monitoring
- Cardiac monitor CONTINUOUSLY Indication: ____________

Diet
- NPO except medications and sips of water

Laboratory - STAT
- Complete blood cell count with manual white blood cell differential
- DIFFERENTIAL MANUAL
- Troponin-I (CKMB & CK-Total are automatically ordered for all Troponin I positive results)
- Prothrombin time (PT) and international normalized ratio (INR)
- Partial thromboplastin time (PTT), activated
- Comprehensive metabolic panel
- Magnesium (Mg) level, serum
- Beta human chorionic gonadotropin (beta-HCG), serum quantitative (If female, pre-menopausal without prior hysterectomy or tubal ligation)

Imaging/Diagnostic Tests
- 12-lead ECG within 5 minutes of arrival; repeat if ongoing chest pain or if condition changes
- Radiograph, chest, 1 view Portable
- CT, chest, WITH contrast reason: R/O aortic dissection
- CT, chest, without contrast reason: R/O aortic dissection
- MRI, chest, WITH contrast reason: R/O aortic dissection
- MRI, chest, without contrast reason: R/O aortic dissection

Respiratory
- Oxygen via nasal cannula 2 liters/minute, titrate to keep SaO2 greater than 94%

Nursing Interventions
- Pulse oximetry continuous
- Notify provider if: Increase in intensity of pain, Heart rate less than 50, Dysrhythmia
- Systolic BP greater than 185 or less than 90, Diastolic BP greater than 105
- Communication order: Give education materials and resources to patient/family

IV Fluids
- Med Lock: Insert two (2) Med locks (no less than 20 gauge, if possible)

Authorized Prescriber Signature: ____________________________ Date: ____________ Time: ____________

* 11SSTEMI 03/15
# UM Upper Chesapeake Health
## STEMI Initial Treatment

### IV Fluids

| NS IV at ________ mL/hr, start on call to Cath Lab |

### Medications

#### Antipatelet Agents

- **Aspirin chewable 243 mg PO now (unless allergy to aspirin or already given by EMS or taken at home)**
- **Aspirin given:**
  - [ ] in ED
  - [ ] by EMS
  - [ ] at home
  - [ ] Date/Time: __________

**Contraindications to Aspirin on arrival:**
- [ ] terminal care, no further treatment
- [ ] peptic ulcer
- [ ] clotting disorder
- [ ] bleeding disorder
- [ ] history of GI bleed
- [ ] aspirin allergy
- [ ] other: __________

- **Clopidogrel (PLAVIX) 600 mg orally now, unless already on PLAVIX; time given/taken at home:**
  - [ ] Do not give clopidogrel in STEMI patients with high probability to proceed for CABG

- **Ticagrelor (BRILINTA) 180 mg PO times 1 now (loading dose); unless already on BRILINTA; time given/taken at home:**
  - [ ] Do not give ticagrelor (BRILINTA) in STEMI patients with high probability to proceed for CABG

### Bivalirudin (ANGIOMAX) Dosing

- **Communication order: to determine weight-based dose, refer to "BIVALIRUDIN (ANGIOMAX) DOSING TABLE" (click link or view at end of order set)**
- **Bivalirudin (ANGIOMAX) Bolus**
  - [ ] Bivalirudin (ANGIOMAX) Concentration: 250mg/50mL (5 mg/mL)
  - 0.75 mg/kg IV push times 1 dose BOLUS (taken from IV bag)

- **Bivalirudin (ANGIOMAX) Continuous IV Infusion**
  - Concentration: 250mg/50mL (5 mg/mL): [check ONE of the following doses according to renal function]
    - [ ] 1.75 mg/kg per hour continuous IV infusion for creatinine clearance 30 mL/minute or greater
    - [ ] 1 mg/kg per hour continuous IV infusion for creatinine clearance 10-29 mL/minute
    - [ ] 0.25 mg/kg per hour continuous IV infusion for creatinine clearance less than 10 mL/minute or on dialysis

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VORB Signature: __________________________ Initials: ______ Date: ______ Time: ______

VORB Signature: __________________________ Initials: ______ Date: ______ Time: ______

**Authorized Prescriber Signature**

11SSTEMI 03/15 (for verbal/telephone orders)
UM Upper Chesapeake Health
STEMI Initial Treatment (Page 3 of 3)

<table>
<thead>
<tr>
<th>Eptifibatide (INTEGRILIN) Dosing</th>
<th>VORB (Initials)</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication order: to determine weight-based dose, refer to &quot;EPTIFIBATIDE (INTEGRILIN) DOSING TABLE&quot; (click link or view at end of order set) Source</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ eptifibatide (INTEGRILIN) BOLUSES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Concentration 2mg/ml in 10 ml vial): 180 microgram/kg IV times 2 BOLUSES, 10 minutes apart</td>
<td></td>
<td></td>
</tr>
<tr>
<td>eptifibatide (INTEGRILIN) CONTINUOUS IV infusion</td>
<td></td>
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<tr>
<td>(Premix concentration 75 mg/100 mL): [Check one of the following doses according to renal function]:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ 2 microgram/kg per minute continuous intravenous infusion if Creatinine Clearance is 50 mL/min or greater; begin infusion after first eptifibatide bolus. Discontinue infusion in _____ hours.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ 1 microgram/kg per minute continuous intravenous infusion if Creatinine Clearance is less than 50 mL/min; begin infusion after first eptifibatide bolus; Discontinue infusion in _____ hours.</td>
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<table>
<thead>
<tr>
<th>Nitrates</th>
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<tbody>
<tr>
<td>□ nitroglycerin 0.4 mg SL every 5 minutes PRN chest pain times 3; notify prescriber if no relief (first line therapy)</td>
<td></td>
</tr>
<tr>
<td>□ nitroglycerin IV infusion; start at 5 microgram/minute IV; titrate every 5 minutes by increments of 5 micrograms/minute to achieve relief of chest pain and maintain systolic BP greater than 100 mm Hg</td>
<td></td>
</tr>
<tr>
<td>□ nitroglycerin paste _________ inch applied topically 3 times a day</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Narcotic Analgesic</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>□ morphine ________mg IV push every _______ minutes, PRN chest pain if no relief after 3 doses nitroglycerin sublingual (HOLD FOR SEDATION AND RESPIRATORY DEPRESSION)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heparin Dosing</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>□ heparin 60 unit/kg IV BOLUS equals _______ units (maximum bolus is 4,000 units)</td>
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</table>

<table>
<thead>
<tr>
<th>Contrast Allergy</th>
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<tbody>
<tr>
<td>□ methylPREDNISolone (SOLUMEDROL) 40 mg IV STAT 1 hour prior to procedure and every 4 hours until procedure is complete</td>
<td></td>
</tr>
<tr>
<td>□ Other steroid order STAT:</td>
<td></td>
</tr>
<tr>
<td>[If high dose steroid is ordered, recommend FSBS after Contrast procedure]</td>
<td></td>
</tr>
<tr>
<td>□ diphenhydRAMINE (BENADRYL) 50 mg IV 1 hour prior to procedure</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Other Medication Orders &amp; Reminders</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>□ If patient is on metformin, HOLD METFORMIN for 48 hours post catheterization. (Reassess renal function prior to restarting metformin)</td>
<td></td>
</tr>
<tr>
<td>● All NSAIDs, with the exception of aspirin, should be discontinued at the time of presentation and should not be administered during hospitalization</td>
<td></td>
</tr>
<tr>
<td>● Utilize Subcutaneous Insulin or IV Insulin order sets to order glucose management protocols</td>
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<thead>
<tr>
<th>VORB Signature:</th>
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<td>115STEMI 03/15*</td>
<td></td>
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Cath Film
Troponin is a diagnostic test

- You know how to interpret a diagnostic test.
- You start with a pre-test probability.
- (If it’s really low or really high, you don’t get the test.)
- If it’s intermediate, you get the test.
- Afterward, you have a post-test probability. You act on the result.
A diagnostic test has a receiver-operator curve.
The Most Important Point

- Troponin is a diagnostic test
- To help determine whether acute coronary syndrome is present
- It can have false positives and false negatives
Acute Coronary Syndrome (ACS)

- Also known as coronary artery plaque rupture

- This is the condition we were worried about in the case: We were concerned that the patient could have ACS with atypical symptoms
Acute coronary syndrome

- Plaque with fibrous cap
- Cap ruptures
- Blood clot forms around the rupture, blocking the artery
Table 2. Diagnostic Performance of Cardiac Troponin Assays at Presentation.

<table>
<thead>
<tr>
<th>Troponin Assay</th>
<th>Sensitivity</th>
<th>Specificity (percent) (95% confidence interval)</th>
<th>Negative Predictive Value (percent) (95% confidence interval)</th>
<th>Positive Predictive Value (percent) (95% confidence interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensitive troponin assays</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abbott–Architect Troponin I</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limit of detection, 0.010 μg/liter</td>
<td>94 (88–97)</td>
<td>87 (84–89)</td>
<td>98 (97–99)</td>
<td>59 (52–66)</td>
</tr>
<tr>
<td>99th percentile, 0.028 μg/liter</td>
<td>86 (79–92)</td>
<td>92 (90–94)</td>
<td>97 (95–98)</td>
<td>69 (61–76)</td>
</tr>
<tr>
<td>10% coefficient of variation, 0.032 μg/liter</td>
<td>85 (77–90)</td>
<td>93 (90–95)</td>
<td>97 (95–98)</td>
<td>70 (62–78)</td>
</tr>
<tr>
<td>Roche High-Sensitive Troponin T</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Limit of detection, 0.002 μg/liter</td>
<td>100 (97–100)</td>
<td>14 (12–18)</td>
<td>100 (96–100)</td>
<td>19 (16–23)</td>
</tr>
<tr>
<td>99th percentile, 0.014 μg/liter</td>
<td>95 (90–98)</td>
<td>80 (77–83)</td>
<td>99 (97–100)</td>
<td>50 (43–56)</td>
</tr>
<tr>
<td>Roche Troponin I</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limit of detection, 0.100 μg/liter</td>
<td>92 (86–96)</td>
<td>88 (86–91)</td>
<td>98 (97–99)</td>
<td>62 (55–69)</td>
</tr>
<tr>
<td>99th percentile, 0.160 μg/liter</td>
<td>84 (76–90)</td>
<td>94 (91–95)</td>
<td>97 (95–98)</td>
<td>73 (65–80)</td>
</tr>
<tr>
<td>10% coefficient of variation, 0.300 μg/liter</td>
<td>75 (66–82)</td>
<td>97 (95–98)</td>
<td>95 (93–97)</td>
<td>83 (75–89)</td>
</tr>
<tr>
<td>Siemens Troponin I Ultra</td>
<td></td>
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</tr>
<tr>
<td>Limit of detection, 0.006 μg/liter</td>
<td>97 (91–99)</td>
<td>68 (64–72)</td>
<td>99 (97–100)</td>
<td>38 (32–44)</td>
</tr>
<tr>
<td>99th percentile, 0.040 μg/liter</td>
<td>89 (82–94)</td>
<td>92 (89–94)</td>
<td>98 (96–99)</td>
<td>68 (60–76)</td>
</tr>
<tr>
<td><strong>Standard assay</strong></td>
<td></td>
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</tr>
<tr>
<td>Roche Troponin T 4th Generation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>99th percentile, unknown</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limit of detection, 0.010 μg/liter</td>
<td>83 (76–90)</td>
<td>93 (91–95)</td>
<td>97 (95–98)</td>
<td>72 (64–79)</td>
</tr>
<tr>
<td>10% coefficient of variation, 0.035 μg/liter</td>
<td>72 (64–80)</td>
<td>97 (96–98)</td>
<td>94 (92–96)</td>
<td>85 (76–91)</td>
</tr>
</tbody>
</table>

* The criterion of 10% coefficient of variation was fulfilled at the 99th percentile.
Your patient has a single negative troponin value.

- When should you check troponin again?
- (Remember, you’re trying to rule out acute coronary syndrome.)
If negative at presentation, check troponin again at least 2 hours after onset of symptoms

Your inpatient has ruled out. When to check troponin again?

- Unless the patient has an episode that raises concern for ACS:

  Do not check troponin again.

(If you do, you’re using the assay in a way that nobody ever intended.)
Your inpatient has ruled in. When to check troponin again?

It takes about a week for troponin level to return to normal after ACS.

Short answer: Do not check again during this hospitalization.

(Longer answer: If there is new concern for ACS one week after ruling out, then check again then.)
Troponin confusion hall of fame

- “If the troponin is positive, that means you need to start heparin.”
- “Isn’t there a new type of MI called a ‘Type 2 Myocardial Infarction,’ and this is the same as demand ischemia?”
- “But where is the troponin coming from if it’s not coming from the heart?”
“Type 2 Myocardial Infarction”

- This is not a clinically helpful concept
- It does not help you think through how to manage your patient

- Slightly useful in research studies
- Very useful to the patient billing office—we get reimbursed well for MI
Myocardial Infarction Types

- **Type 1 (ACS)**
  “Spontaneous myocardial infarction related to ischemia due to a primary coronary event such as plaque erosion and/or rupture, fissuring, or dissection.”

- **Type 2**
  “Myocardial infarction secondary to ischemia due to either increased oxygen demand or decreased supply, e.g. coronary artery spasm, coronary embolism, anemia, arrhythmias, hypertension, or hypotension.”
MI Types, Continued

- Type 3 (ACS that kills you before you can measure troponin)
  “Sudden unexpected cardiac death, including cardiac arrest, often with symptoms suggestive of myocardial ischaemia, accompanied by presumably new ST elevation, or new LBBB, or evidence of fresh thrombus in a coronary artery by angiography and/or at autopsy, but death occurring before blood samples could be obtained, or at a time before the appearance of cardiac biomarkers in the blood.”
Don’t Memorize This

- **Type 4a**
  Myocardial infarction associated with PCI

- **Type 4b**
  Myocardial infarction associated with stent thrombosis as documented by angiography or at autopsy

- **Type 5**
  Myocardial infarction associated with CABG

**Universal Definition of Myocardial Infarction**
Differential diagnosis

- So now you have a troponin level that is elevated. Your pre-test probability for ACS was very low; troponin should not have been ordered.

- Now you’re in a clinical scenario that the troponin-validation studies do not address. What to do?
Don’t memorize this

- **Cardiac diseases and interventions**
  - Cardiac amyloidosis/Cardiac contusion/Cardiac surgery/Cardioversion and implantable cardioverter defibrillator shocks/Closure of atrial septal defects/Coronary vasospasm/Dilated cardiomyopathy/Heart failure/Hypertrophic cardiomyopathy/Myocarditis/Percutaneous coronary intervention/Post cardiac transplantation/Radiofrequency ablation/Supraventricular tachycardia

- **Non-cardiac diseases**
  - Critically ill patients/High dose chemotherapy/Primary pulmonary hypertension/Pulmonary embolism/Renal failure/Subarachnoid haemorrhage/Scorpion envenoming/Sepsis and septic shock/Stroke/Ultra-endurance exercise (marathon)

Thrombosis

- Pulmonary embolism
  Troponin is elevated in 30-50% of cases of clinically proven PE

- Acute Coronary Syndrome

Give heparin!
Trauma

- **Electrical**
  Even a single ICD shock can cause troponin elevation

- **Mechanical**
  Surgery. Cardiac ablation procedures. Trauma.
  (Check troponin after chest trauma.)
Demand, continued: Tachycardia

Tachycardia alone has been implicated as a cause of troponin elevation in case series.

- In one series of 21 patients with elevated cTnI levels and normal coronary angiograms, tachycardia was determined to be the explanation of the troponin elevation in six patients.
- A second series described four patients with troponin elevations after episodes of supraventricular tachycardia (SVT), who had no evidence of CHD.
Demand, continued: Tachycardia

- Myocardial troponin can be released as a consequence of tachycardia alone in the absence of myodepressive factors, inflammatory mediators, and CHD.

Demand, continued: Hypertrophy

- In a series of 74 consecutive patients without clinical evidence of active myocardial ischemia referred for routine echocardiography, seven of 25 patients in the tertile with the greatest LV mass had an elevated cTnI. In contrast, one patient in the intermediate range, and none of patients in the lowest tertile had elevated troponin.

Demand, continued: Hypertrophy

- LVH can lead to occult subendocardial ischemia via increased oxygen demand from increased muscle mass, coupled with decreased flow reserve due to remodeled coronary microcirculation.

- Similar observations have been made in the setting of aortic valve disease.

“Sick”

- **Sepsis**
  Not only does this cause demand ischemia, it may also cause degradation of intramyocyte troponin molecules, allowing them to permeate the cell membrane (hypothetical)

- **Autoimmune/infiltrative**
  Myocarditis, amyloid
Brain

- Subarachnoid hemorrhage (SAH)
- Acute CVA

Troponin is elevated in about 27% of patients with acute stroke, and in SAH case series. Probably due to catecholaminergic surge; autopsy studies demonstrate myocardial band necrosis in some of these patients.

Annoying

- Lab error

- Chronic Kidney Disease
  Can have positive troponin for years. Also have poor prognosis and CAD, too. If they also get atypical chest pain, should we cath these people or not?
Troponin DDx

- **Thrombosis** (ACS, PE)
- **Trauma** (Electrical, mechanical)
- **Demand** (Demand, supply)
- “**Sick**” (Sepsis, immune/infiltrative)
- **Brain** (Large CVA, SAH)
- **Annoying** (Lab error, CKD)
Troponin without ACS

It’s like a positive RPR without syphilis:

- It can be a hint that you’re missing a diagnosis.
- It can also end up being clinically useless.
- There is no clear evaluation strategy, other than to think through the DDx of elevated troponin and see if it helps improve your patient’s diagnosis.
Troponin without ACS, cont.

When you get this, should you look for or treat CAD?

- Get a stress test?
- Get a cath?
- Change your LDL treatment goal?
"There are currently no data from randomized, controlled trials evaluating the efficacy of therapies aimed at reducing risk in patients with troponin elevations in the absence of an ACS." -Up-To-Date

- That said, you probably should give aspirin and beta blockers—in case you’re missing an ACS, the benefit is huge and the risks of these treatments are minimal.
- Outpatient stress test
Causes of Troponin Elevation where Heparin Can Be Lethal

- Demand ischemia from anemia/hypovolemic from blood loss--can appear clinically similar to ACS
- Pericarditis
- Subarachnoid hemorrhage
- Large CVA
- Traumatic cardiac contusion
- Thoracic aortic dissection

- All of the above can present with EKG changes; list is not complete
Degree of troponin elevation as an aid to diagnosis

“This cannot be demand ischemia alone. The troponin level is too high.”

- If there is any clinical study showing the maximum troponin level achievable in any condition, I am not aware of it.

(With the exception of ICD shocks, where we think we know the upper limit.)

- STEMI can present with surprisingly low troponin values.
Degree of troponin elevation as an aid to prognosis

- In almost every study,
- In a broad array of conditions,
- The higher the peak troponin value, the worse the mortality.

Has been demonstrated in studies of ACS, PE, CVA, ESRD, sepsis
Why is troponin better than CK?

- Because it is more accurate than CK, and also more sensitive than CK-MB for detecting ACS.
- (However, troponin stays elevated longer, which is a drawback.)

Conclusion

Case study of ACS with neg trop
DDX of troponin evaluation
How to interpret troponin (keeping in mind false + and false --)