Troponins on the ITU - what do they mean?

Dr. James Wilkinson, Consultant Cardiologist
University Hospital Southampton
October 5th 2017
Title: “Troponins on the ITU -what do they mean?”

Authors: Dr James Wilkinson

Conflicts of Interest: None
Activation of coagulation cascade

Prothrombin
Thrombin
Fibrinogen
Fibrin

Fibrin

RCP Cardiology Update 2017
“Is this patient having an MI?”
Overview of talk

- Setting the scene case
- Troponin overview
  - Definition MI (Type II)
- Treatment on ITU
  - Medical vs Invasive
  - DAPT and timing angio
- Illustrative Cases
- Take home messages
Case ........

- Called from ITU 0400....
- 66 male
- Collapse and OOHVF arrest, no history
- Transient Ant ST depression noted on ECG in ED
- On ITU: I&V, Haemodynamically stable, lacerations to head
- “Do you want to take him for PPCI ?”
Educational objectives

At the end of this talk you should have a better understanding of:

- Causes of raised troponin
- Classification MI
- Concept of type 2 MI
- Management of troponin positive in ITU patients
- DAPT and anti-thrombotic
- Role and timing of intervention
Biochemical markers of myocardial damage
Biochemical markers of myocardial damage

History of Cardiac Markers


AST in AMI  CK in AMI  LDH in AMI  Electrophoresis for CK and LD  Optimized CK assay  RIA for myoglobin  INH for CK-MB  WHO criteria for AMI  CK-MB mass assay  cTnT in AMI  cTnl in AMI  cTnT in UA  GUSTO trials  Isoforms for triaging  cTnT & cTnl for risk stratification  POC testing
Troponins

- Not normally ‘detectable’
- Cytosolic & Myofilament bound
  - Cytosolic released first
  - 1st detectable minutes after insult
- Know your troponin assay
  - Troponin T vs I
  - Various assays, if hs ?NICE
- Use cut-off value specific to local laboratory assay
Chest pain – differential diagnosis:

### Table 6 Differential diagnoses of acute coronary syndromes in the setting of acute chest pain

<table>
<thead>
<tr>
<th>Cardiac</th>
<th>Pulmonary</th>
<th>Vascular</th>
<th>Gastro-intestinal</th>
<th>Orthopaedic</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myopericarditis</td>
<td>Pulmonary embolism</td>
<td>Aortic dissection</td>
<td>Desphagitis, reflux or spasm</td>
<td>Musculoskeletal disorders</td>
<td>Anxiety disorders</td>
</tr>
<tr>
<td>Cardiomyopathies a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tachyarrhythmias</td>
<td>(Tension)-Pneumothorax</td>
<td>Symptomatic aortic aneurysm</td>
<td>Pernic ulcer, gastritis</td>
<td>Chest trauma</td>
<td>Herpes zoster</td>
</tr>
<tr>
<td>Acute heart failure</td>
<td>Bronchitis, pneumonia</td>
<td>Stroke</td>
<td>Pancreatitis</td>
<td>Muscle injury/ inflammation</td>
<td>Anaemia</td>
</tr>
<tr>
<td>Hypertensive emergencies</td>
<td>Pleuritis</td>
<td></td>
<td>Cholecystitis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aortic valve stenosis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cervical spine pathologies</td>
</tr>
<tr>
<td>Tako-Tsubo cardiomyopathy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coronary spasm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac trauma</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Bold = common and/or important differential diagnoses.

* Dilated, hypertrophic and restrictive cardiomypathies may cause angina or chest discomfort.
Other common causes of raised troponins (i.e. Myocardial necrosis/infarction)

- Arrhythmias: AF or any tachy-arrhythmia
- Acute pulmonary oedema - heart failure
- Pulmonary embolus
- Exacerbation of COPD and acute lung pathology
- Myocarditis and myo-pericarditis
- GI bleed
- Acute renal failure
- Severe sepsis
Troponin +ve
chest pain
not all that it always seems (ACS)....

"Now calm down there, ma'am. ... Your cat's gonna be fine ... just fine."
Acute myocardial infarction is defined as myocardial cell death due to prolonged myocardial ischaemia.
Detection of a rise and/or fall of cardiac biomarker values [preferably cardiac troponin] with at least one value above the 99th percentile upper reference limit (URL) and with at least one of the following:

- Symptoms of ischaemia.
- ECG changes of new ischaemia (new ST-T changes or new LBBB).
- Development of pathological Q waves in the ECG.
- Imaging evidence of new loss of viable myocardium or new regional wall motion abnormality.
- Identification of an intracoronary thrombus by angiography or autopsy.
Type 1- Spontaneous myocardial infarction

Type 2- Myocardial infarction secondary to an ischaemic imbalance

Type 3- Myocardial infarction resulting in death when biomarker values are unavailable

Type 4a- Myocardial infarction related to PCI

Type 4b- Myocardial infarction related to Stent thrombosis

Type 5- Myocardial infarction related to CABG
Myocardial Infarction Type 1 (STEMI and NSTEMI)

Spontaneous myocardial infarction related to atherosclerotic plaque rupture, ulceration, fissuring, erosion, or dissection with resulting intraluminal thrombus in one or more coronary arteries leading to decreased myocardial blood flow or distal platelet emboli with ensuing myocyte necrosis. The patient may have underlying severe CAD but on occasion non-obstructive or no CAD.
Myocardial Infarction Type 2

In instances of myocardial injury with necrosis where a **condition other than CAD** contributes to an imbalance between myocardial oxygen supply and/or demand, e.g. coronary endothelial dysfunction, coronary artery spasm, coronary embolism, tachy-brady-arrhythmia, anaemia, respiratory failure, hypotension or hypertension with and without LVH.

(NOT a NSTEMI)
Differentiation between MI Types 1 and 2 according to the Condition of the Coronary Arteries

- Plaque rupture with thrombus (STEMI and NSTEMI)
  - MI Type 1
- Vasospasm or endothelial dysfunction
  - MI Type 2
- Fixed atherosclerosis and supply-demand imbalance
  - MI Type 2
- Supply-demand imbalance alone
  - MI Type 2
Registry data, published 2016

Main causes of type-II MI: Anaemia (31%), sepsis (24%), and arrhythmia (17%).

Older, female majority, more frequently impaired functional level, less intervention.

Significantly higher rate of mortality: in-hospital (11.8% vs 4.2%) and 1-year (23.9% vs 8.6%).
**Type-II Myocardial Infarction – Patient Characteristics, Management and Outcomes**

Gideon Y. Stein¹, Gabriel Herscovici¹, Roman Korenfeld¹, Shlomi Matetzky², Shmuel Gottlieb³,⁴, Danny Alon¹, Natalie Gevrielov-Yusim², Zaza Iakobishvili⁵, Shmuel Fuchs¹*

![Graph showing the percentage of patients experiencing different complications related to type-I and type-II MI. The graph includes categories such as Pul. Edema, Re-MI, Post MI angina, AF, Major bleeding, TIA, ARF, and Infection.](image)

**Figure 1. In-hospital complications.** In-hospital complications of patients with type-I compared to patients with type-II MI. (**) denotes significant difference with p<0.001. Pul. edema - pulmonary edema Re-MI - recurrent myocardial infarction AF - atrial fibrillation TIA - transient ischemic attack ARF - acute renal failure. doi:10.1371/journal.pone.0084285.g001
Type 2 MI and outcome

- SWEDEHEART
- 2011
- All AMI admissions
- 20138 episodes
- Type 2 MI
  - More female/old
  - Less intervention

Figure 2. Crude cumulative risk of death (Kaplan-Meier) in patients with type 1 and type 2 acute myocardial infarction (AMI).
Treatment type 2 MI

- Evidence free zone
- Treat underlying causes
- Do not automatically load DAPT
- No clear role for long term DAPT
- Consider angiography with caution
Treatment of type 1 MI

STEMI ACS

NSTEMI ACS

Plaque rupture with thrombus
Treatment of type 1 MI

STEMI ACS

NSTEMI ACS

Immediate

Heparin

Fondaparinux

Immediate admission

Aspirin

75 mg Dispersible Tablets

✓ Helps prevent blood clots in people who have had a stroke, heart attack or by-pass surgery

Clopidogrel

Immediate admission

Noc M¹, Fajadet J, Lassen JF, Kala P, MacCarthy P, Olivecrona GK, Windecker S, Spaulding C; European Association for Percutaneous Cardiovascular Interventions (EAPCI); Stent for Life (SFL) Group.
ITU patients

- Systemic inflammation
- Impaired absorption (cooling)
- Renal impairment
- Anaemia/transfusion needs
- Need for procedures
- Comorbidities
- Age
Is this really a NSTEMI?

- History
- Age and risk factors
- 12 lead ECG
- Previous revascularisation
  - CABG - can wait
- Echo
  - RWA
- Other findings e.g. valve disease

No STEMI
Fine pharmacology balance

Anti-thrombus  Bleeding
ACS treatment on ITU

- I.V. Heparin infusion—allows strict control and can be stopped immediately

- DAPT
  - Aspirin yes—can be given I.V.
  - P2Y12
    - For NSTEMI consider loading post diagnostic angio
    - I.V. cangrelor— if you have it

- Remind staff importance of DAPT post PCI (especially non-cardiac ITU)
Who needs an angiogram?
Who needs revascularisation?
Prevalence of atheroma

- 0.5 mm threshold
- 0.3 mm threshold

Prevalence of Coronary Atherosclerosis (%)
- 13-19: 17%, 21%
- 20-29: 21%, 37%
- 30-39: 66%, 60%
- 40-49: 85%, 71%
- ≥50: 91%, 85%

Age (years)
Importance of ischaemia

Risk assessment using single-photon emission computed tomographic technetium-99m sestamibi imaging
Sherif Iskander, and Ami E. Iskandrian
J. Am. Coll. Cardiol. 1998;32;57-62

Figure 1. Rate of hard cardiac events (death or nonfatal MI) in patients with normal and abnormal stress SPECT images.

12000 patients with similar coronary stenosis severity at angio
Importance of ischaemia

Risk assessment using single-photon emission computed tomographic technetium-99m sestamibi imaging
Sherif Iskander, and Ami E. Iskandrian
J. Am. Coll. Cardiol. 1998;32;57-62

Figure 1. Rate of hard cardiac events (death or nonfatal MI) in patients with normal and abnormal stress SPECT images.

12000 patients with similar coronary stenosis severity at angio
How do we assess ischaemia in ITU patients (to decide if they have ischaemic lesions needing revascularisation)?
Invasive way to assess ischaemia

Positive FFR \leq 0.80, highly reproducible
The pressure wire data

- If you stent an non-ischaemic lesion (FFR > 0.8) you cause harm (worse prognosis—death, MI and revascularisation and no effect on angina)

- If you do not stent an ischaemic lesion (FFR ≤ 0.8) you cause harm (worse prognosis and worse angina)

- Routine pressure wire guidance improves outcome

- All angiograms done with pressure wire?
FFR vs Angiography

FFR vs Angiography

European Heart Journal
doi:10.1093/eurheartj/ehu338

RCP Cardiology Update 2017
FFR vs Angiography

Conservative

Stenosis (%)

European Heart Journal
doi:10.1093/eurheartj/ehu338
FFR vs Angiography

Conservative

PCI/CABG

Stenosis (%)
Example 2 men in 50s diabetic, smokers with atypical pain (risk 80%)
Example 2 men in 50s diabetic, smokers with atypical pain (risk 80%)

Severe narrowing >70% in Cx

Severe narrowings >70% in LAD and Cx
Example 2 men in 50s diabetic, smokers with atypical pain (risk 80%)

Severe narrowing >70% in Cx
FFR 0.59 $\rightarrow$ Stent

Severe narrowings >70% in LAD and Cx
FFR LAD 0.88, Cx 0.84
Medical therapy
Common cardiac pathology

- Arrhythmias
  - If haemodynamic compromise DCCV
  - Rate control and choice of anticoagulant

- Heart failure
  - Pulmonary oedema: Cardiogenic vs non-cardiogenic?
  - Standard treatment and monitoring

- Ventilation

- Involve Cardiology early
Risks of angiography (1 in 1000)
Risks of angiography (1 in 1000)
Risks of angiography (1 in 1000)
Risks of angiography (1 in 1000)
Risks of angiography (1 in 1000)

Death
Stroke
MI
CIN
Arrhythmia
Back to the cases.....
66 male. OOHVF ?ant ST depression. No info. 0400
66 male. OOHVF ?ant ST depression. No info. 0400
66 male. OOHVF ?ant ST depression. No info. 0400
Outcome
Outcome

As possible head injury and uncertainty DAPT not given pre-angio
Outcome

- As possible head injury and uncertainty DAPT not given pre-angio
- Subsequent history available in case:
  - Known alcoholic
  - Very aggressive in pub, sudden onset slurred speech and staggering to left
  - Got on bike and collapsed hitting head
Outcome

- As possible head injury and uncertainty DAPT not given pre-angio

- Subsequent history available in case:
  - Known alcoholic
  - Very aggressive in pub, sudden onset slurred speech and staggering to left
  - Got on bike and collapsed hitting head

- MRI head: Thalamic infarct
Outcome

- As possible head injury and uncertainty DAPT not given pre-angio

- Subsequent history available in case:
  - Known alcoholic
  - Very aggressive in pub, sudden onset slurred speech and staggering to left
  - Got on bike and collapsed hitting head

- MRI head: Thalamic infarct

- ICD prior to discharge and cardiology FU
Another case..

- 55 male, collapse riding bike
- Found unconscious and CPR given
- Ambulance DCCV x 1 for VF, intubated and ventilated
- Anterior-lat TWI on ambulance ECG
- Head injury→CT head: no bleed or #
- Would you take to cath lab??
Bystander disease, confirmation of HCM on MRI

ICD and home. Symptom free under FU 3yrs later
55 VF, “ant-lat STEMI”
55 VF, “ant-lat STEMI”
55 VF, “ant-lat STEMI”
55 VF, “ant-lat STEMI”
Outcomes post OOHCA
Outcomes post OOHCA

- This case
  - Immediate bystander CPR, cooled
  - Rapidly came off inotropes
  - Excellent cardiac outcome
Outcomes post OOHCA

This case

- Immediate bystander CPR, cooled
- Rapidly came off inotropes
- Excellent cardiac outcome
- Care withdrawn and died of hypoxic brain injury 10 days later.....
Outcomes post OOHCA

This case

- Immediate bystander CPR, cooled
- Rapidly came off inotropes
- Excellent cardiac outcome

Care withdrawn and died of hypoxic brain injury 10 days later.....

Many cases who do well with PCI will die or be left with significant disability from hypoxic brain injury
Take home messages

- Other causes of raised troponin besides ACS
- Importance of type 2 MI (not a NSTEMI)
- Consider each case individually and carefully
- Don’t always give immediate DAPT in ITU NSTEMI cases
- In NSTEMI angiography can often wait until patient is extubated/off ITU
- Angiography can be harmful (CIN etc)
Questions

james.wilkinson@uhs.nhs.uk

www.cardiology.co.uk

RCP Cardiology Update 2017