Management of Undifferentiated Chest Pain in the Emergency Department

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EMERGENCY PHYSICIAN,
INSITUT JANTUNG NEGARA
* 55 year old man presented with 2 hours history of severe pressure-like chest pain associated with dyspnoea & profuse sweating
* Background of HPT, heavy smoker
* BP 160/95, PR 78, SO2 95%, RR 20
* On examination, sweating
  
  Lungs: basal crepitations
Diagnosis?

Acute Myocardial Infarction
...Ahhh.... If only life was always that simple...
36 year old man with history of intermittent chest pain for 2 weeks – Central chest cramping pain at rest, persistent. Occasionally associated with sweating.

Risk factors – HPT, Heavy smoker, FH IHD

Vital signs: BP 126/70, PR 75, SO2 100%, RR 18, Pain score 6/10

Clinical examination unremarkable
* POC Troponin – normal
Question

- Do I admit or observe this patient?
- If not, how do I safely discharge this patient?
- What investigation modalities would help me make a clinical decision?
- What would be my discharge plan?
Case 3

* 60 year old man complained of left sided pricking pain 3 hours ago – lasts < 5 minutes, associated with giddiness. Not associated with exertion.
* PH – IHD with CABG done 4 years ago. Since then has been well. HPT, DM, hypercholesterolemia
* Vital signs: BP 145/93, PR 90, SO2 98%, Pain score now 3/10
* Clinical examination unremarkable
* Last echo 1 year ago – septal hypokinesia, EF 56%
- ECG – same as before
- POC Troponin – normal
Do I admit or observe this patient?
If not, how do I safely discharge this patient?
What investigation modalities would help me make a clinical decision?
What would be my discharge plan?
Critical issues: Objectives

- Make an accurate assessment
- Correctly define non-ACS patients & send them home safely
- Correctly diagnose ACS &
- Stratify low risk vs. high risk
What are the challenges in managing chest pain in ED?

- Too many patients
- Too little time with patients
- Lack of past medical information
- No previous ECG to compare
- Patients are too ill
- Atypical presentation / unreliable history
- Limited resources & point of care tests
- Late follow up appointment
- Always worrying about repercussions
What are the causes of chest pain in ED?

* 51% cardiac (AMI 19%)
* 14% pulmonary
* 9% somatization (mental stress causing symptoms)
* 7% muscoloskeletal
* 11% no definite final diagnosis


_Chest pain in the emergency department: the broad spectrum of causes._
Knockaert DC¹, Buntinx F, Stoens N, Bruyninckx R, Delooz H.
<table>
<thead>
<tr>
<th>Cardiac</th>
<th>Pulmonary</th>
<th>Haematological</th>
<th>Vascular</th>
<th>Gastro-intestinal</th>
<th>Orthopaedic/infectious</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myocarditis</td>
<td>Pulmonary embolism</td>
<td>Sickle cell crisis</td>
<td>Aortic dissection</td>
<td>Oesophageal spasm</td>
<td>Cervical discopathy</td>
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<tr>
<td>Pericarditis</td>
<td>Pulmonary infarction</td>
<td>Anaemia</td>
<td>Aortic aneurysm</td>
<td>Oesophagitis</td>
<td>Rib fracture</td>
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<td>Cardiomyopathy</td>
<td>Pneumonia Pleuritis</td>
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<td>Cerebrovascular disease</td>
<td>Peptic ulcer</td>
<td>Muscle injury/inflammation</td>
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<tr>
<td>Valvular disease</td>
<td>Pneumothorax</td>
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<td></td>
<td>Pancreatitis</td>
<td>Costochondritis</td>
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<tr>
<td>Tako-Tsubo cardiomyopathy</td>
<td></td>
<td></td>
<td></td>
<td>Cholecystitis</td>
<td>Herpes zoster</td>
</tr>
<tr>
<td>Cardiac trauma</td>
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</tbody>
</table>
AMI (ESC)

- Myocardial necrosis in a setting consistent with myocardial ischaemia
- Detection of a rise &/fall of cardiac markers (preferably troponin) with at least 1 value above 99\(^{th}\) percentile upper limit of normal & at least 1 of the following:
  - Symptoms of ischaemia
  - New or presumed new ST-T changes or LBBB
  - Development of pathological Q waves
  - Imaging evidence of new loss of myocardium or RWMA
  - Intracoronary thrombus on angiography or autopsy
We rely on...

* History – non-specific, atypical
* Clinical examination – can be normal
* ECG – non-specific changes, old changes, misreading
* Cardiac enzymes – What is available? How reliable are they?
* Other tests? – echo, stress test, CXR, etc.
What is typical chest pain? Does it apply to us in ED?

- “Burning/indigestion” 23% with MI
- “Aching” 13% with MI
- “Pressure” 24% with MI
- Other 23% with MI

- Up to 30% of MI is “silent”
- Of patients who had chest pain & were discharged & died, 50-70% had misread ECGs
Low risk features (With normal or non-specific ECG)

- Far right side
- Pain primarily abdomen
- Pain lasts seconds
- Pain improves with exertion
- Clear alternative non-cardiac cause for pain (GI etiology is NEVER a clear alternative diagnosis)
- Palpation reproduces pain repeatedly
- Fully pleuritic
- Pain brought on by position/movement
- Pain can be localised by fingertip
- Sharp/stabbing pain
We rely on...

* History – non-specific, atypical
* Clinical examination – can be normal
* ECG – non-specific changes, old changes, misreading
* Cardiac enzymes – What is available? How reliable are they?
* Other tests? – echo, stress test, CXR, etc.
What are the challenges in diagnosing AMI in ED?

- Recognizing ECG changes early
- Normal ECG on presentation (3-16%)
  - Early patient presentation
- Small MI (3% of myocardium involved for ECG changes)
  - Location eg. Posterior MI
- Missing the diagnosis (2-10%)
  - Women
  - Patients who came at night
  - Younger patients age <50


**Clinical Investigations**

Myocardial Infarction with an Initially Normal Electrocardiogram—Angiographic Findings

Lev Caster, M.D., David Cooke, M.D., Robert Zalenski, M.D., Robert Rybman, Ph.D., Jeffrey B. Laker, M.D.,
Department of Medicine, Division of Cardiology, Lutheran General Hospital, Park Ridge, Illinois, USA

Misdiagnosed Acute Coronary Syndrome: Characteristics of Patients with Acute Coronary Syndrome Discharged Home from the Emergency Department

Darawshe A MD¹, Rabkin Y MD², Zadok Batsheva MD¹, Abdelhadi F MD¹, Feldman A MD¹ and Rosenfeld R MD²

Diagnostic ECG for ACS

- New ST elevation
  - Not secondary to abnormal depolarisation eg. LVH
- New ST depression ≥ 1mm in 2 contiguous leads
  - Not otherwise explained
  - Changed from previous ECG (dynamic changes)
- T inversion ≥1mm in 2 contiguous leads
- New Q waves
Non-diagnostic ECGs

- Old or non-pathological Q waves
- Secondary ST-T abnormalities
  - Due to abnormal depolarization eg. LVH, RBBB, LBBB
  - Minor, non-dynamic ST-T abnormalities eg. ≤1mm ST depression or T inversion
- New changes not specific for ischaemia / infarction
We rely on...

- History – non-specific, atypical
- Clinical examination – can be normal
- ECG – non-specific changes, old changes, misreading
- Cardiac enzymes – What is available? How reliable are they?
- Other tests? – echo, stress test, CXR, etc.
CXR: other diagnosis
ESC definition of myocardial infarction includes:

* Imaging evidence of new loss of viable myocardium of new Regional Wall Motion Abnormalities (RWMA)

But

* Operator dependent with learning curve for echo
* New vs. old

However

Still can be used to aid in alternative diagnosis

*European Heart Journal (2012) 33, 2551–2567*
Stress test

- Availability
- Only detects stenosis
- 70% sensitive
- 5% incidence of AMI within 3 years of negative stress test
What else?

Risk Stratification
Cardiac Risk Scores

* TIMI
* GRACE
* HEART
* EDACS

What would your ideal Risk Score be like?
TIMI Risk Score for USA/NSTEMI

- JAMA, 2000
- Included all patients diagnosed as USA/NSTEMI
- Endpoints over 14 days:
  - All-cause mortality
  - New or recurrent MI
  - Severe recurrent ischemia prompting urgent revascularization
- Cardiac enzyme = CKMB, Troponins
### TIMI Score

<table>
<thead>
<tr>
<th>Factors</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age: (\geq 65)</td>
<td>1</td>
</tr>
<tr>
<td>Markers: Elevated serum cardiac markers (CKMB/Troponin)</td>
<td>1</td>
</tr>
<tr>
<td>ECG: ST deviation (\geq 0.5) mm</td>
<td>1</td>
</tr>
<tr>
<td>Risk factors: At least 3 risk factors for CAD FH, HPT, DM, hypercholesterolemia, current smoker</td>
<td>1</td>
</tr>
<tr>
<td>Ischemia: Severe angina ((\geq 2) episodes in the last 24h)</td>
<td>1</td>
</tr>
<tr>
<td>CAD: Significant coronary stenosis (\geq 50)%</td>
<td>1</td>
</tr>
<tr>
<td>Aspirin: Use of aspirin in the last 7 days</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Score</th>
<th>% reached endpoint at 14 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>4.7%</td>
</tr>
<tr>
<td>2</td>
<td>8.3%</td>
</tr>
<tr>
<td>3</td>
<td>13.2%</td>
</tr>
<tr>
<td>4</td>
<td>19.9%</td>
</tr>
<tr>
<td>5</td>
<td>26.2%</td>
</tr>
<tr>
<td>6-7</td>
<td>40.9%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Score</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>Low</td>
</tr>
<tr>
<td>3-4</td>
<td>Intermediate</td>
</tr>
<tr>
<td>5-7</td>
<td>High</td>
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</tbody>
</table>
## GRACE Score (2003)

1. **Find Points for Each Predictive Factor:**

<table>
<thead>
<tr>
<th>Killip Class</th>
<th>Points</th>
<th>SBP (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0</td>
<td>≤80</td>
</tr>
<tr>
<td>II</td>
<td>20</td>
<td>80-120</td>
</tr>
<tr>
<td>III</td>
<td>39</td>
<td>120-140</td>
</tr>
<tr>
<td>IV</td>
<td>59</td>
<td>≥140</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Creatinine Level, mg/dL</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-0.39</td>
<td>1</td>
</tr>
<tr>
<td>0.40-0.79</td>
<td>4</td>
</tr>
<tr>
<td>0.80-1.19</td>
<td>7</td>
</tr>
<tr>
<td>1.20-1.59</td>
<td>10</td>
</tr>
<tr>
<td>1.60-1.99</td>
<td>13</td>
</tr>
<tr>
<td>2.00-3.99</td>
<td>21</td>
</tr>
<tr>
<td>&gt;4.0</td>
<td>28</td>
</tr>
</tbody>
</table>

**Other Risk Factors:**
- Cardiac Arrest at Admission: 2 points
- ST-Segment Deviation: 4 points
- Elevated Cardiac Enzyme Levels: 1 point

2. **Sum Points for All Predictive Factors:**

\[
\text{Killip Class} + \text{SBP} + \text{Heart Rate} + A
\]

\[
\text{Creatinine Level} = \text{Total Points}
\]
All patients who presented to ED with chest pain
Excluding patients with ST elevation – PCI
122 patients were followed up for endpoints
Endpoints – AMI, PCI, CABG, death over 400 days
Cardiac marker = Troponin I
<table>
<thead>
<tr>
<th>HEART Score</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>History</strong></td>
<td></td>
</tr>
<tr>
<td>Highly suspicious</td>
<td>2</td>
</tr>
<tr>
<td>Moderately suspicious</td>
<td>1</td>
</tr>
<tr>
<td>Slightly suspicious</td>
<td>0</td>
</tr>
<tr>
<td><strong>ECG</strong></td>
<td></td>
</tr>
<tr>
<td>Significant ST depression</td>
<td>2</td>
</tr>
<tr>
<td>Nonspecific repolarisation disturbance</td>
<td>1</td>
</tr>
<tr>
<td>Normal</td>
<td>0</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
</tr>
<tr>
<td>&gt;= 65</td>
<td>2</td>
</tr>
<tr>
<td>45-65</td>
<td>1</td>
</tr>
<tr>
<td>&lt;45</td>
<td>0</td>
</tr>
<tr>
<td><strong>Risk Factors</strong></td>
<td></td>
</tr>
<tr>
<td>&gt;= 3 risk factors or history of atherosclerotic disease (DM, HPT, smoking, Cholesterol, FH, obesity)</td>
<td>2</td>
</tr>
<tr>
<td>1-2 risk factors</td>
<td>1</td>
</tr>
<tr>
<td>No risk factors</td>
<td>0</td>
</tr>
<tr>
<td><strong>Troponin</strong></td>
<td></td>
</tr>
<tr>
<td>&gt; 2x normal limit</td>
<td>2</td>
</tr>
<tr>
<td>1-2x normal limit</td>
<td>1</td>
</tr>
<tr>
<td>&lt;= normal limit</td>
<td>0</td>
</tr>
</tbody>
</table>
## Interpretation

<table>
<thead>
<tr>
<th>Score</th>
<th>% End points</th>
<th>Acceptable management</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>2.5%</td>
<td>Can be safely discharged with follow up</td>
</tr>
<tr>
<td>4-6</td>
<td>20.3%</td>
<td>Admit for serial Troponin &amp; provocative testing</td>
</tr>
<tr>
<td>&gt;= 7</td>
<td>72.7%</td>
<td>Admit &amp; suggest for early invasive measures with inpatient cardiology assessment</td>
</tr>
</tbody>
</table>

*Risk Scores for Patients with Chest Pain: Evaluation in the Emergency Department*

B.E. Backus, 1, 7  A.J. Six, 2  J.H. Kelder, 3  W.B. Gibler, 4  F.L. Mol, 1  and P.A. Doevendans 1

[View original document](https://doi.org/10.2174/157340311766676862)
Accelerated Diagnostic Protocols (ADPs)

- **ASPECT (2011):** 2-hour Diagnostic Protocol to Assess Patients with Chest Pain Symptoms in the Asia-Pacific region
- **ADAPT (2012):** 2-hour ADP to Assess Patients with Chest Pain Symptoms Using Contemporary Troponins
- **APACE (2012):** Advantageous Predictors of ACS Evaluation
- **EDACS (2014):** ED Assessment of Chest Pain Score
2-hour Diagnostic Protocol to Assess Patients with Chest Pain Symptoms in the Asia-Pacific region

Pretest Probability scoring:
- TIMI = 0
- ECG
- Cardiac Biomarkers (Troponin, Myoglobin, CKMB) at 0h & 2h

MACE in 30 days occurred in 0.9% of low risk discharged patients

Sensitivity 99.3%, Specificity 11%
MACE = Major Adverse Cardiac Events

- Death (unless clearly non cardiac)
- Cardiac arrest
- Emergency PCI
- Cardiogenic shock
- Ventricular arrhythmia needing intervention
- High-degree AV block needing intervention
- AMI
2-hour Accelerated Diagnostic Protocol to Assess patients with Chest Pain Symptoms using Contemporary Troponins as the Only Biomarker

- Chest pain: > 5 mins of acute chest, epigastric, neck, jaw or arm pain or discomfort or pressure without any non-cardiac source
- Patients were discharged based on Low Risk identified as:
  - TIMI 0
  - ECG negative
  - cTnI (lab) at 0 & 2 hours after arrival negative
- MACE at 30 days – 0.25%
- Sensitivity 99.7%, Specificity of 23.4%

ADAPT (2012)
Advantageous Predictors of ACS Evaluation

- 1-hour Rule-out & Rule-in of AMI using hs-Tn
- Inclusion: Patients with chest pain in the last 12 hours
- Looked at absolute rise &/or fall of Troponin

APACE (2012)
Algorithm for diagnosis of acute myocardial infarction

436 Patients with chest pain—validation cohort

- Oh \(< 12 \text{ and } \Delta 1h \leq 3$
  - Rule-out
    - 259 Patients (60%)
      - Sensitivity: 100%
      - NPV: 100%

- Others
  - Observational zone
    - 101 Patients (23%)
      - Prevalence of AMI: 8%

- Oh \(\geq 52\) or \(\Delta 1h \geq 5$
  - Rule-in
    - 76 Patients (17%)
      - Specificity: 97%
      - PPV: 84%
* Emergency Department Assessment of Chest pain Score (EDACS)
* Combined with Troponin at 0 & 2 hours from arrival & normal ECG = Accelerated Diagnostic Protocol (ADP)
* Aim: To identify patients with very low short term risk of MACE. Safe for early discharge & outpatient investigations
* MACE within next 30 days
Safely identify 40-50% of patients presenting to ED with chest pain as having low risk of short term MACE.

- Sensitivity 99%, Specificity 50%
<table>
<thead>
<tr>
<th>EDACS: Clinical characteristics</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>18-45</td>
<td>+2</td>
</tr>
<tr>
<td>46-50</td>
<td>+4</td>
</tr>
<tr>
<td>51-55</td>
<td>+6</td>
</tr>
<tr>
<td>56-60</td>
<td>+8</td>
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<td>+10</td>
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<tr>
<td>66-70</td>
<td>+12</td>
</tr>
<tr>
<td>71-75</td>
<td>+14</td>
</tr>
<tr>
<td>76-80</td>
<td>+16</td>
</tr>
<tr>
<td>81-85</td>
<td>+18</td>
</tr>
<tr>
<td>&gt;86</td>
<td>+20</td>
</tr>
<tr>
<td>Male</td>
<td>+6</td>
</tr>
<tr>
<td>Aged 18-50 &amp; either:</td>
<td></td>
</tr>
<tr>
<td>Known CAD or 3 or more risk</td>
<td>+4</td>
</tr>
<tr>
<td>factors</td>
<td></td>
</tr>
<tr>
<td>Symptoms &amp; signs:</td>
<td></td>
</tr>
<tr>
<td>Diaphoresis</td>
<td>+3</td>
</tr>
<tr>
<td>Radiates to arm or shoulder</td>
<td>+5</td>
</tr>
<tr>
<td>Pain occurred or worsened with</td>
<td></td>
</tr>
<tr>
<td>inspiration</td>
<td>-4</td>
</tr>
<tr>
<td>Pain reproducible by palpation</td>
<td>-6</td>
</tr>
</tbody>
</table>
## EDACS-ADP

| Low Risk          | EDACS < 16  
|                  | No new ischaemia on ECG  
|                  | 0 and 2 hours Troponin –ve  
| Recommendation    | Patient safe for discharge to early outpatient follow-up investigation (or proceed to early inpatient testing)  
| Not Low Risk      | EDACS > 16  
|                  | New ischaemia on ECG  
| Recommendation    | Either 0 or 2 hour Troponin +ve  
|                  | Proceed with usual care with further observation and delayed troponin  

Do cTnI or cTnT

Do Serial Troponins at presentation & 3-6 hours after symptom onset

Do additional Troponin after 6 hours in patients with normal serial Troponins with ECG changes / intermediate or high risk clinical features

CK-MB & myoglobin are NOT useful for diagnosis of ACS

Troponin elevations are useful in short- & long-term prognosis
CHEST PAIN

Intermediate / high risk
- Refer cardio

Low risk
- CPMU / Observation
  - Serial ECG, Trop (0 & 2 Hr)
  - KIV Stress test / Echo
    - Positive
      - Admit
    - Negative
      - Discharge
        - Wellness Centre
        - Cardio Clinic
        - Platinum Clinic

Discharge Criteria
- No angina
- No new or dynamic ECG changes

Stress test / Echo as outpatient
Issues

* High volume of patients with low risk chest pain
* No physical space
* Risk scores – high vs. low, understanding with cardiologists
* Cardiac enzymes – POC vs. hs
* ADPs – understanding with cardiologists
Summary

* Have sound ECG knowledge
* Symptom characteristics are important
* ‘Typical chest pain’ does not really apply to ED
* Risk stratify your patients
* Do not make decisions based on 1 ECG or 1 Troponin level
* Low risk + normal/NS ECG + normal serial Troponins = very low risk of adverse events but doesn’t rule out IHD
* What troponin test kit are you using?
* Use an ADP that is suited to your setting
THANK YOU