Cardiac CT in emergency department: patients with acute chest pain

AFIM- Haïfa –May 2011

Sablayrolles J. L., Feignoux J, Izzilio R.
Centre Cardiologique du Nord - Saint Denis – France
Preamble: The diagnosis of acute chest pain remains a challenging problem

- 6 M of PTS with acute chest pain in ED.
- Admission rate between 30-72 %.
- 44 % had significant pathology (extra cardiac in majority of cases).
- 15-25% of Pts are diagnosed as having an acute coronary syndrome.
- Cost estimated of triage & management = 8 billion $.
- 2-8 % of Pts are discharged from ED & later diagnosed as having ACS. The mortality rate = 25 %.
- We need algorithms based on “zero tolerance” for missing ischemic chest pain even in low risk patients.

What is the place of cardiac CT?
How to manage chest pain?

• Symptoms are variable often atypical.
• It is important to distinguish:
  life threatening causes that need rapid or immediate intervention from those that are less likely to be fatal but steel need in-patient treatment & those that can be managed on an out-patient basis.
• For triage, we use:
<table>
<thead>
<tr>
<th>Probable diseases</th>
<th>CT protocol</th>
<th>CT technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pleural, pulmonary &amp; abdominal diseases</td>
<td>Standard Chest CT</td>
<td>Without ECG</td>
</tr>
<tr>
<td></td>
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<td>Large FOV - injection</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>Pulmonary CTA</td>
<td>Without ECG - +++ injection/ acq. synchronization</td>
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<tr>
<td>Coronary artery diseases</td>
<td>Dedicated coronary CTA</td>
<td>ECG synchronization</td>
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<td></td>
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<td>Small &amp; cardiac FOV - Bete-blockers</td>
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<td></td>
<td></td>
<td>+++ injection/ acq. Synchronization</td>
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<td></td>
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<td>Post processing</td>
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<tr>
<td>Atypical chest pain</td>
<td>Triple Rule Out</td>
<td>ECG synchronization</td>
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<td></td>
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<td>Large coverage – intermediate FOV</td>
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<td></td>
<td></td>
<td>&amp; Retro- reconstruction</td>
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<td></td>
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<td>Beta-blockers</td>
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<td>Post processing</td>
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</tbody>
</table>
Triple Rule-Out

- Assessment of the coronary, aorta and pulmonary artery:
- large coverage
- ECG gating – Beta-blockers.
- Injection / acquisition synchronization +++
  
  We need a good opacification of these three anatomic segments.

triphasic phase

1. 80-90 cc @ 5 cc/sec of contrast media
2. 20 cc @ 2 cc/sec of contrast media + 20 cc @ 2 cc/sec of isotonic solution
3. 20 cc @ 2.5 cc/sec of isotonic solution

⇒ Smartprep : We will start 1-2sec earlier than for a heart
### HD 750 CT

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPM</td>
<td>56</td>
</tr>
<tr>
<td>Pulse mode</td>
<td>Yes</td>
</tr>
<tr>
<td>kV / mA</td>
<td>120 / 625</td>
</tr>
<tr>
<td>Coverage</td>
<td>520</td>
</tr>
<tr>
<td>Filter</td>
<td>HD std ASIR40</td>
</tr>
<tr>
<td>Dose</td>
<td>DLP: 671</td>
</tr>
<tr>
<td></td>
<td>11 mSv</td>
</tr>
</tbody>
</table>
LV: apical thrombus

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LAD I: in-stent restenosis
# Causes of non traumatic chest pain

<table>
<thead>
<tr>
<th>CV diseases</th>
<th>45 %</th>
<th>others</th>
<th>55 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Coronary syndrom</td>
<td>25 %</td>
<td>• Musculoskeletal D.</td>
<td>17 %</td>
</tr>
<tr>
<td>• Pulmonary embolism</td>
<td>6 %</td>
<td>• Cholecystitis, pancreatitis…</td>
<td>10 %</td>
</tr>
<tr>
<td>• Aortic Dissection</td>
<td>0.4 %</td>
<td>• Pneumothorax, pneumonia…</td>
<td>8 %</td>
</tr>
<tr>
<td>(intramural hematoma</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>penetrating ulcer)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Pericarditis/ myocarditis</td>
<td>8 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Aortic aneurysm / rupture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Tamponade</td>
<td></td>
<td></td>
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</tbody>
</table>

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Thoracic Aorta diseases

- Aortic Dissection
- intramural hematoma
- penetrating ulcer
- Aortic aneurysm: rupture, dissection

Role of the CTA

- Appearance and size of the lumen
- wall: plaque, thrombus, flap, hematoma, stent or by-pass
- LV study, pericardium, aortic valves
- CA, Aortic arch, collateral circulation
- measures of diameters (like US) perpendicular to aortic z-axis
  - vasalva sinus
  - sino tubular junction
  - ascending aorta (RPA)
  - aortic arch
  - proximal & distal descending aorta

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CTA & acute dissection

Coverage from the aortic arch to iliac arteries with gating

- True (size) & false lumen with flap
- Tear localization = classification
- Pericardium effusion
- Aortic valves rupture
- CA ostium dissection
- Extension: aortic arch, abdominal aorta, CT & SMA, renal arteries, iliac arteries

CTA = diagnostic & therapeutic choice

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Acute Dissection

De Bakey classification

Type I                    Type II           Type III

- Type I, II, A    =   surgery in emergency
- Type III, B      =    F/U without run off ischemia

Stanford classification

Type A                    Type B

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Dissection type 1
Pericardium effusion
Aortic dissection Type 3
intra-mural Hematoma: classification like dissection

- no dissection - thick wall > 7mm
- d = 60-70 UH - classification like dissection

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Intra mural hematoma type 3 = F/U
CTA & Aortic dissection / intramural hematoma

0.4 % of thoracic pain

- Tear detection: Se. 95 % Sp. 100 %
- Aortic arch extension: Se. 95 % Sp. 100 %
- Pericardium effusion: Se. 83 % Sp. 100 %

CT angiography is the main vascular imaging test for investigating aortic dissection

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Aortic aneurysm with dissection
Penetrating aortic ulcer
Atypical thoracic pain (M 34): Acute pericarditis

arterial phase

5 ': late phase

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Myocarditis

First acquisition

Delayed acquisition

Normal CA

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Coronary CTA & acute chest pain

- Cardiac CT seems well-suited for quickly & non invasively triaging patients with equivocal presentation, non-diagnostic ECG, initially negative serum markers.

- With High sensitivity & NPV, CCTA is accurate in excluding CAD & defining severe stenosis. In acute chest pain, Pts with normal or minimally abnormal results are unlikely to have pain produced by ischemia & can be discharged. Pts with severe stenosis > 70 % are likely to have significant lesions in cath lab.

- Intermediate stenosis (40 – 60 %) requires verification from additional testing: stress testing or stress imaging.
Triple rule out

- M 37 – 80kg
- Atypical chest pain for one week.
- Limit cardiac enzymes
- Fever
- Indication: Myopericarditis?

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Latero-inferior heart infarction
Left marginal Occlusion

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Occlusion = soft plaque & positive remodeling
Plaque rupture:
thrombus, soft plaque, lipid core

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M 57 Y refuses CAG
Atypical thoracic pain with risk factors
ECG + in antero apical
P 36Y 65KG - Atypical chest pain - NI ECG

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Atypical Chest Pain
After CA Revascularization
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After PCI
72 years old
CABG: post-surgery control
D+30
thoracic pain

**5 bypass**

LIMA
RIMA in Y
Diag
LMB
LCx
PDA

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Place of cardiac CT

Acute chest pain

Non cardiac:
PE, aortic disease,
Pericardial effusion….

Possible ACS

Typical ACS

No ST elevation

ST elevation

Positive markers

NI ECG
NI markers

Cardiac CT - Triple rule out

Negative

Positif

Cath Lab

Stress test

Negative

Positif

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Conclusion

• In ED, non invasive procedure like Cardiac CT has the ability to differentiate cardiac & non-cardiac causes of atypical chest pain without the need for such as invasive procedure with greatly benefits & reduce the costs for a comprehensive diagnostic work-up.

• However, we need high image quality
  ➡ detect & F/U disease
  ➡ provide information for therapeutic decision
  ➡ optimize procedure: ATL or by pass surgery
  ➡ F/U after procedure

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