MDCTA In Acute Chest Pain

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DISCLOSURES

No financial disclosures & I have no money

If I Were To Await Perfection, This Presentation Would Not Have Been Possible.
Objectives

- Role of Coronary MDCTA in ER
- Feasibility and cost effectiveness
- Technical considerations in ER
- Difficulties/Limitations
- Reimbursement
- Future
Essentials for Cardiac Imaging

- **Spatial resolution:**
  To evaluate the fine anatomic details of coronary arteries

- **Temporal resolution:**
  To evaluate coronaries without motion artifact

- **Contrast resolution:**
  Critical for determining coronary plaque composition
Challenges and Limitations

• Consensus between EM and ER facilitates with selection of appropriate patients for MDCTA and also its limitations
• Inability to breath hold
• Irregular heart rate
• Morbid Obesity
• Severe coronary calcification (Agatston > 1,000)
• Radiation exposure
Management in ED

- 6 million visits to ED per annum in USA with chest pain syndromes
- Management is challenging, time consuming, costly and often inconclusive
- Acute Coronary Syndrome encompasses ST-segment elevation myocardial infarction (STEMI), non ST-segment elevation MI (NSTEMI) and unstable angina (UA).
- 15% of these have subsequent confirmation of acute coronary syndrome
- 2% with non-diagnosed ACS are mistakenly discharged
Management in ED

- Standard of Care
- Current standard for risk stratification
- History
- Physical exam
- Serial EKG
- Chest X-ray
- Laboratory studies & imaging including cardiac biomarkers, stress echo or a nuclear medicine study

3 Categories of chest pain patients presenting to ED for suspected acute coronary syndrome

Low risk: 79% of patients with chest pain (TIMI 0-2)

Only 5% of TIMI low risk patients have acute coronary syndrome

<table>
<thead>
<tr>
<th>Analysis of Workups</th>
<th>Length of Stay (Hours)</th>
<th>Charges $$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard of care</td>
<td>25.4 ± 6.3</td>
<td>7,597 ± 2,216</td>
</tr>
<tr>
<td>MDCTA plus observation</td>
<td>14.3 ± 5.0</td>
<td>6,153 ± 1,196</td>
</tr>
<tr>
<td>MDCTA without observation</td>
<td>5.0</td>
<td>4,251 ± 420</td>
</tr>
</tbody>
</table>

Mean length of stay and charges

Low risk patients with chest pain in ED: Negative 64 MDCTA may reduce length of stay and hospital charges:
Cost-effectiveness of coronary MDCT in the triage of patients with acute chest pain.
Pros and Cons of MDCTA

- CORE 64, CORE 320 results
- **ACCURACY**
  - Sensitivity 95.9%
  - Specificity 91.6%
  - Negative predictive value 97 – 99%
  - Positive predictive value > 95%

- Radiation dose & Resources

Low Risk Patients With Chest Pain In ED: Negative 64 MDCTA May Reduce Length Of Stay And Hospital Charges:

Comprehensive cardiovascular ECG-gated MDCT as a standard diagnostic tool in patients with acute chest pain.
  G Runza et al: EJR 64 (2007) 41-47
Cardiac MDCTA: Prime Time Indications

- Level of suspicion insufficient for catheterization
- Inconclusive treadmill testing - Echo
- Atypical chest pain
- Suspicion of anomalous coronary arteries
- Pericardial diseases
- Cardiac tumors
- Lt. Atrium-RF ablation of ectopic foci in AF
- S/P CABG, Stents (CORE 64)

Myocardial Perfusion, Plaque Imaging
MDCTA Protocol

Metoprolol: To achieve heart rates < 66 bpm

Heart rate > 80 BPM 125 mg
Heart rate > 75 BPM 100 mg
Heart rate > 70 BPM 75 mg
Heart rate > 65 BPM 50 mg

Note: Nitroglycerine 0.4 µg may increase rate > 65,

Give IV Metoprolol 5 mg q 5 min x 4
Cardiac Rate / Phases

Why beta blockers?

<table>
<thead>
<tr>
<th>Heart Rate</th>
<th>Diastolic msec</th>
<th>Systolic msec</th>
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<tr>
<td>75 Bpm</td>
<td>530</td>
<td>270</td>
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<tr>
<td>50 Bpm</td>
<td>760</td>
<td>440</td>
</tr>
</tbody>
</table>

Heart Rate / Phases:
- HR < 70 BPM: R 1000 ms 450-800 ms
- HR > 70 BPM: R 82-336 ms 1000 ms

- 0% 10-45% 50% R-R 950 ms
Without Nitroglycerine  
With 0.4 mg Nitroglycerine
Radiation Dose Exposure

- Nature (Background) 82 %
- Man Made Radiation Imaging 18 %
  - Out of this 18 %:
    - Medical Imaging (X-ray, CTA etc) 56 %
    - Nuclear Medicine 21 %
    - Consumer products 18 %
    - Others 3 %

No federal regulation for patient radiation dose, except mammography. All follow the dictum of ALARA.
Radiation Exposure from Cardiac Imaging

- **BL**: 3 mSv
- **CXR**: 0.1 mSv
- **CS**: 2 mSv
- **Cath**: 6 mSv
- **MIBI**: 11 mSv
- **CT**: 20 mSv
- **Thall**: 29 mSv
Consistent with the “diffuse” nature of coronary artery disease, plaque development and progression is seen in various stages.
Coronary Artery Calcium

- NO CALCIFICATION (zero score)
- MODERATE CALCIFICATION
- SIGNIFICANT CALCIFICATION (high score)
Radiation Reduction Strategies

- Heart Rate Control
- Kvp and mAs
- Tube current modulation
- Prospective versus retrospective imaging
- Volume scan length


Absorbed Radiation Dose in Radiosensitive Organs During Coronary MDCTA: Effects of kVp and Heart Rate Variation: Boris Nikolic et al AJR 2010; 195:1347-1354
Reimbursement for MDCTA

- 12 Medicare districts in the country with each having autonomy about deciding which studies they would reimburse (Local Coverage Determination)

- A committee was formed of the vendors and some clinicians in order to try and curtail the reimbursement of latest imaging technologies including cardiac MDCTA.

- Reasons given for curtailment were that unless the efficacy and benefits of were clearly determined and documented through research, these would not be brought under clinical arena

- CORE 64, CORE 320, ACCURACY and several others trials have successfully demonstrated beyond doubt the value of cardiac MDCTA
Coronary MDCTA VS. Triple Rule Out

- Different protocols and contrast dynamics. Coronary: Bolus is targeted to the left circulation and clearing of the right heart.

- Triple rule out: Both right and left circulation should be well enhanced simultaneously to evaluate the aorta, pulmonary and coronary arteries.

- Triple rule out has almost twice the radiation dose of coronary alone and therefore patients who have a low clinical suspicion of PE or AAS especially younger patients, dedicated coronary imaging with radiation reduction techniques is suggested.

Coronary MDCTA vs. HS- Troponin in the ED

- Hs- Troponin is very sensitive but less specific
- Hs- Tnt may be elevated even in the absence of significant stenosis → CTA can rule out significant stenosis
- CTA can clarify non-cardiac chest pain
- New Hs- Troponin tests have not been validated in US
- Litigation consequences of a missed MI would make it difficult to implement such a strategy in the US without further validation.
Conclusion

• MDCTA accurately detects and noninvasively establishes or excludes obstructive CAD. MDCTA has the potential to substantially alter the algorithms, used for chest pain assessment in ED*.

• MDCTA of coronary arteries performs good to excellent in the diagnosis of CAD in the acute setting and can be used for early exclusion of NSTEMI or UAP in emergency department**.

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