Objectives

• Review of available radiologic examinations used to screen for coronary artery disease and abdominal aortic aneurysm
• Discussion of the current status of evidence-based imaging for these indications
Acknowledgement

• Dr. Paul Schoenhagen, Staff Physician Cleveland Clinic Heart and Vascular Institute and Imaging Institute

Coronary Artery Disease

• Multi-factorial: lifestyle and genetic factors
• Modifiable factors often overlooked until there is evidence of clinical disease
• Multiple tests and clinical assessment tools have been developed to risk stratify patients and direct treatment of hyperlipidemia, hypertension and diabetes
Coronary Artery Disease

- 6.4% of US population
- Largest cause of mortality accounting for 1 in 5 deaths (Death rate of 177.8 per 100,000 population)
- 1.5 million people who may not develop symptoms until 6th and 7th decades


Mason Sones 1958
Issues

• Do coronary calcifications predict outcome?
• Which patients should undergo non-invasive imaging?
• What is the appropriate use of coronary artery CT and MR?

Coronary Artery Calcium Scoring

Has been shown in asymptomatic patients to be predictive of coronary artery disease, but little data to support added predictive value over and above clinical Framingham model in all categories
Coronary Artery Calcium Scoring

• Associated with 4x risk of MI and coronary death in met-analysis of 9 reports with diverse, asymptomatic populations by O’Malley et al (Am J Cardiol 2000;85: 945-8)

• 2003 study by Shaw et al developed a multi-variate model incorporating calcium scores with typical clinical risk factors to predict all cause mortality. Effect found greater than predicted by other risks. RR increased from 1.6 to 4.0 above individuals with the lowest calcium burdens (Rad 2003;228:826-833)

Coronary Calcium and Framingham risk score

• Prospective study
• N=1461
• Mean f/u 7.0 years
• 84 pts AMI or CHD death
Other Non-invasive Imaging

- There is moderate amount of support to suggest that stress echocardiography be recommended prior to angiography in low-risk patients (Garber et al, Ann Intern Med 1999;130:719-728)

- As echocardiography is highly operator dependent, nuclear medicine SPECT studies may be considered as an alternative
Other Non-invasive Imaging

Coronary Angiography with CTA and MRA

<table>
<thead>
<tr>
<th></th>
<th>CTA (16-detector)</th>
<th>MRA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>98</td>
<td>93</td>
</tr>
<tr>
<td>Specificity</td>
<td>54</td>
<td>42</td>
</tr>
<tr>
<td>PPV</td>
<td>50</td>
<td>70</td>
</tr>
<tr>
<td>NPV</td>
<td>99</td>
<td>81</td>
</tr>
</tbody>
</table>

Garcia MJ et al. JAMA 2006; 296:403-411
Kim WY et al. NEJM 2001;345:1863-9
0.75 mm collimator
1 mm slice thickness

0.6 mm collimator
0.6 mm slice thickness

RESULTS OF RATINGS

The final ratings for CCT (Tables 1 to 8) and CMR (Tables 12 to 17) are listed by indication sequentially, by purpose and clinical scenario, as obtained from the second round rating sheets submitted by each panelist. In addition, Tables 9 to 11 and 18 to 20 arrange the indications into 3 main scoring categories (appropriate [median score of 7 to 9], uncertain [median score of 4 to 6], and inappropriate [median score of 1 to 3]) for CCT and CMR, respectively. Other tables, including documentation of the mean absolute deviations from the median and level of agreement for each indication, are found in the online Appendices A and B at www.acc.org. Abbreviations used in the tables and the text of this report are listed below.

J Am Coll Cardiol 2006; 48:1475-1497
### Table 1: Detection of CAD: Symptomatic

<table>
<thead>
<tr>
<th>Indication</th>
<th>Appropriateness Criteria (Median Score)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low chest pain</td>
<td>A (7)</td>
</tr>
<tr>
<td>No ECG changes and normal amines</td>
<td>U (5)</td>
</tr>
<tr>
<td>High pre-test probability of CAD</td>
<td>A (7)</td>
</tr>
<tr>
<td>No ECG changes and normal amines</td>
<td>U (4)</td>
</tr>
<tr>
<td>High pre-test probability of CAD</td>
<td>U (4)</td>
</tr>
</tbody>
</table>

#### CT Angiography

**Calcium Scoring**

<table>
<thead>
<tr>
<th>Indication</th>
<th>Appropriateness Criteria (Median Score)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low CHD risk (Framingham risk)</td>
<td>A (1)</td>
</tr>
<tr>
<td>Moderate CHD risk (Framingham)</td>
<td>U (6)</td>
</tr>
<tr>
<td>High CHD risk (Framingham)</td>
<td>U (6)</td>
</tr>
</tbody>
</table>

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**CT Angiography**

<table>
<thead>
<tr>
<th>Indication</th>
<th>Appropriateness Criteria (Median Score)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asymptomatic (Use of CT Angiography)</td>
<td>I (0)</td>
</tr>
<tr>
<td>Moderate CHD risk (Framingham)</td>
<td>I (0)</td>
</tr>
<tr>
<td>High CHD risk (Framingham)</td>
<td>I (0)</td>
</tr>
</tbody>
</table>

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**CT Angiography**

<table>
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<th>Indication</th>
<th>Appropriateness Criteria (Median Score)</th>
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<tbody>
<tr>
<td>Asymptomatic (Calcium Scoring)</td>
<td>I (1)</td>
</tr>
<tr>
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</table>
Abdominal Aortic Aneurysm

• Majority of AAA’s are the result of atherosclerosis (other causes include trauma, infection and inflammation)

Abdominal Aortic Aneurysm

• 10th leading cause of death in men over age 50 in the United States, resulting in over 15,000 deaths annually

• Responsible for 2.1% of deaths in men over the age of 65 in England and Wales (Lancet 2002;360:1531-1539). Upon rupture, 50% mortality before reaching care. 30-70% operative mortality for the remainder

• Ultrasonography has a sensitivity of 95 percent and specificity of nearly 100 percent when performed in a setting with adequate quality assurance. Abdominal palpation has poor accuracy and is not an adequate screening test
Abdominal Aortic Aneurysm

Multicenter Aneurysm Screening Study (2002) investigated the impact of ultrasound screening in a population of 67,800 men aged 65-74 years at four centers in the UK.

AAA Screening (MASS study)

- Randomized controlled trial design
- > 3 cm aneurysm followed for mean of 4.1 years
- Surgery considered if diameter increased to > 5.5 cm, if aneurysm expanded > 1 cm/year or if symptoms developed
- Health-related quality of life was measured
- Primary end-point was mortality due to AAA
AAA Screening (MASS study)

- 65 AAA related deaths in the screened group vs. 113 in the control group with a 53% risk reduction (95% CI 30-64%) in those who underwent screening
- 30 day mortality following elective surgery was 6% compared with 37% following emergency surgery
- Cost-effectiveness analysis was measured as survival free from mortality related to AAA for each patient up to 4 years and was expressed as the incremental cost per additional life year gained: mean of $51,000 ($64,600 quality adj)

US Preventive Services Task Force Recommendations

Summary of Recommendations:

- The USPSTF recommends one-time screening for abdominal aortic aneurysm (AAA) by ultrasonography in men aged 65 to 75 who have ever smoked
- The USPSTF makes no recommendation for or against screening for AAA in men aged 65 to 75 who have never smoked
- The USPSTF recommends against routine screening for AAA in women
AAA Treatment Recommendations

• In men with intermediate-sized AAAs (4.0-5.4 cm), periodic surveillance offers comparable mortality benefit to routine elective surgery with the benefit of fewer operations

• Although there is no evidence to support the effectiveness of any intervention in those with small AAAs (3.0-3.9 cm), there are expert opinion-based recommendations in favor of periodic repeat ultrasonography for these patients

• All patients are advised secondary prevention with anti-platelet therapy, statin therapy, treatment of hypertension and smoking cessation

AAA Treatment Recommendations

• Depending on co-morbidity, the indication for an operation is an AAA diameter of 5.5 cm. The anatomical characteristics of the AAA guides the choice for an open operation or endovascular aneurysm repair (EVAR).