Coronary Calcium Scoring: the Logical Way to Assess CVS Risk?

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“(Is) Coronary Calcium Scoring: the Logical Way to Assess CVS Risk?”

“Coronary Calcium Scoring: is challenging the established [and entrenched?] epidemiological concepts of CVS risk assessment ”
Assessing CVS Risk

Atherosclerosis: A highly complex, and poorly understood, ageing process of the arteries which develops over many decades

CVS Risk Assessment: A difficult task
Can Framingham Predict CVS Risk in Young ACS Patients in New Zealand?
Auckland City Hosp CCU Pts 1 June 06 to 30 June 07
J Looi, CJ Ellis et al CSANZ 2008

Pts with NZ Framingham CVS Risk > 15% over 5 Years

‘Young’ (male<55, female<65 years) n = 229 pts, no prior CVS disease
Are We Surprised that Epidemiological Studies Struggle to Accurately Detect CVS Risk for Individuals in New Zealand?
Illogical Process?

In Other Areas of Medicine, we ‘Look for Disease’
• Breast Cancer: Mammogram
• Colon Cancer: Colonoscopy

BUT
• Coronary Artery Disease: ‘Coloured Charts’ or Equations?

What happens if we ‘Look for Disease’ in Coronary Artery Disease?
• Calcium Scoring
• CT Cardiac Angiography
Calcified Coronary Arteries

- Intuitive for CVS Risk
  - Look for disease
  - Concept used elsewhere
- Coronary Atherosclerosis & calcification is the ‘End Product’ of all CVS risk factors [known or unknown]
CTA Patients have 2 ‘scans’

1. Calcium Score
2. Main Scan
Coronary Calcium Score: Agatston Method

- 30-40 contiguous slices obtained at 3mm intervals down the heart to include the entire coronary tree (ECG ‘gated’)
- ‘Agatston score’: Algorithm using density of calcium (Hounsfield Units) and the volume of calcified area
- ‘Effective’ radiation dose of ~1mSv/Scan
  - (Mammography ~1mSv)

St Francis Heart Hospital, New York, 1st prospective, population-based study:
- 4,613 asymptomatic people aged 50-70 years
- Mean age 59 (+ 6) years, 65% male
- FU at 4.3 years
- 119 CVS events
- Pts with a CVS Event had a higher CS (Agatston units) at baseline:
  - median 384 (127-800) vs 10 (0-86) p<0.0001
Using a Coronary Calcium Score (CS) threshold of > 100 Agatston units RR (95%CI):

9.6 (6.7 – 13.9) for all CVS events
11.1 (7.3 – 16.7) for all CAD events
9.2 (4.9 – 17.3) for all non-fatal MI & death

Calcium Score (CS) predicted:

CVS events independently of Framingham Risk factors and CRP (p=0.004)
Was superior to the Framingham Risk Equation (Receiver-operator curve 0.79 ± 0.03 vs 0.69 ± 0.03, p=0.0006)
Enhanced stratification of Framingham Risk categories, low, intermediate, high risk (p<0.0001)
St Francis Heart Study: Coronary Event Rates as a function of Calcium Score within Framingham Risk Groups

% per year (Observed)

% per 10 Years (Predicted)

Arad JACC 2005;46:158-65
Largest Study (25,253 Patients):
Range of Calcium Scores

Budoff et al 2007 JACC
Results

“During a mean follow-up of 6.8 +/-3 years, the death rate was 2% (510 deaths).

The CAC Score was an independent predictor of mortality in a multivariable model controlled for age, gender, ethnicity, and cardiac risk factors, p < 0.0001.
Risk-Adjustment Cumulative Survival by CAC Score

- Age
- Hypercholesterolaemia
- Diabetes M
- Smoking
- Hypertension
- FH Premature CHD
  - (Men < 55, Women < 65 Years)
Risk-Adjusted Cumulative Survival by CAC Score
Coronary Calcium & Coronary Events:  
MESA Study  
NEJM 2008;358:1336-45

Study

- Multi-Ethnic Study of Atherosclerosis (MESA: NHBLI Funded) investigates the prevalence, correlates and progression of subclinical CVS disease (Calcium score)
- Population-based sample from 6 urban communities (n=6722), no clinical CVS disease at entry:
  - White (38.6%)
  - Black (27.6%)
  - Hispanic (21.9%)
  - Chinese (11.9%)
- Median 3.8 years FU, 162 coronary events, 89 ‘major’ (MI/death from IHD)
Calcium Score & Any Coronary Events: MESA Study

NEJM 2008;358:1336-45

P<0.001
High Calcium Scores in Patients with low Framingham Risk of CVS Disease: The Auckland Experience of 1000 Consecutive Patients at Mercy Hospital

CJ Ellis, ME Legget, C Edwards, N Van Pelt, JA Ormiston, J Christiansen, H Winch, M Osborne, G Gamble.
8.8% (95% CI 6-10) of patients predicted to be at low 5 year CV risk have CT scores > 400.
Potential Identification of more High & Low-Risk Individuals using Calcium Scoring

High: > 20%

Intermediate: 10% - 20%

Low: < 10%

Estimated 10-Year AND Long-Term Risk
Coronary Calcium Score & Coronary Artery Plaque: Risk Assessment

- **Calcified** 20%
- **Fibrotic** 80%
- **Lipid Rich** 80%

PROVEN:
- Plaque Detectable by IVUS, CTAngio, Pathology

UNPROVEN (to date):
- 20%
Framingham-Based: 5 or 10-Year Risk & “Lifetime-Risk”

CVS Risk Assessment

Family History

“Modern Risk Factors”

Calcium Scoring (& CT Angiography)
Which Test is Appropriate?

CT Cardiac Angiogram
- Equivocal symptoms
- Equivocal ECG changes
- $1600
- (Usually) SX-funded
- Excellent test for selected patients
- ‘Rule Out’ significant coronary disease

Calcium Score ( Alone )
- Asymptomatic ( ONLY )
- $500
- NOT SX-funded
- ‘Screening’
- The most accurate CVS risk assessment tool
New Zealand Patients with a Family History of Cardiovascular Disease Are More Likely to be Above the 90th Percentile of an Age and Sex-Matched Population: Potential Benefits of the Calcium Scoring Tool

Background: Published studies identify a strong link between cardiovascular (CVS) disease as increased relative risk of coronary heart disease (CHD).

- Calcium scores, obtained from a cardiac computed tomography (CT) scan, are strongly predictive of atherosclerotic disease.

Aim: We sought to determine whether there is a strong association with a positive finding of clinically significant evidence.

Results (Continued):

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Relative Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family History</td>
<td>5.5</td>
</tr>
<tr>
<td>Diabetes</td>
<td>3.6%</td>
</tr>
<tr>
<td>Active smoking</td>
<td>4.4%</td>
</tr>
<tr>
<td>Hypertension</td>
<td>38%</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>47%</td>
</tr>
</tbody>
</table>

OR 1.88 (95% CI)


discussion and conclusion

Conclusion: This study demonstrates that a strong association with a positive finding of clinically significant evidence is associated with increased relative risk of coronary heart disease (CHD). Future studies are needed to further investigate this relationship.
Summary. Coronary Calcium Scoring: the Logical Way to Assess CVS Risk?

- Atherosclerosis is a complex ageing process
  - There are both genetic & environmental factors
  - Assessment of CVS risk is difficult
  - Guidelines are only guidelines!
- Epidemiological population studies do not accurately translate to an individual’s risk of CVS disease, particularly in the young or middle-aged
  - Focus on the patient in front of you!
- The current, International trend is to ‘individualise risk’
  - Add: ‘Modern’ Risk Factors
  - Add: Calcium score: It does seem logical!
  - Further momentum is likely to come from other CT cardiac angiogram studies of atheromatous plaque burden