CT Calcium Scoring & CVS Risk Assessment in 2011

(In 12 Minutes: 10 Points)

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& Auckland Heart Group:
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AHG Winter Symposium, Auckland; 6 August 2011
CVS Disease: Is it a Major Problem in New Zealand?

**Cause of NZ Deaths**
- CVS Disease: 40%
- Cancer: 30%
- ‘Other’ Cause: 30%
Expensive Treatments

Point 1: CVS Disease is an Expensive & Major Problem in New Zealand: Prevention is Better than Cure
Do We Really Understand Atherosclerosis?
Atherosclerosis: Highly Complex

Lifestyle

Genetic

Point 2: Atherosclerosis is Poorly understood: but is driven by *lifestyle* or *genetic* factors
Atherosclerosis: A Complex Ageing/Disease Process
How Do We Assess CVS Risk in New Zealand?
Framingham-Based CVS Risk Tables: Risk Factors Used in NZ

- Age (decades)
- Gender
- Diabetes Status (Y/N)
- Hypertension
- Smoker (Y/N)
- Total Cholesterol/HDL Ratio
### Additional 5% CVS Risk Factors (2003/2009 NZ Guidelines)

<table>
<thead>
<tr>
<th>Family history of premature CHD or ischaemic stroke:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• In a first-degree male relative before the age of 55 years or</td>
</tr>
<tr>
<td>• In a first-degree female relative before the age of 65 years</td>
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<table>
<thead>
<tr>
<th>Maori</th>
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<table>
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<tr>
<th>Pacific peoples or people from the Indian subcontinent</th>
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<table>
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<tr>
<th>People with both diabetes and microalbuminuria</th>
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</table>

<table>
<thead>
<tr>
<th>People who have had type 2 diabetes mellitus:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• For more than 10 years or</td>
</tr>
<tr>
<td>• Who have an HbA1c consistently greater than 8%</td>
</tr>
</tbody>
</table>

(People with the metabolic syndrome) **GONE 2009**

<table>
<thead>
<tr>
<th>IF Total Cholesterol &gt; 8 then risk &gt; 15%</th>
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<table>
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<tr>
<th>if Total Cholesterol/ HDL &gt; 8 then risk &gt; 15%</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>if BP consistently &gt; 170/100 then risk &gt; 15%</th>
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</thead>
</table>
Point 3: In NZ We Assess this Complex Ageing/Disease Process with only 6 Major and a few additional Minor Risk Factors from a 50 year-old Study of 5,600 people in the USA........
Can the USA Framingham Tables Really Predict CVS Risk: in Young ACS Patients in New Zealand?
"Your current risk right now"............[Really?!]
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

229 pts: ‘Young’ (male<55, female<65 years), no prior CVS disease
Point 4: The NZ Framingham Guideline Tables *Cannot* Predict CVS Risk in Young ACS Patients in New Zealand
We will soon have the ‘PREDICT’ New Zealand Data, so we won’t need to use Framingham Tables

[Unfortunately Wrong]
<table>
<thead>
<tr>
<th>Outcomes</th>
<th>ICD–10–AM codes</th>
<th>Number of first events (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coronary heart disease</td>
<td>I20–I25 (except I252) Acute coronary syndromes, chronic ischemic heart diseases</td>
<td>770</td>
</tr>
<tr>
<td></td>
<td>E1053, E1153, E1453 Coronary heart disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I461 Sudden cardiac death, so described</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R96 Other sudden death, cause unknown</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R98 Unattended death</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3530400–3530501 Coronary angioplasty or stent</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3531000–3531005 Percutaneous coronary intervention</td>
<td></td>
</tr>
<tr>
<td>Cardiac arrest or sudden cardiac death</td>
<td>3849700–3850304, 9020100–9020103 Coronary artery bypass</td>
<td>301</td>
</tr>
<tr>
<td></td>
<td>3863700 Re-operation for reconstruction of occluded coronary artery</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3845619 Other intrathoracic procedures on arteries of heart without cardiopulmonary bypass</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3865308 Other intrathoracic procedures on arteries of heart with cardiopulmonary bypass</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3850500 Open coronary endarterectomy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I63 Cerebral infarction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I64 Stroke, not specified as haemorrhage or infarction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I66 Occlusion and stenosis of cerebral arteries, not resulting in cerebral infarction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I678 Other specified cerebrovascular diseases</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I693 Sequelae of cerebral infarction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I694 Sequelae of stroke, not specified as haemorrhage or infarction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I698 Sequelae of other and unspecified cerebrovascular diseases</td>
<td></td>
</tr>
</tbody>
</table>
40% of Endpoints are ‘TIAs’………Is This Accurate?
Some Problems with PREDICT 10 Comparison Study: “Framingham vs. New Zealand Data”

• Framingham data collected by careful FU with Research Nurse [expensive study]

• PREDICT cohort is based on public hospital admissions linked to deaths & readmissions [cheap]
  – House surgeon & coder dependent
  – Accuracy uncertain e.g. Excess of ‘TIAs’ [40% endpoints]

• Other Inaccuracies:
  – Only 14% of eligible patients enrolled ?which
  – Silent MI, UAP, TIAs (in community): not recorded
  – Private hospital admissions: not recorded
    • PCIs/CABGs: not recorded
    • MIs/ UAP/PVD: not recorded
    • Heart failure admissions etc.: not recorded
Point 5: Unfortunately the PREDICT CVS Risk Assessment Programme is Flawed in Design

- The best Epidemiological models of CVS risk assessment are inaccurate
- PREDICT has some useful ideas, but is fundamentally flawed in design
  - Especially relying on weak endpoints to drive the study
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 of Risk Factors?

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

Point 6: Beware: CT Coronary Calcium Scoring is challenging the established [and entrenched?] epidemiological concepts of CVS risk assessment
What is a CT Calcium Score Test?

• X-Ray ‘slices’ of the heart
• 3mm Intervals
• About 50 cardiac slices per scan
• Computer-assisted algorithm
• Score relates to volume and density of calcium in the coronary arteries (Units: “Agatston”)

Coronary Artery Scanning
- SEVERE
CALCIFICATION
Images from a CT Calcium Score Test

No calcium

Heavy calcium
Does a CT Calcium Score Test Help with CVS Risk Assessment?
A Coronary Calcium Score of $\geq 100$ Agatston units

- $x$ 10 times increase risk of a CVS events

The Coronary Calcium Score

- Was superior to the Framingham Risk Equation
  (Receiver-operator curve $0.79 \pm 0.03$ vs $0.69 \pm 0.03$, $p=0.0006$)

- 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 (CVS Events)

% per 10 Years (Predicted)

Arad JACC 2005;46:158-65
High calcium scores in patients with a low Framingham risk of cardiovascular (CVS) disease: implications for more accurate CVS risk assessment in New Zealand

Chris J Ellis, Malcolm E Legget, Colin Edwards, Niels Van Pelt, John A Ormiston, Jonathan Christiansen, Helen Winch, Mark Osborne, Greg Gamble
Calcium Score & More Accurate CVS Risk Assessment: Results

CJ Ellis, ME Legget, C Edwards et al.

8.8% (95% CI 6-10) of patients predicted to be at low 5 year CVrisk have CT scores > 400
CVS Risk Assessment

Framingham-Based: 5 or 10-Year Risk & “Lifetime-Risk”

“Modern Risk Factors”

Family History

Calcium Scoring (& CT Angiography)

Point 7: A Calcium Score is MORE Predictive of CVS Risk than the Entire Framingham Equation
CT Cardiac ‘Scans’

1. Calcium Score Test

2. ‘Full’ CT Cardiac Angiogram
   [Always get a Ca Score as well!]

Point 8: There are 2 Types of CT Scan Available
Which Cardiac CT Test is Appropriate?

**Calcium Score (Alone)**
- Asymptomatic (ONLY)
- $530
- NOT SX-funded
- ‘Screening’
- The most accurate CVS risk assessment tool
- Can refer patient *only* for Ca score: Directly to an AHG Cardiologist
- **OR** refer for assessment/ETT and Ca score

**(Full) CT Cardiac Angiogram**
- Equivocal symptoms
- Equivocal ECG changes
- $1600
- (Usually) SX-funded
- Excellent test for selected patients
- ‘Rule Out’ significant coronary disease
- Need to refer patient for initial assessment [not only for a full CT Angiogram]
- (Also get a Ca Score with a full CT angiogram)
Point 9: The Radiation Dose of CT Cardiac Scans Seems to be Reasonable in the Medical Context

**Calcium Score (Alone)**

~ 1 mSv: Same as a Mammogram

**(Full) CT Cardiac Angiogram**

~ 7 mSv: Similar to an Airline Pilots (3 to 6 mSv) Annual Exposure when Flying (NB: Annual Background Dose ~ 3 mSv)
Summary: CT Calcium Scoring & CVS Risk Assessment in 2011 (In 12 Minutes!)

"Your pulse is very, very weak!"
Point 10: Calcium Score Testing is Now Here

• The CT Calcium Score Test is available **NOW**
  – Painless, proven, safe, effective

• Some patients may also be helped by a Cardiology assessment
  – Including a Calcium score/CT Cardiac angiogram

• ‘Individualised’ CVS risk assessment **is the future**
  – It focuses the problem to those who *actually develop* significant atherosclerosis

• Public patient provision for Calcium scoring *could be undertaken** NOW*
  – With time, there will [eventually] be access: be patient!