Introduction

- Calcium score : a number (or score) obtained with computerized tomography heart scan

Introduction

- Detect deposits of calcium in coronary arteries with computerized tomography.
- The amount of calcium deposited in coronary arteries is added up and a "score" is given.
- The amount of calcium in the coronary arteries varies considerably with age and gender.
- For this reason, coronary calcium scores are presented as percentile scores telling you how much calcium you have compared to other men or women of your age.

We should know…

- Negative test (Score=0) – atherosclerotic & unstable plaque unlikely
- Negative test –low risk of cardiovascular event in the next 2 –5 years
- Positive test = Atherosclerotic disease (+/-obstruction)
- If have significant obstructive luminal disease – test will be positive

We should know…

- The greater the amout of Calcium the greater the likelihood of occlusive disease BUT not 1:1 correlation
- Zero calcium $\neq$ No atherosclerotic plaque

We should know…

- No IV contrast medium
- Ideally in sinus rhythm
- CXR: 0.02 mSv (2.4 days)
- Ca Score = 75x CXR (170 days)
- CT Chest = 400x CXR (2.7 years)
- CT Abdomen = 500x CXR (3.3 years)

We should know…

A CT heart scan for coronary artery calcium scoring does **NOT:**

- ☐ predict exactly if you will have a heart attack
- ☐ provide a detailed map of coronary artery narrowings
- ☐ serve as a substitute for a coronary angiogram or stress test
- ☐ predict which artery is likely to rupture and cause a heart attack

Who needs the test ?

- ☐ Family history of heart disease
- ☐ Total cholesterol > 200 mg/dl
- ☐ Hypertension
- ☐ Tobacco use
- ☐ Diabetes mellitus
- ☐ Physically inactive
- ☐ Overweighting
- ☐ Male over age 35
- ☐ Postmenopausal female

What affects the test ?

- ☐ Fast heart rate (atrial fibrillation)
- ☐ Smoking
- ☐ Caffeine use

Prepare

- ☐ No special preparation is necessary in advance of a cardiac computed tomography (CT) examination.

- ☐ Avoid caffeine and smoking for four hours before the exam.

- ☐ Heart rate $>$ 90/min $\rightarrow$ β - blocker

Methods

- **_Agatston Score_** – Traditional method (EBCT : MDCT)

- **_Volume Equivalent_** – Plaque area x slice thickness (mm^3)

- **_Mass Equivalent_** – Plaque volume x mean plaque density (mg CaHA)

Calcium Score Guidelines

Calcium Score	Plaque Burden	Probability of Significant CAD	Implications For CV Risk	Recommendations
0	No identifiable plaque	Very low, generally <5%	Very Low	Reassure patient. Discuss general public health guidelines for primary prevention of CV disease.
1-10	Minimal identifiable plaque burden	Very unlikely, <10%	Low	Discuss general public health guidelines for primary prevention of CV diseases
11-100	Definite, at least mild atherosclerotic plaque burden	Mild or minimal coronary stenosis likely	Moderate	Counsel about risk factor modification, strict adherence with primary prevention goals.
101-400	Definite, at least moderate atherosclerotic plaque burden	Non-obstructive CAD highly likely, although obstructive disease possible	Moderately High	Institute risk factor modification and secondary prevention goals. Consider exercise testing for further risk stratification.
>400	Extensive atherosclerotic plaque burden	High likelihood (>90%) of at least one significant coronary stenosis	High	Institute very aggressive risk factor modification. Consider exercise for pharmacologic nuclear stress testing to evaluate for inducible ischemia.

Distribution - men

Percentile Rank	AGE						
MEN	40-45	45-50	51-55	56-60	61-65	66-70	71+
10%	0	0	0	1	1	3	3
25%	0.5	1	2	5	12	30	65
50%	2	3	15	54	117	166	350
75%	11	36	110	229	386	538	844
90%	69	151	346	588	933	1151	1650

Distribution - women

Percentile Rank	AGE						
WOMEN	40-45	45-50	51-55	56-60	61-65	66-70	71+
10%	0	0	0	0	0	0	0
25%	0.1	0.1	0.1	0.2	0.5	1	4
50%	0.1	0.1	1	1	3	25	51
75%	1	2	6	22	68	148	231
90%	3	21	61	127	208	327	698

Potential Roles

- Atypical chest pains
- Risk Factors for IHD
- Stress Test –Equivocal results
- Stress Imaging –Equivocal results
- Need for additional Confidence of likelihood of IHD

Recommendations

- Do not use test in isolation
- Use as part of overall assessment – symptoms and risks
- Use test only if the result will refine your risk assessment or alter management.

Prediction

- The calcium score directly correlates with the risk of cardiac events

- Higher scores: greater plaque burden and a higher the risk for cardiac events regardless of whether symptoms are present

Prediction

- ☐ Asymptomatic individuals:
  - ■ a calcium score of 0 indicates absence of detected calcium and an extremely low likelihood (<1%) of any CAD
  - ■ negative predictive value 95-100% for stenosis >50%

Prediction

- The odds ratio of developing symptomatic cardiovascular disease:
    - 3:1 for people with scores of 1 to 80
    - 8:1 for people with scores between 80 and 400 and
    - nearly 25:1 for people with scores above 400

Prediction

- The odds ratios of the traditional risk factors for coronary heart disease:
  - 1.8:1 for total cholesterol over 240 mg/dl
  - 1.8:1 for HDL under 35 mg/dl
  - 5.4:1 for diabetes
  - 3.6:1 for cigarette smoking
  - 2.6:1 for hypertension

Prediction

- Soft plaque (new atherosclerotic plaque which has not yet calcified) will be missed with EBT
  - CACS of less than 11 is associated with an extremely low rate of cardiac events rate
 - Clinical importance of soft plaques for the prediction of future events is very low

Prediction

- Stratify middle age patients for the risk of future coronary events
- Strong predictor of mortality in the elderly independent of other cardiovascular risk factors

Prediction

- University of Groningen Hospital in Netherlands
  - from 2,032 people ages 55 to 85, with a mean age of 77, who underwent EBCT calcium scoring between 1997 and 2000
  - 0-100: 47%
  - 100-500: 26%
  - >500: 27%
  - The mean duration of follow-up was 2.7 years, during which time 92 subjects died

Prediction
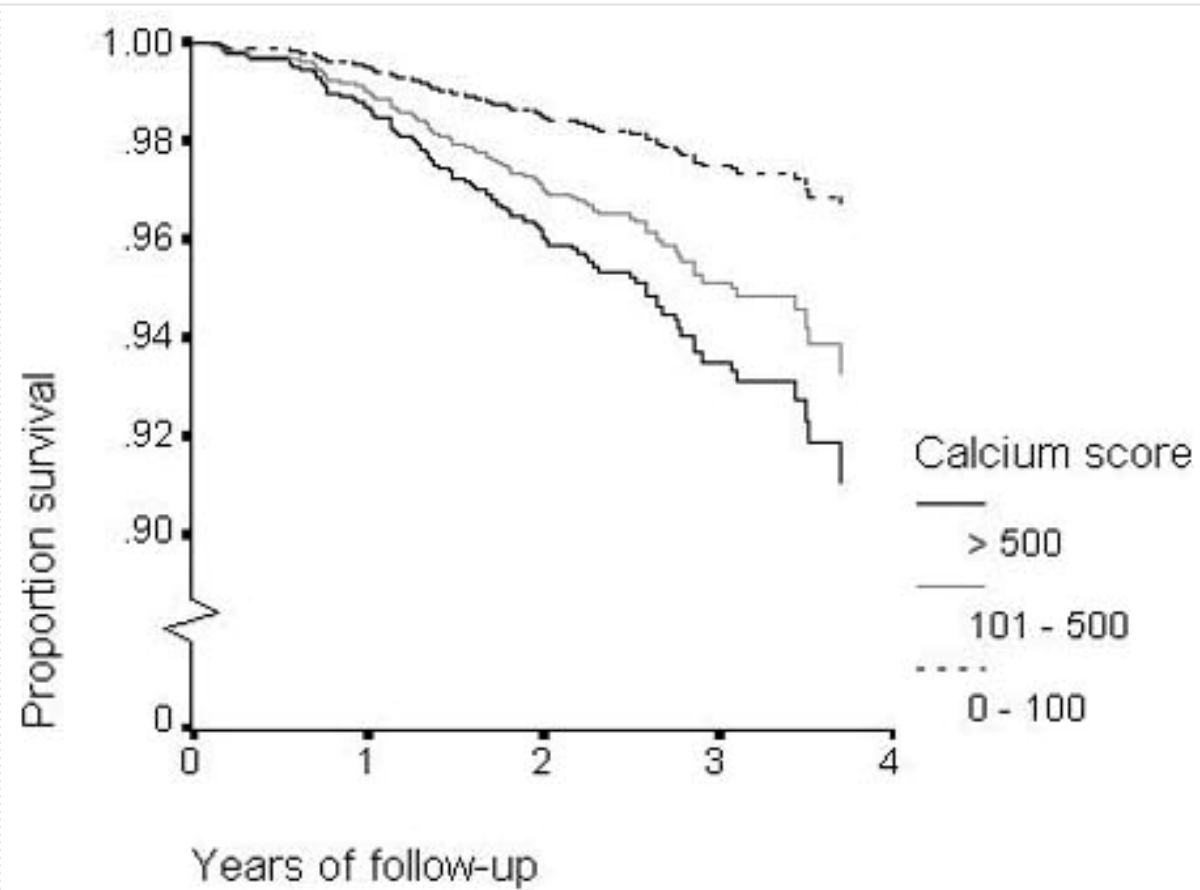
Prediction

- Calcium scores 101-500: double risk of mortality

- Calcium scores over 500: 2.7 times increased risk of mortality

- The increase in mortality
  - between the lowest and the middle category of calcium scores (0-100 and 101-500) : 12.3%
  - between the middle and the highest scores (101-500 and >500) : 23.7%

Future

☐ Integrating the Calcium Score with the Framingham Risk Score (FRS)

Future

- 2004, Johns Hopkins University in Baltimore
  - calculated the Framingham scores of 5,324 asymptomatic individuals
  - stratified into low-risk, intermediate-risk, and high-risk groups
    - Low-risk is defined as a 10 year risk of less than 10%,
    - intermediate-risk is defined as a 10 year risk of 10 to 20%
    - high-risk is defined as a 10 year risk greater than 20%
  - underwent EBCT coronary artery scanning

Framingham Score 10 yr. event risk recalculated according to Coronary Calcium Score range

Framingham 10 yr risk	CAC = 0	CAC 1-80	CAC 81-400	CAC 401-600	CAC > 600
1%	0.3%	0.6%	2%	4%	7%
2%	0.6%	1.1%	4%	7%	13%
3%	0.9%	1.7%	6%	10%	18%
4%	1.2%	2.2%	7%	13%	23%
5%	1.5%	2.8%	9%	16%	27%
6%	1.7%	3.2%	11%	19%	31%
7%	1.9%	3.8%	13%	22%	35%
10%	2.4%	5.4%	16%	25%	36%
15%	3.2%	8.3%	23%	33%	45%
20%	3.8%	9.8%	28%	38%	48%

Low-risk = Green, Intermediate-risk = Yellow and High-risk = Red

Future

☐ Alternatively, the FRS can recalculated by adding the following points for coronary calcium score ranges

CAC Score Range	Adjustment to Framingham Point Score	
	Men	Women
0	-5	-5
1 to 80	-3	-3
81 to 400	+2	+4
401 to 600	+5	+9
>600	+8	+12