

# **CARDIAC IMAGING FOR SUBCLINICAL CAD**

**WHY DON'T YOU ADOPT MORE SMART TECHNIQUE?**

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# We are talking about

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- **Coronary artery Calcium scoring, CACS**
- **Coronary CT angiography, CCTA**

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- **In subclinical CAD**

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- **Coronary CT angiography, CCTA**
  
- **In subclinical CAD**
  
- **Prognostic value ?**
- **Rule out CAD ?**

# We know that

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- **CACS is strong independent risk factor**
- **Established in large series, long term follow up outcome result**
- **In symptomatic pt. CCTA is better than CACS**

**ACCF/AHA 2007 Clinical Expert Consensus Document on Coronary Artery Calcium Scoring by Computed Tomography in Global Cardiovascular Risk Assessment and in Evaluation of Patients With Chest Pain**

*Circulation* 2007;115;402-426; originally published online Jan 12, 2007;

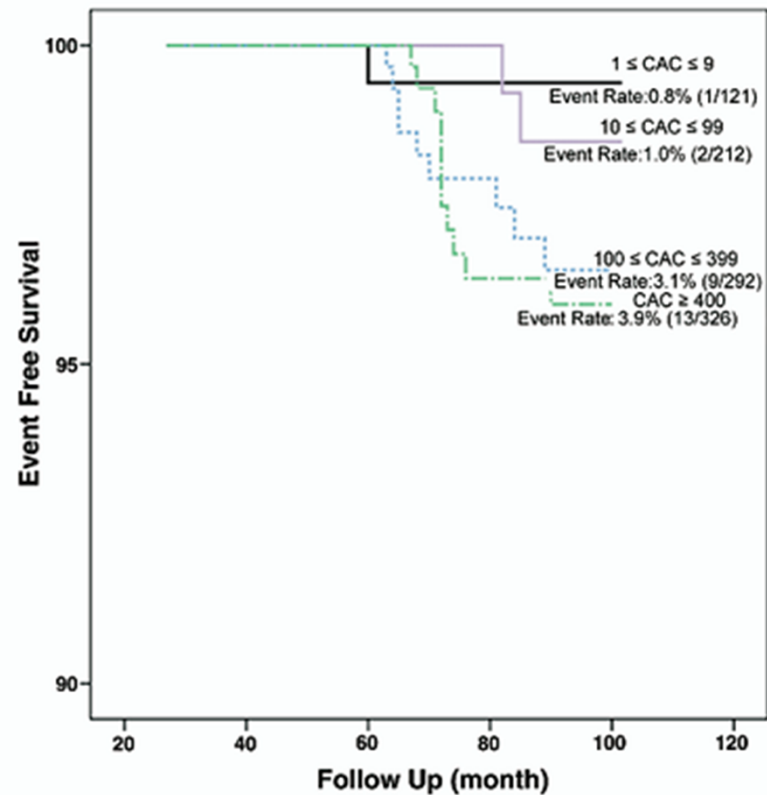
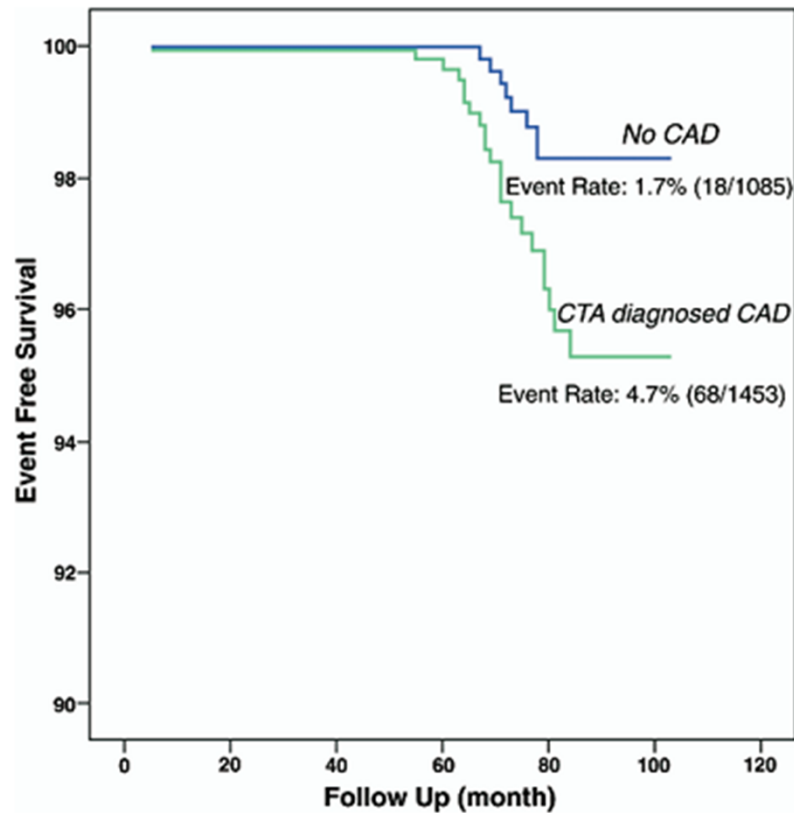
- **No clear consensus on the role of CAC testing in symptomatic patients**
- **CACS is recommended only in the intermediate risk group of the asymptomatic patients.**
- **The CASC for low risk group or high risk group is no longer recommended.**

# Question

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- **Is CCTA also good predictor of cardiac event in patient with intermediate risk?**
- **There are very limited number of study about this.**

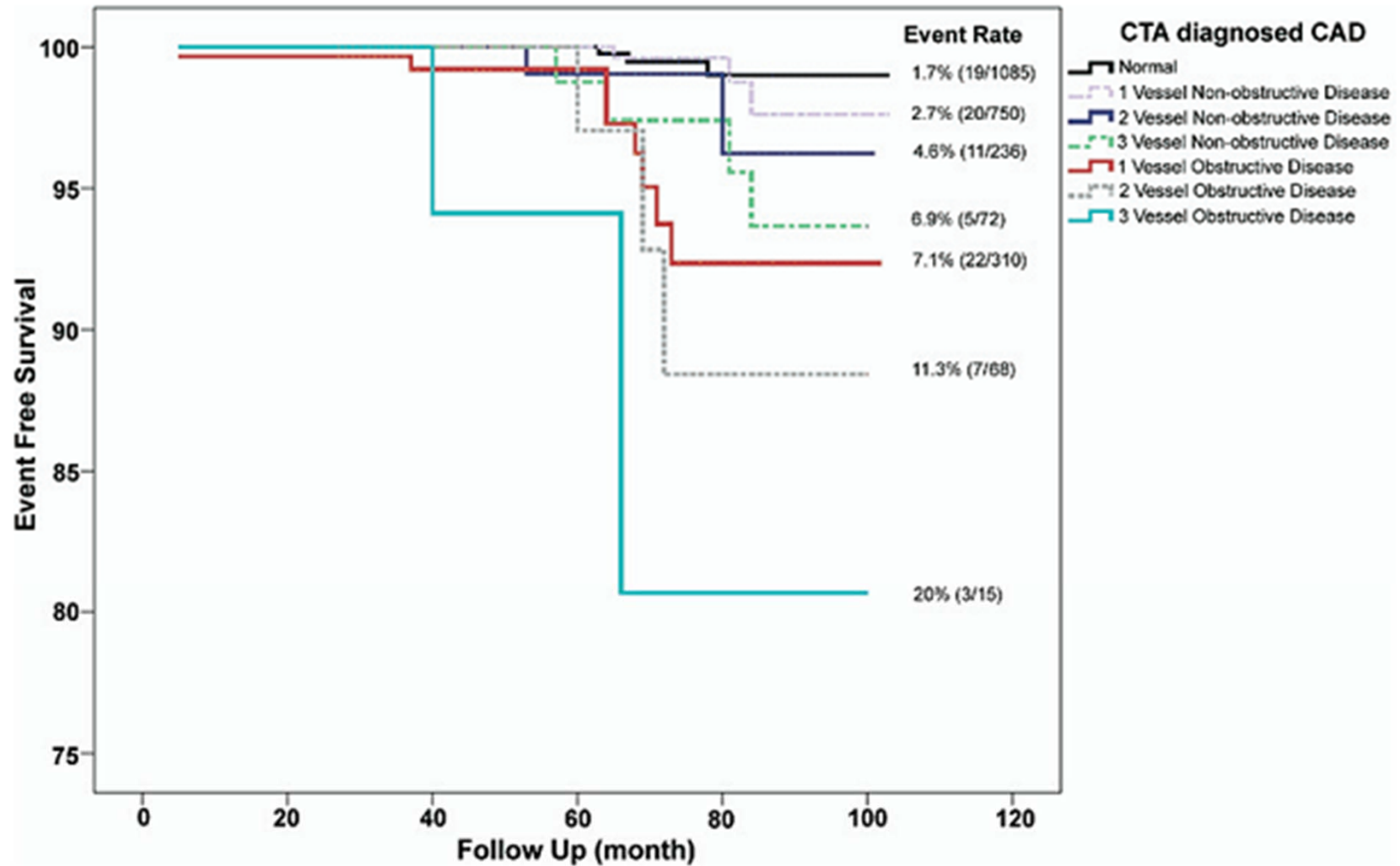
# Event-Free Survival by CCTA



- 2538 pt. over a mean of 6.5 y
- EBCT



# CCTA Event-Free Survival



# Coronary Artery Disease/Prognostic Ability of CTA and CAC

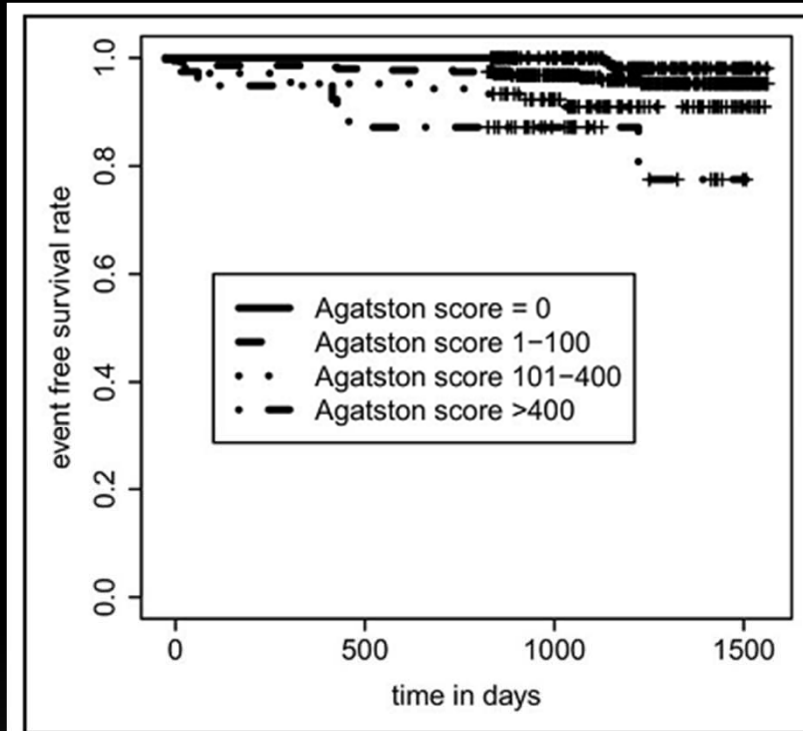


Figure 1. Event-free survival according to categories of Agatston coronary calcium score.

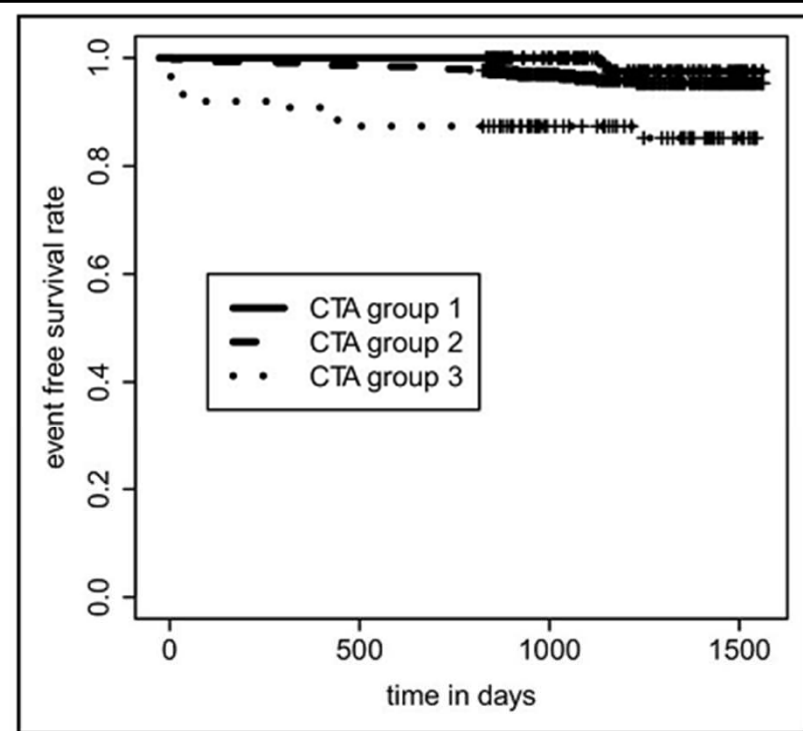
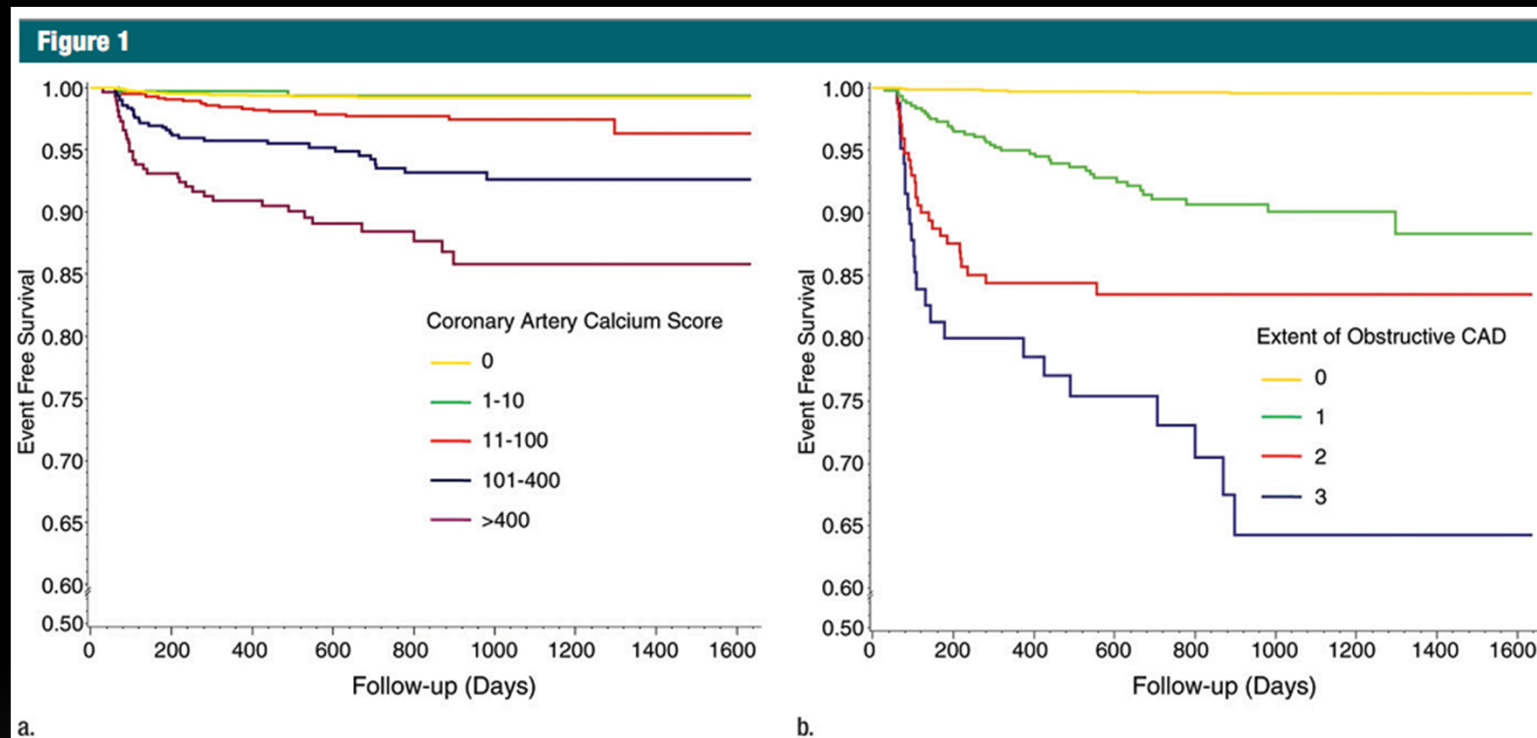


Figure 2. Event-free survival according to the 3 coronary computed tomographic angiographic groups with normal coronary arteries (group 1), minor atherosclerotic disease (group 2), and intermediate stenoses (group 3).

- 706 pt. over a mean of 3.2 y
- 64 MDCT

# Value of CACS in Low-Risk Pt



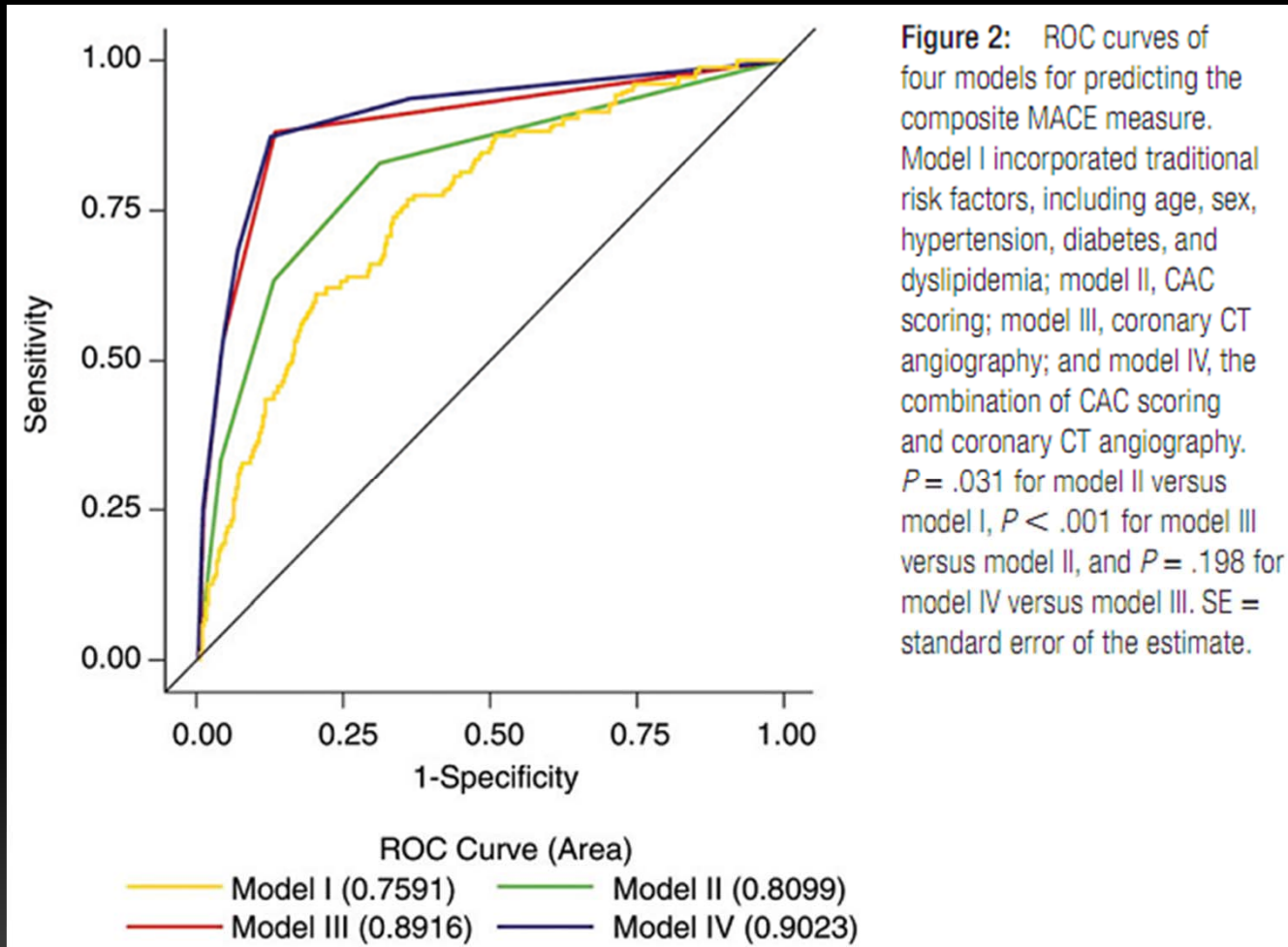
a.

b.

**Figure 1:** Adjusted survival probability plots show event-free survival. (a) Plot of survival according to CAC scoring results shows that even after adjustment, the event-free survival rate is proportionally worse as the CAC score increases. The *P* values were .666, .001, less than .001, and less than .001, respectively, for CAC scores of 1–10, 11–100, 101–400, and greater than 400 when compared with a CAC score of 0. (b) Plot of survival according to coronary CT angiography results shows that even after adjustment, event-free survival rate is proportionally worse as the extent of CAD increases. The *P* values were all less than .001 for one-, two-, and three-vessel obstructive CAD when compared with normal findings or nonobstructive CAD. Adjustments were performed for traditional risk factors, including age, sex, hypertension, diabetes, and dyslipidemia. Survival times are expressed in days.

- 3979 pt. over a mean of 2.3 y
- 64 MDCT

# Value of CACS in Low-Risk Pt



**CCTA is better than CS in predicting MACEs in low-risk patients suspected of having CAD**

# Prognostic value in subclinical CAD

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- **Limited evidence**
- **Equivocal result**
- **Relatively short follow up period of CCTA than that of CACS**

# Question

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- **Can CCTA rule out CAD in an individual?**



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# Question

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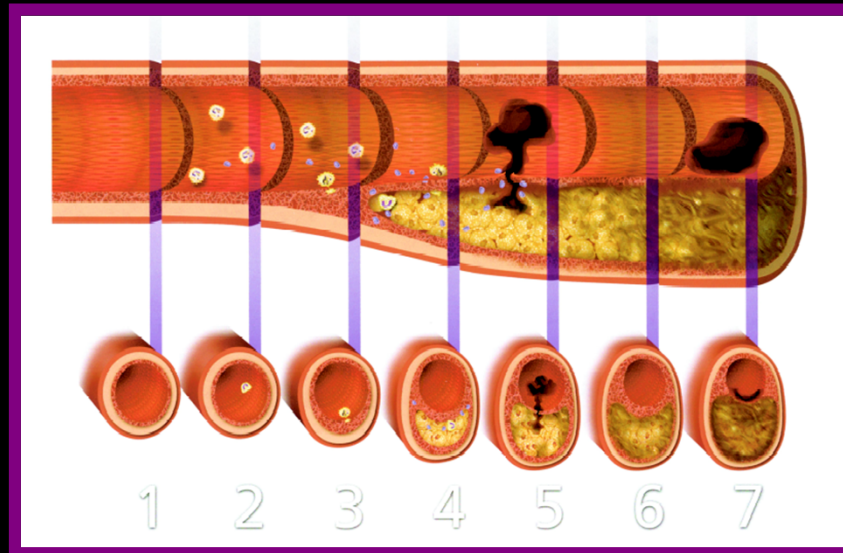
- **Is CCTA also good predictor of cardiac event ? Yes, but not superior yet**
- **Can CCTA rule out CAD in an individual? Yes!**
- **Can CACS rule out CAD in an individual?**

# CCTA vs CACS

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- **CCTA show coronary artery itself and plaque even if it is not calcified at all.**
- **CACS show only calcification of plaque**

# Atherosclerotic Plaque: Arterial remodeling



Peter Libby. Current Concepts of the Pathogenesis of the Acute Coronary Syndromes. *Circulation*. 2001;104:365-372

- AHA type of atherosclerotic plaque of coronary artery
- I. Early lesions with isolated macrophage-foam cells
- II. Multiple foam-cell layers
- III. Isolated extracellular lipids
- IV. Fibrolipid plaques with confluent extracellular lipid pools
- Va. Fibromuscular tissue layers and atheroma
- Vb. Advanced lesions with calcifications
- Vb. Advanced lesions with fibrous tissue
- VI. Complicated plaques with surface defects, hemorrhage, or thrombus deposition

Fuster. *Circulation* 1994 90 2126

# Coronary calcium scoring

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- **Calcified atherosclerotic plaque for predictive role of CACS**
- **Weak correlation of CACS with angiographic stenosis**
- **Poor correlation with histopathologic stenosis**
- **Good correlation with overall plaque burden**
  - **Ca++ area = ~20% of plaque area**
  - **Non-calcified plaque! (calcium not present or not detectable)**

# Calcium score zero

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- **The incidence of significant stenosis or high risk plaque in whom with zero calcium = 2~5%**

Prevalence of computed tomographic angiography–verified high–risk plaques and significant luminal stenosis in patients with zero coronary calcium score.

Morita H, Int J Cardiol. 2011 Mar 18.

Coronary artery disease. Calcium score of zero: not a gatekeeper to rule out coronary artery disease.

Truong Q, Rev Cardiovasc Med. 2010 Fall;11(4):271–3.

The absence of coronary artery calcification does not rule out the presence of significant coronary artery disease in Asian patients with acute chest pain.

Yoon YE, Int J Cardiovasc Imaging. 2011 Feb 24.

# Calcium score zero

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- **The absence of coronary calcification does not exclude obstructive coronary artery disease or the need for revascularization in patients referred for conventional coronary angiography.**

J Am Coll Cardiol. 2010 Feb 16;55(7):627-34. Gottlieb I et al

- Is the evidence strong enough to reduce the treatment intensity in patients with calcium score 0 in patients who are considered intermediate risk before coronary calcium score?
- **No evidence is available that allows the Committee to make a consensus judgment on this question. Accordingly, the Committee felt that current standard recommendations for treatment of intermediate risk patients should apply in this setting.**

AHA 2007 consensus document

# Comparing CACS vs CCTA

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- **Both exam are CT**
- **Radiation dose**
- **Contrast media**



# Radiation

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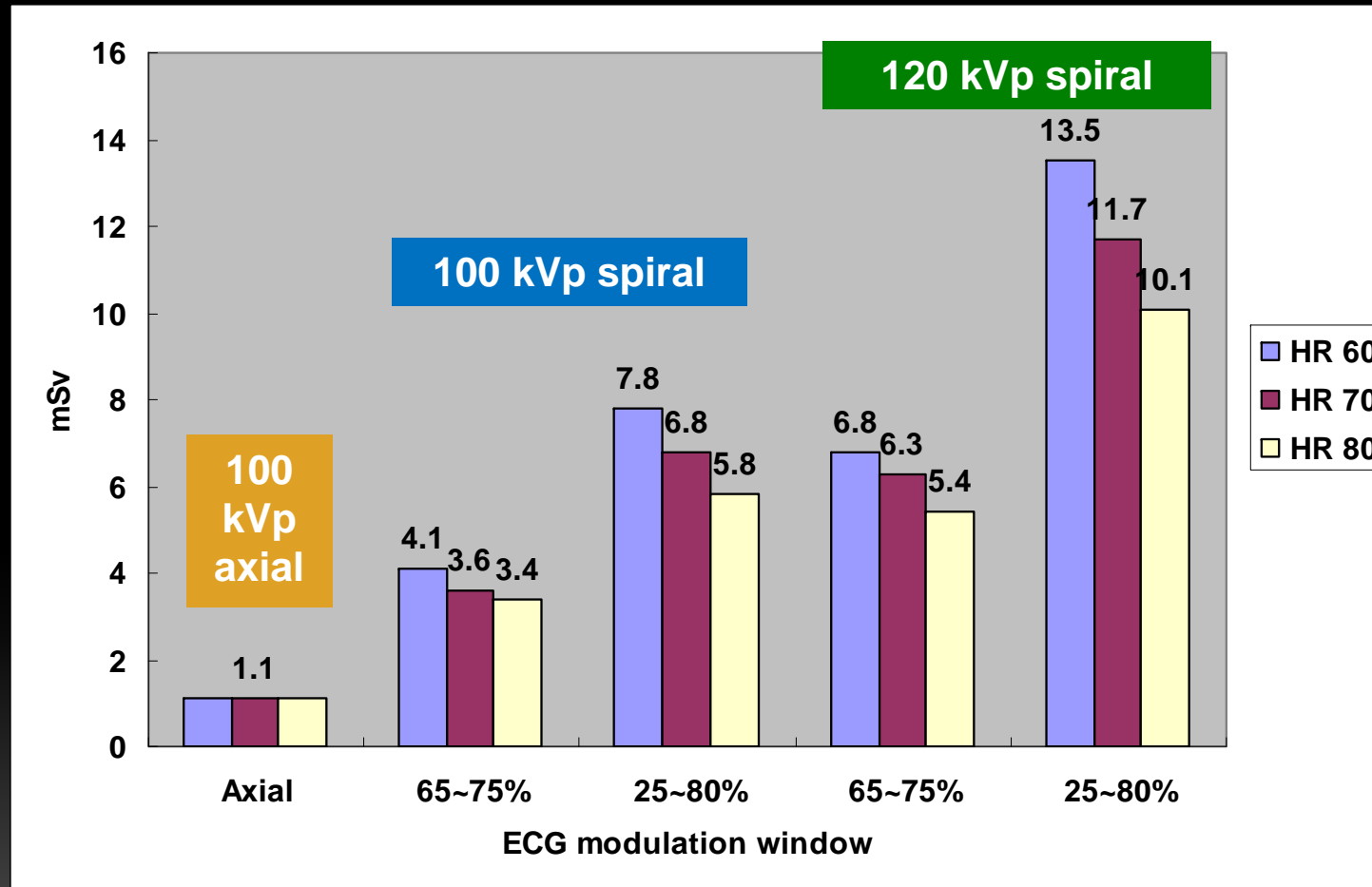
- **Which radiation dose is higher?**
  - **CACS**
  - Or
  - **CCTA**

# Radiation

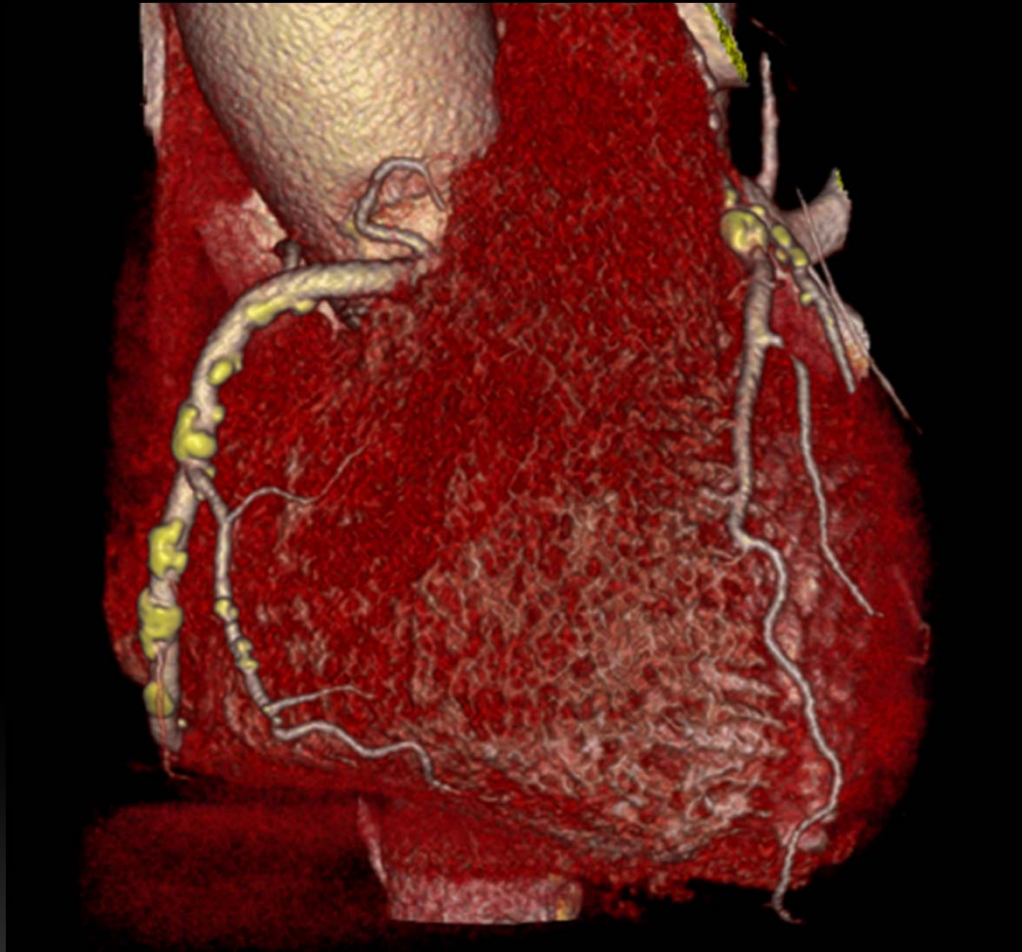
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- **Which radiation dose is higher?**
  - **CACS**
  - Or
  - **CCTA**
- **It depends on the exam protocol**

# Radiation dose of CCTA



# 640 MSCT for Cardiac Study



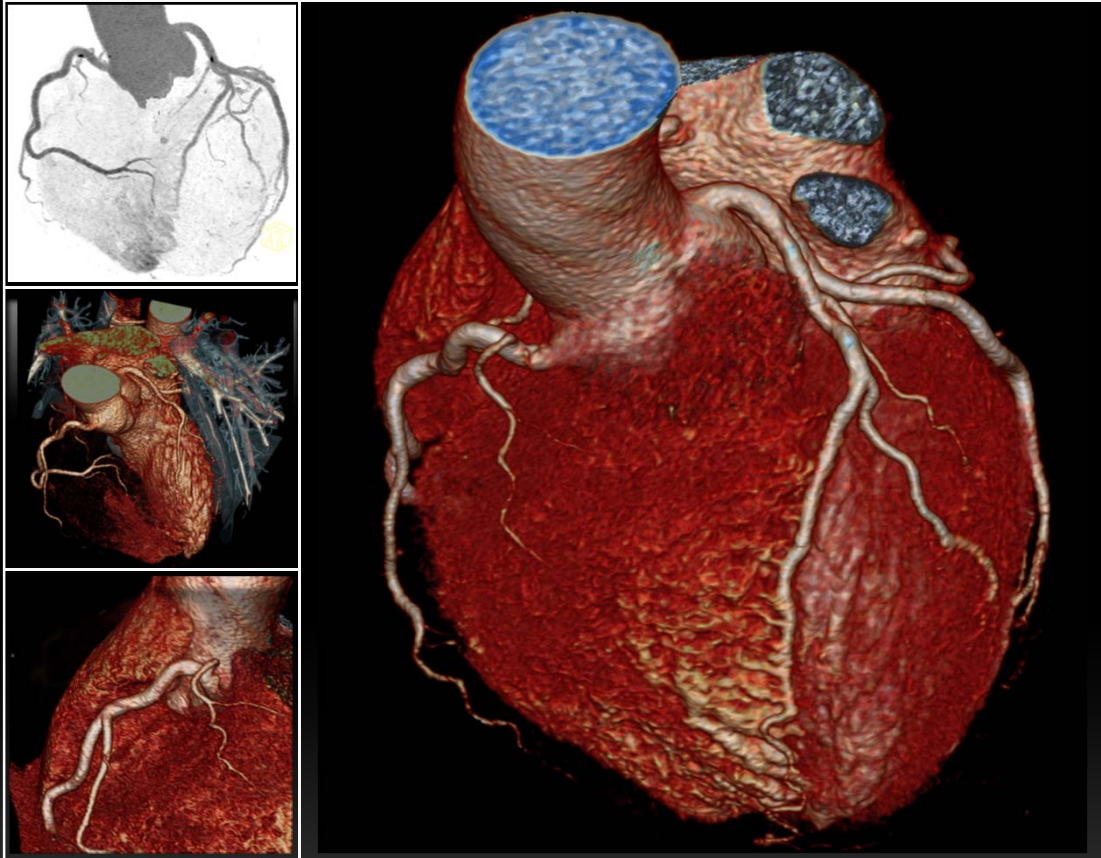
320 x 2  
<0.5 mm slice th.  
Half rotation 175 ms  
acquisition

<1 mSv



Slide from Toshiba

# Definition Flash Sub-mSv heart



**0.8 mSv**  
**250 ms acquisition**

**temp res. 75 ms**

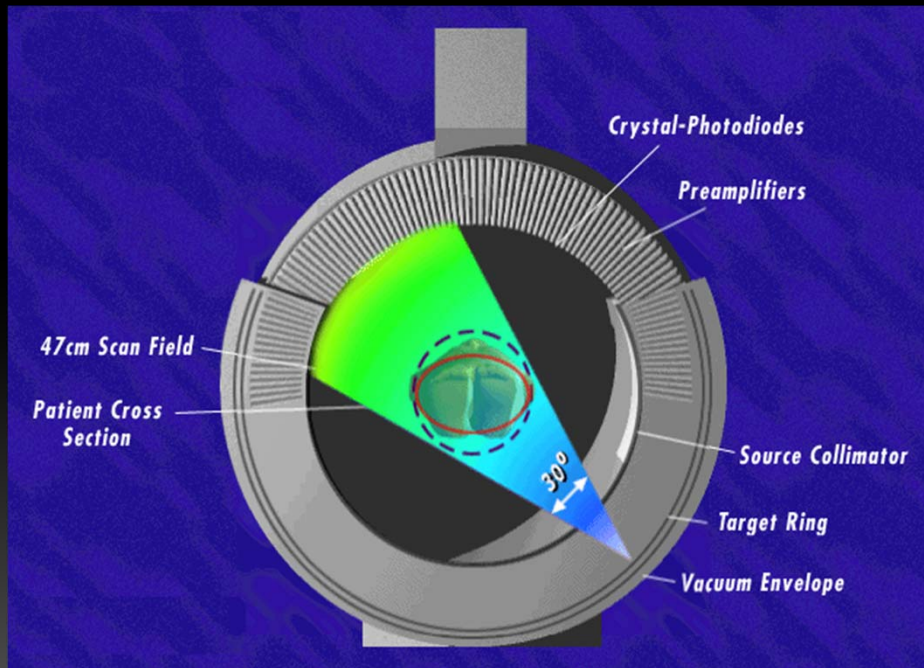
**128 (64\*0.6), Z-FFS**

**<1 mSv**

Slide from Siemens

# History of CT

- **1970**      **First clinical image of CT**
- **1984**      **EBCT – calcium scoring**
- **2005**      **clinical CCTA with MDCT**



# Summary

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- **Calcium scoring is a history**
- **CCTA can exclude CAD**
- **CCTA can used for treatment planning for individuals**

**Thank you !**

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