Coronary Artery Calcium Scoring in the Management of Heart Disease

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OBJECTIVES

1. What is CAC scoring?
2. How are CAC scores utilized in clinical decision making?
3. Who should get a CAC score?

CLASS OF RECOMMENDATION

CLASS 1 (STRONG) — Benefit >>> Risk

Suggested phrases for writing recommendations:
- Is recommended
- Is indicated/useful/effective/beneficial
- Should be performed/administered/other
- Comparative-Effectiveness Phrases†:
  - Treatment/strategy A is recommended/indicated in preference to treatment B
  - Treatment A should be chosen over treatment B

CLASS IIa (MODERATE) — Benefit >> Risk

Suggested phrases for writing recommendations:
- Is reasonable
- Can be useful/effective/beneficial
- Comparative-Effectiveness Phrases†:
  - Treatment/strategy A is probably recommended/indicated in preference to treatment B
  - It is reasonable to choose treatment A over treatment B

CLASS IIb (WEAK) — Benefit ≥ Risk

Suggested phrases for writing recommendations:
- May/might be reasonable
- May/might be considered
- Usefulness/effectiveness is unknown/unclear/uncertain or not well established

CLASS III: No Benefit (MODERATE) — Benefit = Risk
(Generally LOE A or B use only)

Suggested phrases for writing recommendations:
- Is not recommended
- Is not indicated/useful/effective/beneficial
- Should not be performed/administered/other

CLASS III: Harm (STRONG) — Risk > Benefit

Suggested phrases for writing recommendations:
- Potentially harmful
- Causes harm
- Associated with excess morbidity/mortality
- Should not be performed/administered/other

LEVEL OF EVIDENCE

LEVEL A

- High-quality evidence* from more than 1 RCT
- Meta-analyses of high-quality RCTs
- One or more RCTs corroborated by high-quality registry studies

LEVEL B-R **(Randomized)**

- Moderate-quality evidence* from 1 or more RCTs
- Meta-analyses of moderate-quality RCTs

LEVEL B-RR **(Nonrandomized)**

- Moderate-quality evidence* from 1 or more well-designed, well-executed nonrandomized studies, observational studies, or registry studies
- Meta-analyses of such studies

LEVEL C-LD **(Limited Data)**

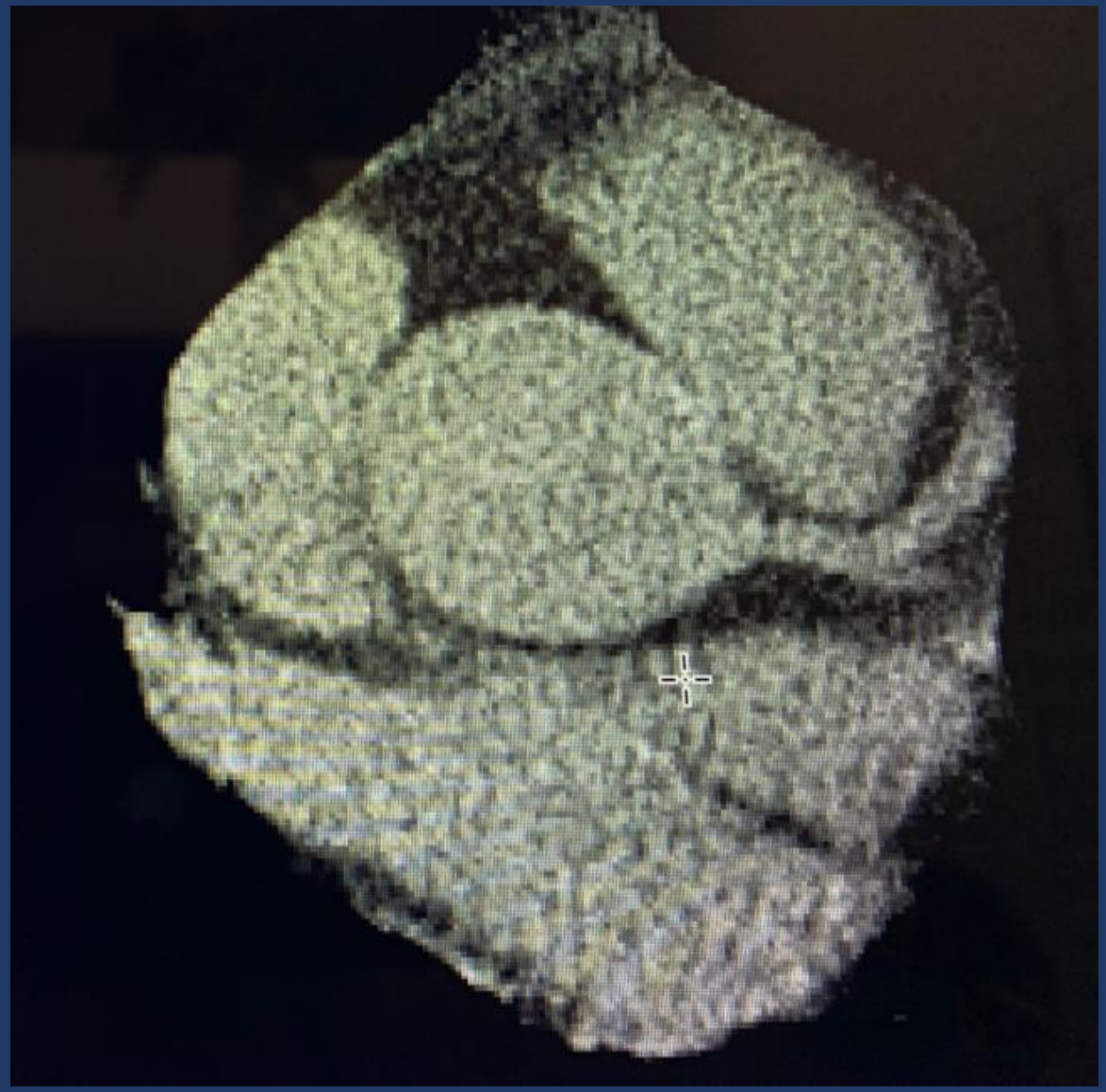
- Randomized or nonrandomized observational or registry studies with limitations of design or execution
- Meta-analyses of such studies
- Physiological or mechanistic studies in human subjects

LEVEL C-EO **(Expert Opinion)**

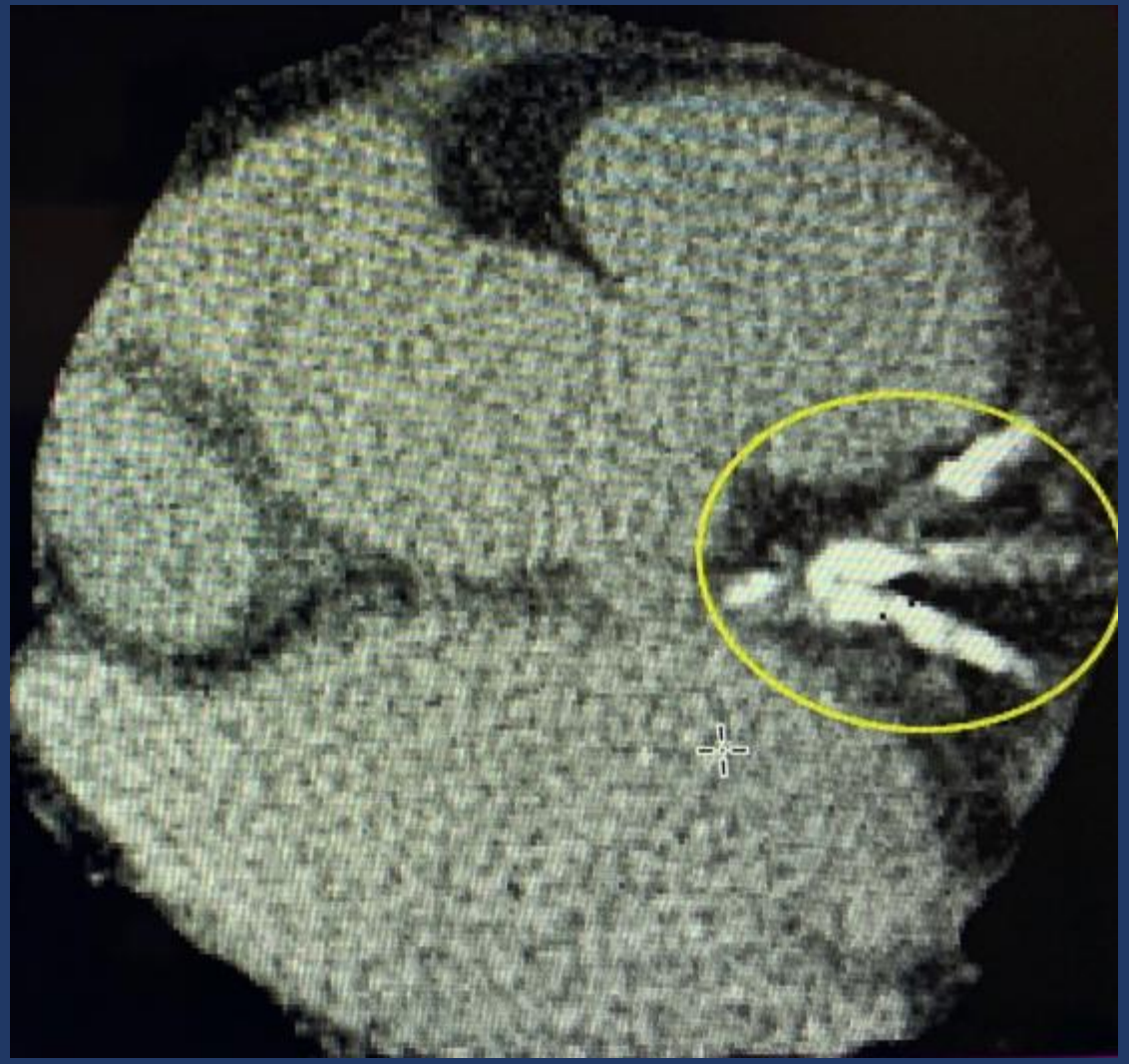
Suggested phrases for writing recommendations:

- Potentially harmful
- Causes harm
- Associated with excess morbidity/mortality
- Should not be performed/administered/other

Picture of normal CAC



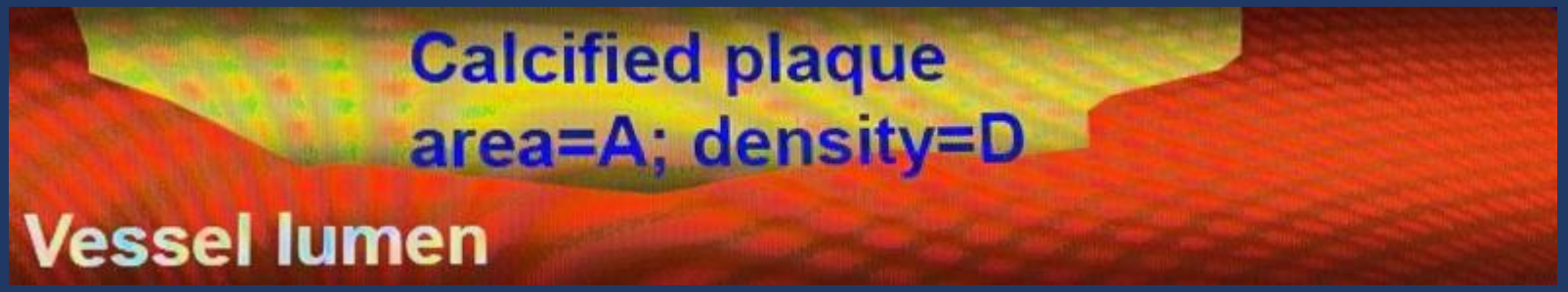
Picture of high CAC



CAC Scan Parameters

- Tube voltage of 120kv
- Variable tube current (e.g. mA) depending on patient size
- (to achieve a sufficient balance between radiation dose and image noise)
- The scans should be acquired using an axial mode with prospective ECG triggering during diastole
- Images should be reconstructed using 2.5-3mm slices for the purpose of calculating the Agatston score
- Additional thin slice reconstruction (e.g. 2mm slice thickness) may be helpful in some cases

The Agatston Score: 120 KvP Acquisition



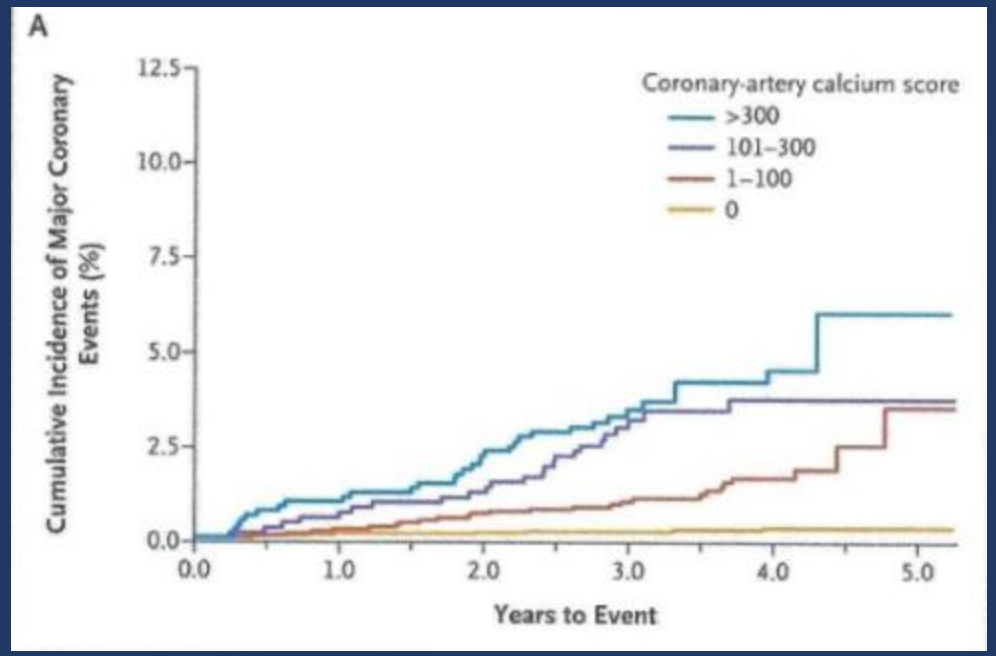
- Density = 130 – 200; coefficient 1
- Density = 201 – 300; coefficient 2
- Density = 301 – 400; coefficient 3
- Density > 401; coefficient 4

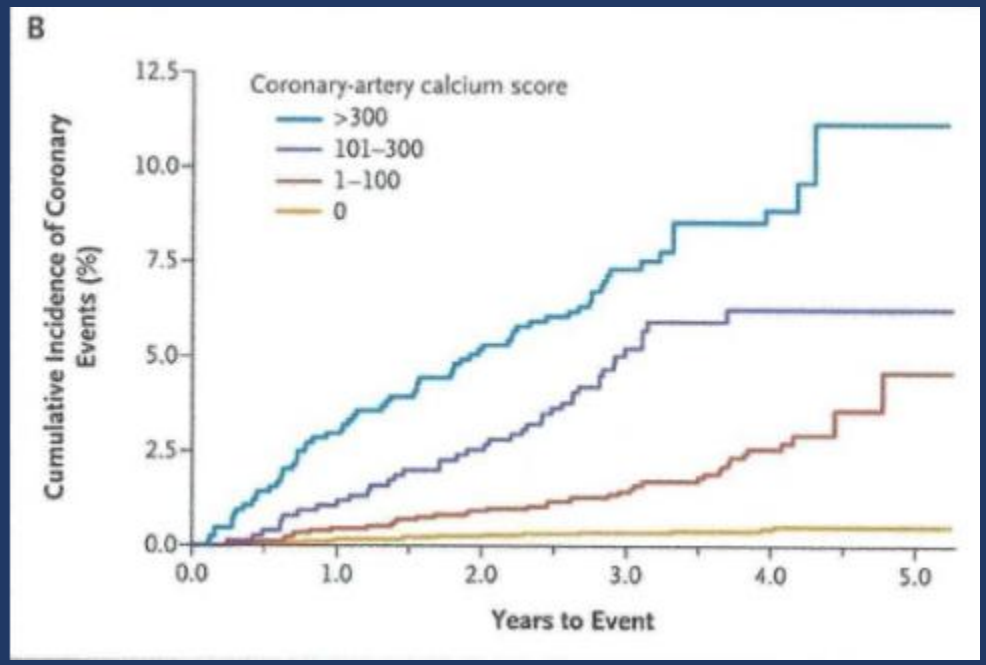
Agatston Score = $A \times D_{coef}$

CAC Scores and CV Risk

CAC Score	Plaque Burden	Implication for CV Risk
0	Minimal	Low
1-100	Definite, Mild	Moderate
101-300	Definite, Moderate	High
>300	Severe	Very High

Kaplan Meir curves: CAC versus Time





Who should get CAC scoring?

- Adults 40-75 years of age, without diabetes, with LDL-C 70-189 mg/dl and a 10 year ASCVD risk of 7.5-19% if a decision about statin therapy is uncertain.
- COR IIa, LOE B-NR
- CAC scoring can be useful to decide on the need for and intensity of preventive therapies.

CAC=0: It is reasonable to withhold statin therapy and reassess in 5-10 years as long as higher risk conditions are absent (diabetes, strong family hx of premature heart disease, cigarette smoking)

CAC=1-99 and <75th percentile: It is reasonable to initiate statin therapy for patients 55 years of age and older.

CAC>100 and/or >75th percentile: It is reasonable to initiate statin therapy

COR IIa LOE B-NR

Absolute CAC score is the best predictor of cardiac risk in all patients.

CAC percentile score predicts relative risk vs age, sex, and race/ethnicity matched peers and predicts lifetime trajectory. More useful in patients under 50.

COR I LOE B-NR

Special considerations for race/ethnicity, sex, and age: Relative ASCVD risk increases proportionally with CAC scores similarly with all races and ethnicities.

For a given CAC score incidence rates of CVD and all cause mortality are higher in Blacks and Hispanics compared to Whites and Asians.

Additional Points of importance:

- For a given CAC score, diffuse distribution of CAC suggests higher risk than more localized CAC.
- The presence of left main CAC that is >25% of the total score suggests higher risk.
- A CAC score >300 is associated with proportionately higher ASCVD risk than scores >100, a finding suggesting benefit from greater LDL-C lowering. It is reasonable to initiate a high intensity statin, and if necessary guideline based add on LDL-C lowering therapy to achieve a >50% reduction in LDL-C and optimally <70 mg/dl.

Additional Points of importance (cont):

- A CAC score > 1000 is associated with an annual risk similar to that of the placebo group in the FOURIER trial, a finding consistent with the potential value of very aggressive LDL-C lowering along with other risk reduction strategies.
- Note in those with CAC score >1000, stress testing or invasive coronary arteriography, in the absence of clinically relevant symptoms is not recommended.
- COR III (harm)

Diabetics and CAC: In adults 40-75 with DMII, and a CAC score greater than 100 it is reasonable to choose a high intensity statin.

In adults 30-39 with DMI >20 years or DMII >10 years CAC scoring may be reasonable to aid in ASCVD risk stratification and consider statin treatment.

In patients with CAC>100 it is reasonable to initiate aspirin 81 mg daily in those who do not have contraindications to such therapy.

Statins delipidate plaque, decreasing volume on non calcified plaque, and increasing volume of calcified plaque.

CAC scoring remains a risk predictor in statin treated patients similar to risk discrimination observed in statin naïve patients.

Repeat CAC scoring: it is recommenced to repeat testing based upon the estimated baseline risk of the patient, varying from 3 to 7 years in most patients. In patients with CAC of zero and no other risk factors, it is reasonable to wait 10 years.

References:

1. Orringer CE, Blaha MJ et al, The National Lipid Association Scientific Statement on Coronary Artery Calcium Scoring to Guide Preventive Strategies for ASCVD Risk Reduction, Journal of Clinical Lipidology (2021), doi: https://doi.org?10.1016/j.jacl.2020.12.005.
2. Grundy, SM., et al., 2018 AHA/ACC/AACVPR/AAPA/ABC/ACPM/ADA/AGS/APhA/ASPC/NLA/PCNA Guideline on the Management of Blood Cholesterol: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. Circulation, 2019. 139(25): p. E1082 e1143.
3. Lloyd-Jones, DM., et al., Use of Risk Assessment Tools to Guide Decision Making in the Primary Prevention of Atherosclerotic Cardiovascular Disease: A Special Report From the American Heart Association and American College of Cardiology. J AM Coll Cardiol, 2019. 73(24): p. 3153-3167.

QUESTIONS?