# Monument Health Resources

Monument Health providers & caregivers have access 24/7 to resources and tools to help us live well at home and work.

Exercise areas - Cardiac rehab/PT area in all markets are available at no cost to caregivers/providers. Excludes EXOS but membership discounts available.

Weight Management dietician visits 6-12 visits are covered if you have First Choice.

**Naturally Slim** is a new program open to all MH staff that are eligible for medical benefits (regularly scheduled to work 20+ hours/week) at no cost. This is a lifestyle program, using technology to help with weight loss, physical activity, nutrition, sleep, stress, resilience. 1st quarter results for MH:

- 217 participant
- 3% weight loss (6.1 lbs)
- 982 lbs total weight loss

Contact LiveWell at 755-8040 if we can help.

# Coronary Calcium Scoring

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MONUMENT HEALTH

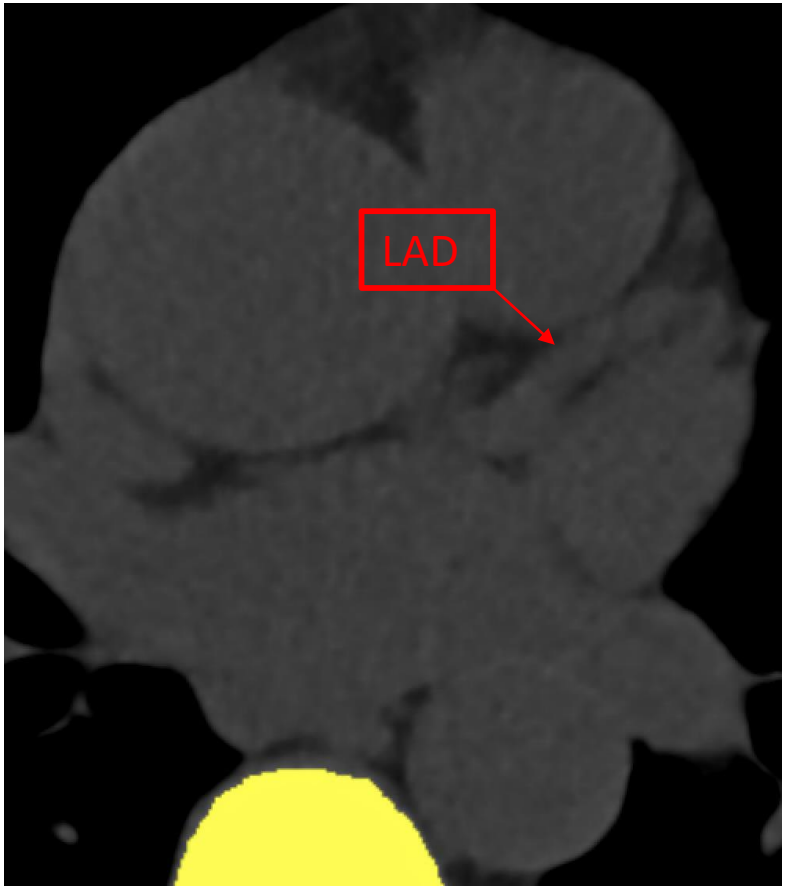
# Objectives

- What is a coronary calcium score?
- How do we use the coronary calcium score clinically?
- Is every calcium score equal?
- Is all atherosclerosis the same?
- How can we use Non-Gated CT?
- Remember the non-coronary findings

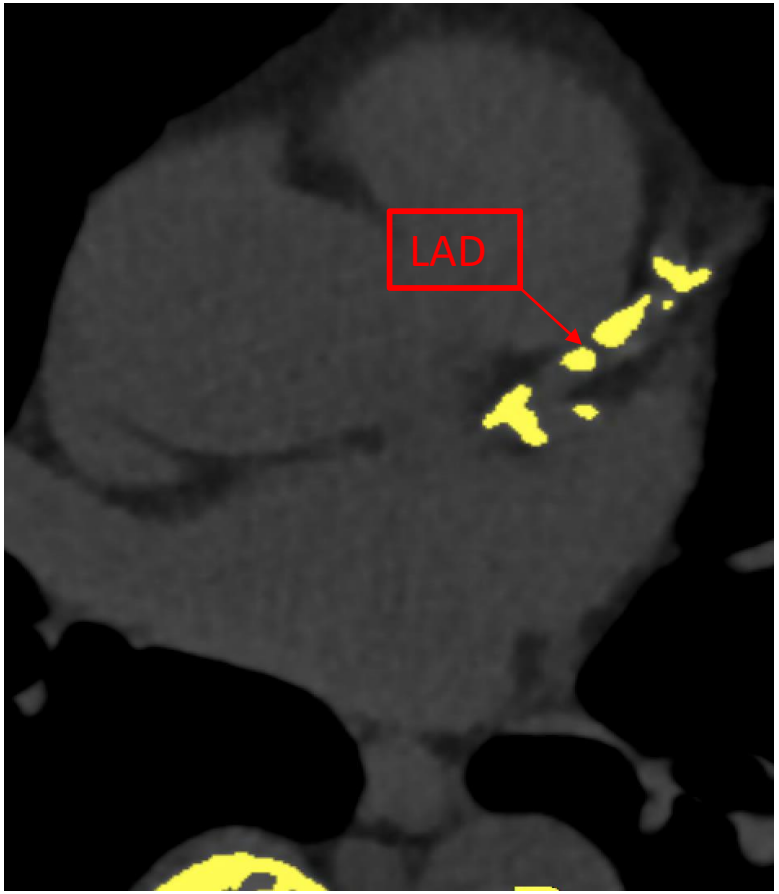
# How is CAC measured

- Hounsfield Units (HU) used in CT scans to measure radiodensity
  - Air is -1000
  - Water is 0
  - Bone is +1000
- when 3 pixels equaling 1mm^2 average >130 HU

## Normal




## Abnormal



# Radiation Equivalents

| Procedure | Effective Dose in Millisieverts (mSv) |
|---|---|
| Dental X-ray | 0.005 |
| Chest X-ray | 0.1 |
| Mammogram | 0.4 |
| Coronary artery calcium scan | 1 |
| Coronary angiography | 5 |
| Abdominal/pelvic CT scan | 10 |
| Nuclear medicine stress test with technetium-99m | 10 |
| Coronary CT angiography | 3-5 |
| Nuclear medicine stress test with thallium-201 | 22 |

# Who to Screen?

- ASCVD risk score
  - Intermediate risk patients (7.5-20%)
  - Borderline risk patients (5-7.5%)
- Framingham score
- Reynolds Risk score
- MESA risk score

No Data on Native Americans

# Additional Considerations for or against CAC Scoring

**Consider Screening Earlier**

- Strong family history
- High Lifetime ASCVD Risk

**No Screening Necessary**

- High 10 year ASCVD Risk
- LDL >190mg/dL
- Familial Hypercholesterolemia

# Important to Note

Calcium score CT’s do **NOT** detect ”soft” or noncalcified low density plaque

# Event Rates Based on Score

**TABLE 2 Summary of CAC Absolute Event Rates From 14,856 Patients in 5 Prospective Studies (11,19,21,24,25)**

| CAC Score | FRS Equivalent | 10-Year Event Rate, % |
|---|---|---|
| 0 | Very low | 1.1–1.7 |
| 1–100 | Low | 2.3–5.9 |
| 101–400 | Intermediate | 12.8–16.4 |
| >400 | High | 22.5–28.6 |
| >1,000 | Very high | 37.0 |

CAC = coronary artery calcium; FRS = Framingham Risk Score.

# Treatment Guidelines

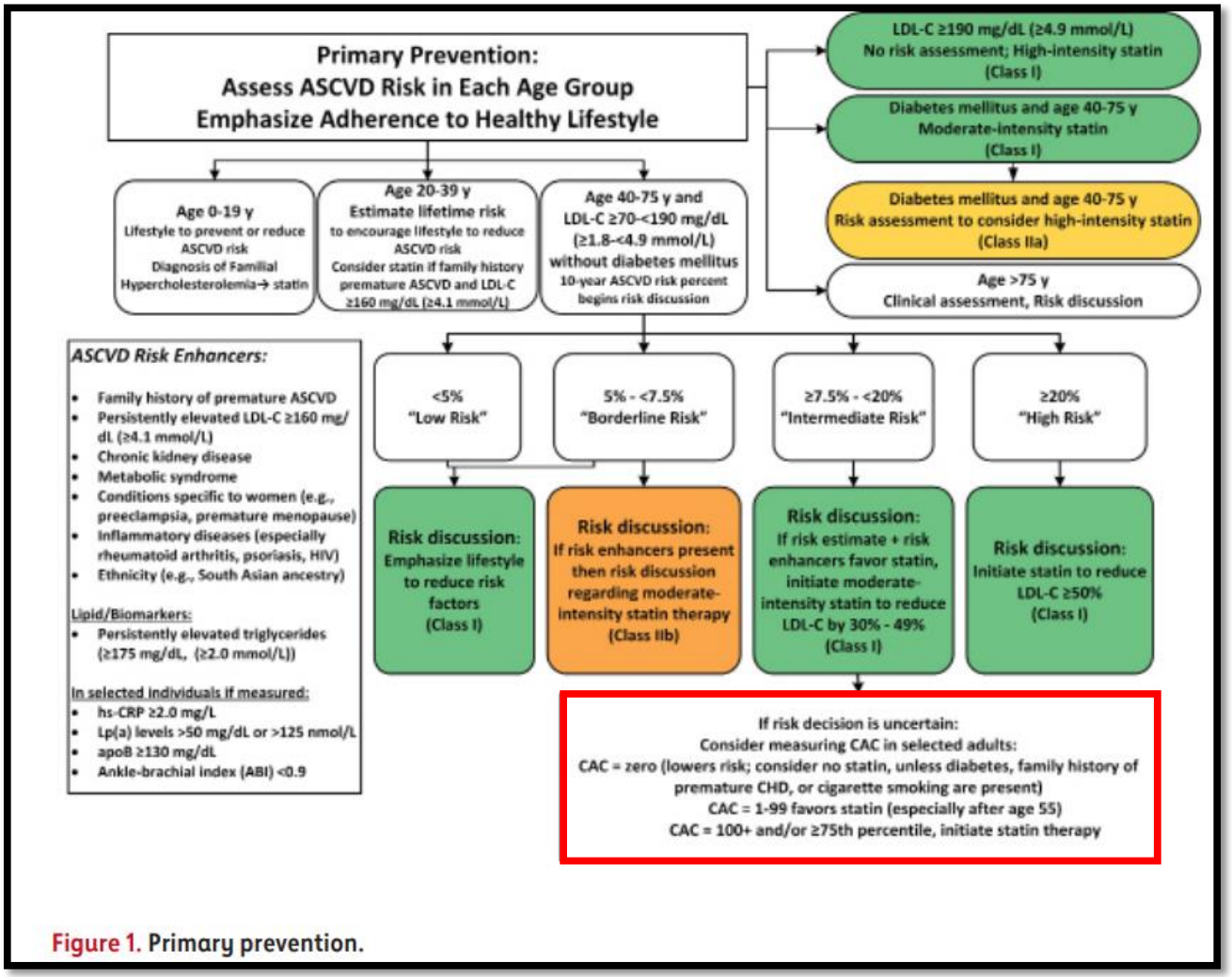



**Figure 1.** Primary prevention.

# 2017 SCCT Expert Consensus Recommendations

CAC score risk classification and treatment recommendations[1]:

| | | |
|---|---|---|
| 0 | Very low | Statin not recommended[a] |
| 1-99 | Mildly increased | Moderate intensity statin if <75th percentile<br>Moderate to high intensity statin if >75th percentile |
| 100-299 | Moderately increased | Moderate to high intensity statin + ASA 81 mg |
| >300 | Moderate to severely increased | High intensity statin + ASA 81 mg |

Excluding familial hypercholesterolemia

# MESA: 10 year CHD Risk Assessment

**1. Gender** Male ○ Female ○

**2. Age (45-85 years)** _____ Years

**3. Coronary Artery Calcification** _____ Agatston

**4. Race/Ethnicity** **Choose One**

- Caucasian ○
- Chinese ○
- African American ○
- Hispanic ○

**5. Diabetes** Yes ○ No ○

**6. Currently Smoke** Yes ○ No ○

**7. Family History of Heart Attack** Yes ○ No ○
(History in parents, siblings, or children)

**8. Total Cholesterol** _____ mg/dL or _____ mmol/L

**9. HDL Cholesterol** _____ mg/dL or _____ mmol/L

**10. Systolic Blood Pressure** _____ mmHg or _____ kPa

**11. Lipid Lowering Medication** Yes ○ No ○

**12. Hypertension Medication** Yes ○ No ○

Calculate 10-year CHD risk

# MESA: CAC comparison

Input your age, select your gender and race/ethnicity, input (optionally) your observed calcium score and click "Calculate".

**Age (45-84):**

**Gender:** female

**Race/Ethnicity:** black

**Observed Agatston Calcium Score (optional):**

Calculate

# How to Manage score >400

- Consider cardiac stress testing
- ASA 81mg + High Intensity Statin
- Cardiology referral if stress test positive
- Always reach out when needed!

# Stress Testing Based on CAC Score

- Incidence of Positive Nuclear Stress Test with corresponding CAC score
  - CAC <100 = 1.3%
  - CAC 100-400 = 11.3%
  - CAC >400 = 35%
- ISCHEMIA Trial
- Never appropriate to proceed directly with LHC in asymptomatic patients based on CAC score alone

# Medication Adherence

**TABLE 5** Effect of CAC Scanning on Primary Prevention Patient Adherence

| First Author (Ref. #) | N | Follow-Up, yrs | CAC | Statin |
|---|---|---|---|---|
| Kalia et al. (47) | 505 | 3.6 | >400 | 90% |
| | | | 100-400 | 75% |
| | | | 1-99 | 63% |
| | | | 0 | 44% |

# The Power of Zero

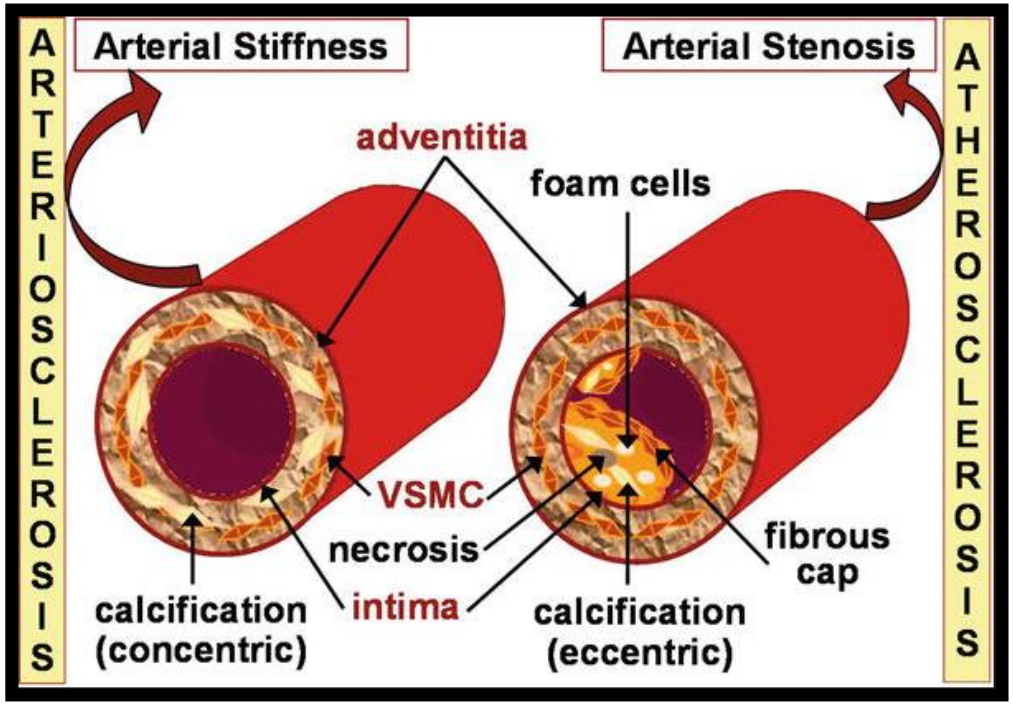
**TABLE 3 Reclassification of FRS Risk by CAC Primary Prevention Outcome Studies**

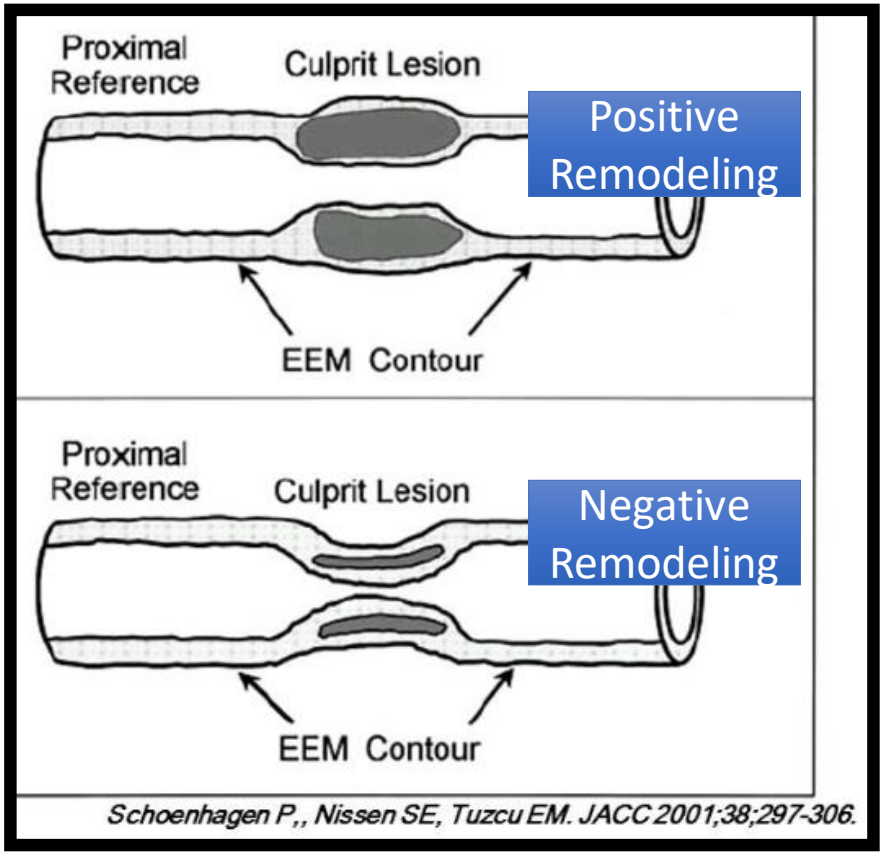
| Study | % Reclassified | N | Age, yrs | Follow-up, yrs |
|---|---|---|---|---|
| MESA (31) | | 5,878 | 62.2 | 5.8 |
| FRS 0%–6% | 11.6 | | | |
| FRS 6%–20% | 54.4 | | | |
| FRS >20% | 35.8 | | | |
| NRI | 25 | | | |

**Caution in High Risk Patients**

- **NPV >99% with score of 0**
- Budhoff 2007 cohort study followed 25k patients for up to 12 years with 0 score and they had low CV mortality rate

# Vascular Disease Types



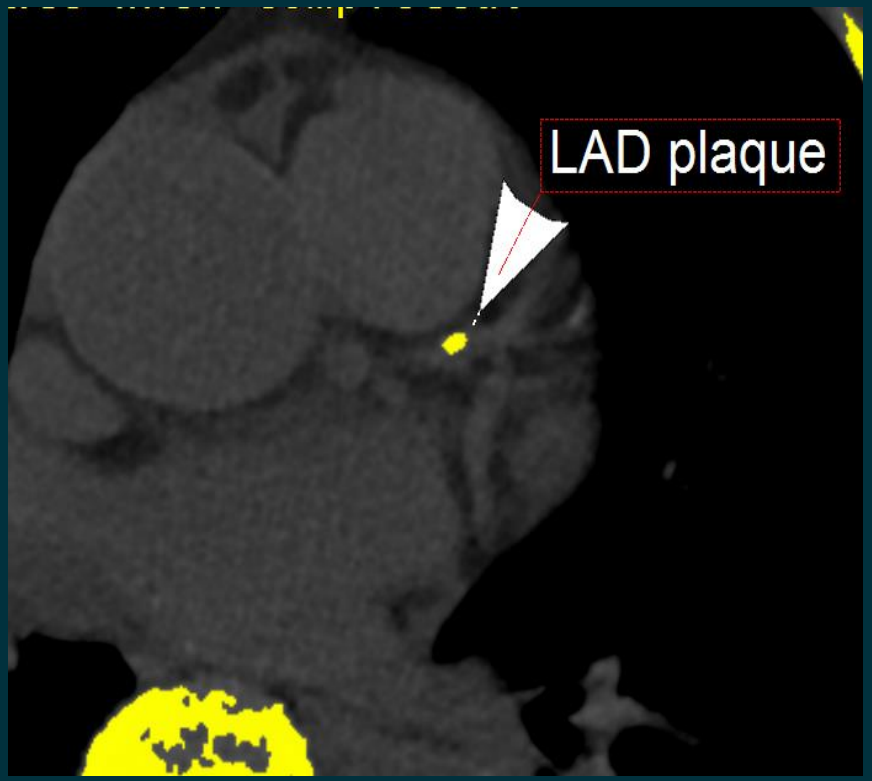
# Is All Plaque Equal?

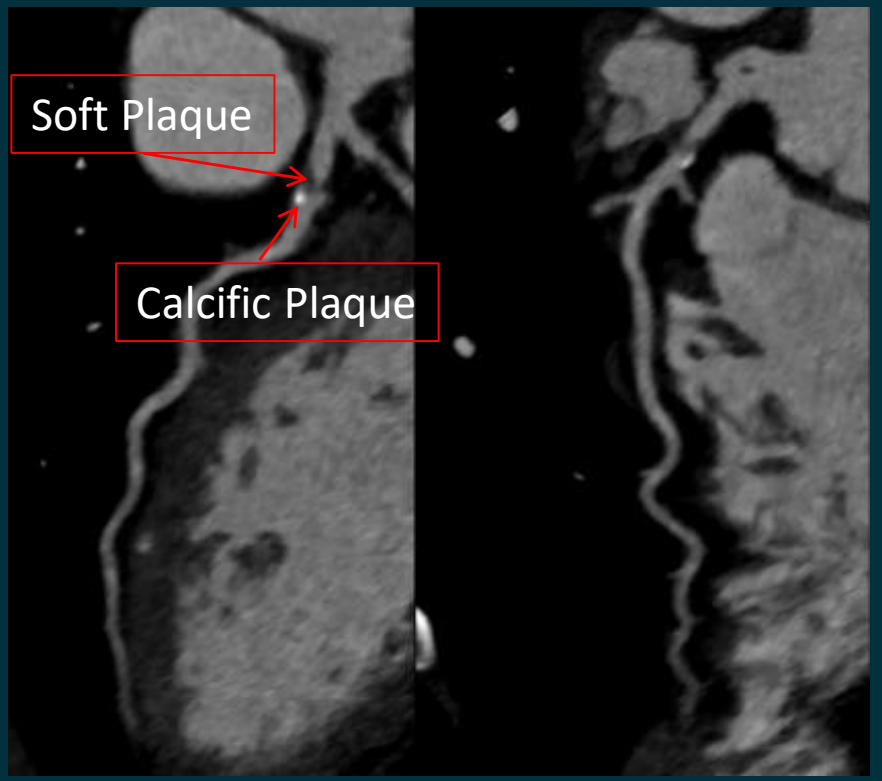
- CAC score has poor sensitivity with degree of obstruction
- Spotty calcification
- Eccentric/positive remodeling
- Noncalcified plaque <30 HU
- Amount of noncalcified plaque
- Location of plaque
- Multivessel plaque
- Napkin Ring sign

**NO!!!**

# Case Report 1

| Coronary Calcium | Coronary CT angiogram of same plaque |
| --- | --- |



# Case Report 2

**MESA score and Recommendations**

Based on Mesa risk score, patient is 98th percentile for age, gender and race with a total coronary calcium score of 499. Would strongly consider high intensity statin therapy and ASA 81mg. Stress testing would also be reasonable. There is multi-vessel CAD and appears to involve the distal left main, proximal LAD and LCx. There is also plaque throughout the proximal RCA. Image of patients LAD plaque is copied in below to review with her. Noncoronary structures are being over read by radiology.

**Aorta**

- Size: normal
- Calcium: mild aortic plaque
- Orientation: right and posterior of PA

**Pulmonary artery**

- Size: normal

**Pericardium**

- Thickness: normal
- Effusion: none
- Calcification: none

**Coronary Arteries**

- Location: normal
- Calcium Score Total: 499

# Case Report 3

**MESA score and Recommendations**

Based on Mesa risk score, patient is 47th percentile for age, gender and race with a total coronary calcium score of 99. Would consider starting at least moderate intensity statin therapy, however given that the plaque is located throughout the proximal and mid LAD, would not be unreasonable to start high intensity statin therapy and consider aspirin 81 mg daily. An image of patient's LAD plaque is copied and below for review with him. Noncoronary structures are being over read by radiology. Additionally the pulmonary artery appears dilated and may represent underlying pulmonary hypertension, consider echocardiogram to evaluate pulmonary pressures.

**Aorta**

- Size: normal
- Calcium: None
- Orientation: right and posterior of PA

**Pulmonary artery**

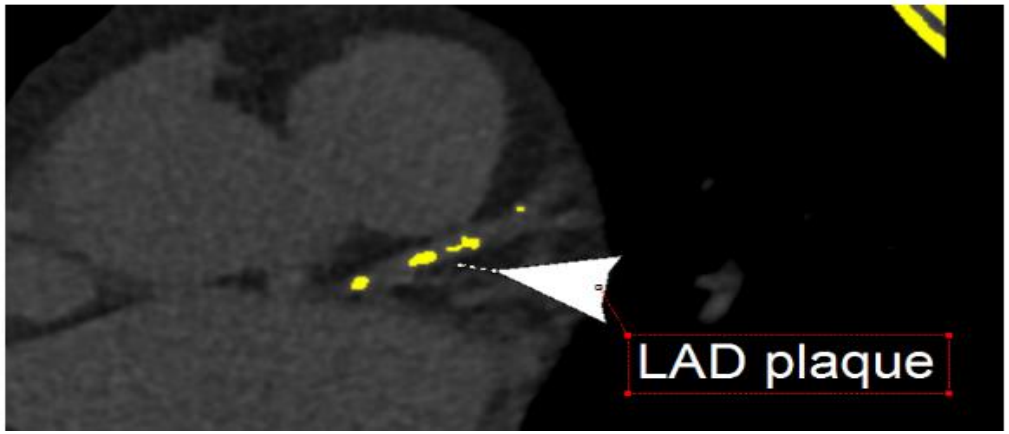
- Size: Dilated at 3.2 cm

**Pericardium**

- Thickness: normal
- Effusion: none
- Calcification: none

**Coronary Arteries**

- Location: normal
- Calcium Score Total: 99



# Case Report 4

**MESA score and Recommendations**

Based on Mesa risk score, patient is 57th percentile for age, gender and race with a total coronary calcium score of 10. Given LDL greater than 190 mg/dL would strongly consider starting patient on high intensity statin therapy, especially in light of calcific plaque. When the LDL is greater than 190 mg/dL there is concern for familial hypercholesterolemia and the burden of soft plaque may be grossly underestimated by a coronary calcium score. Noncoronary structures being read by radiology. An image of patient's right coronary artery plaque is copied and below to review with her.

**Aorta**

- Size: normal
- Calcium: Mild aortic plaque
- Orientation: right and posterior of PA

**Pulmonary artery**

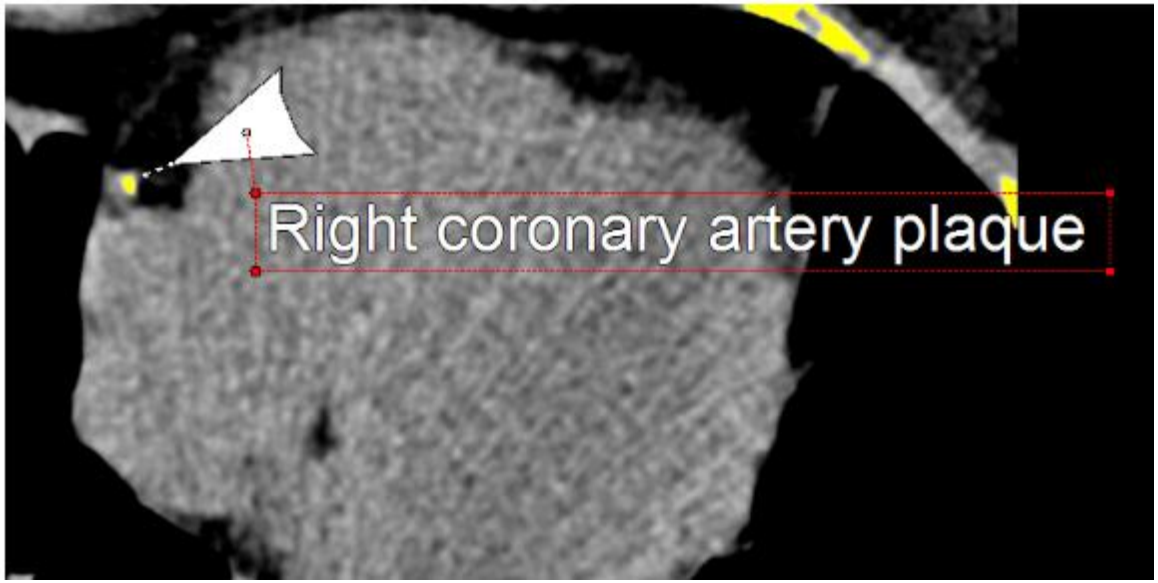
- Size: normal

**Pericardium**

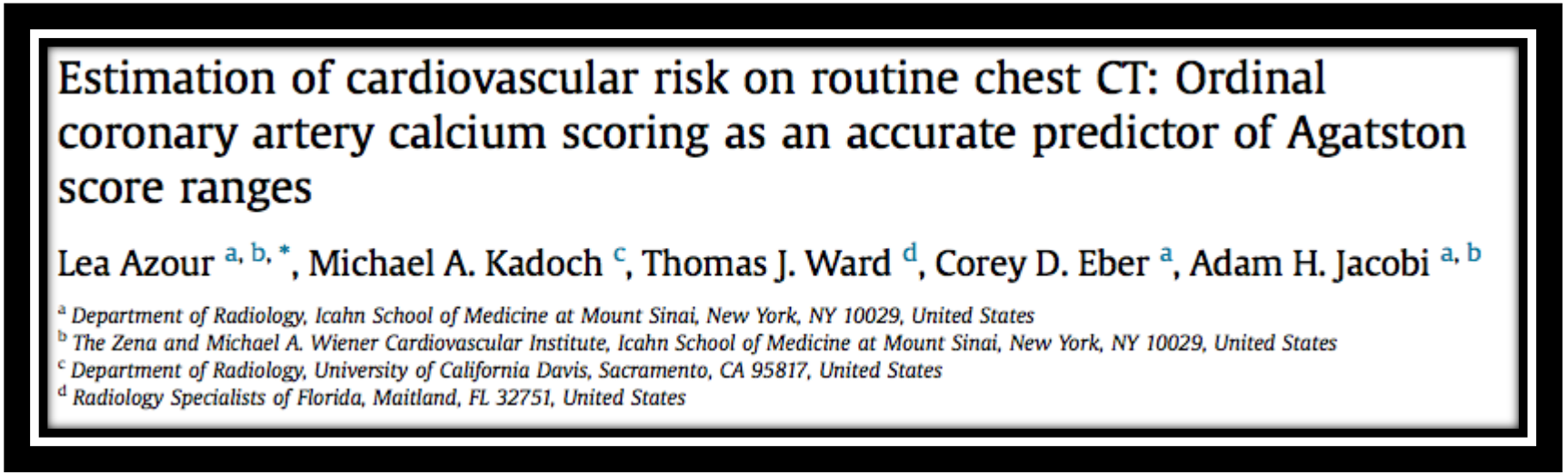
- Thickness: normal
- Effusion: none
- Calcification: none

**Coronary Arteries**

- Location: normal
- Calcium Score Total: 10



# Non-Gated CT



Estimation of cardiovascular risk on routine chest CT: Ordinal coronary artery calcium scoring as an accurate predictor of Agatston score ranges

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- Calculating the Oridinal Score to Compare to the Agatston Score
- Identify coronary artery if no plaque then 0, if <1/3 of vessel then 1 point, if 1/3 to 2/3 of vessel then 2 points, if >2/3 of vessel then 3 points
- Repeat for each vessel and add the points for each vessel

# Non-Gated CT

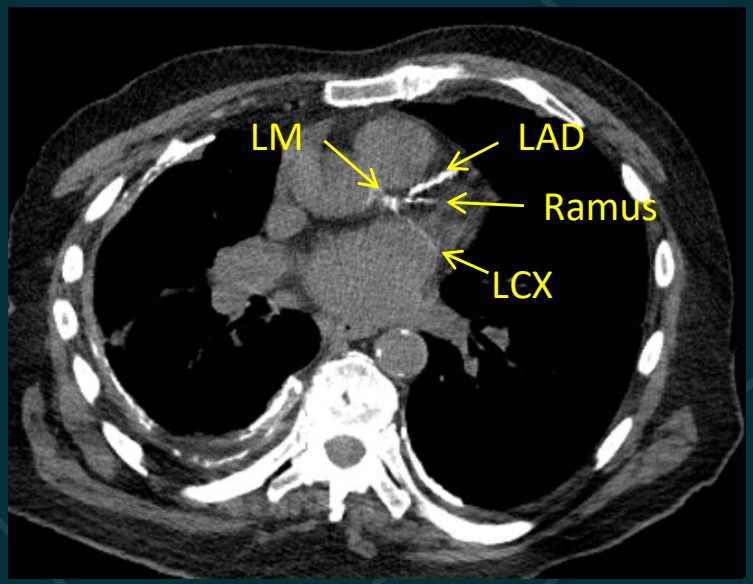
| Ordinal Score | Coronary Artery Calcium | Criteria[+] | Probability of Cardiovascular Risk Relative to Age and Gender Matched Peers[+] |
|---|---|---|---|
| 0 | Absent | Total ordinal score of 0 in men over 55, and women over 65, years | Low |
| ≥1 | Present | Total ordinal score ≥ 1 in an individual ≤ 45 years | High |
| 1-3 | Mild | Total ordinal score ≥ 1 in any individual | Variable |
| 4-5 | Moderate | | |
| ≥6 | Severe | Total ordinal score ≥ 6 in any individual | High |

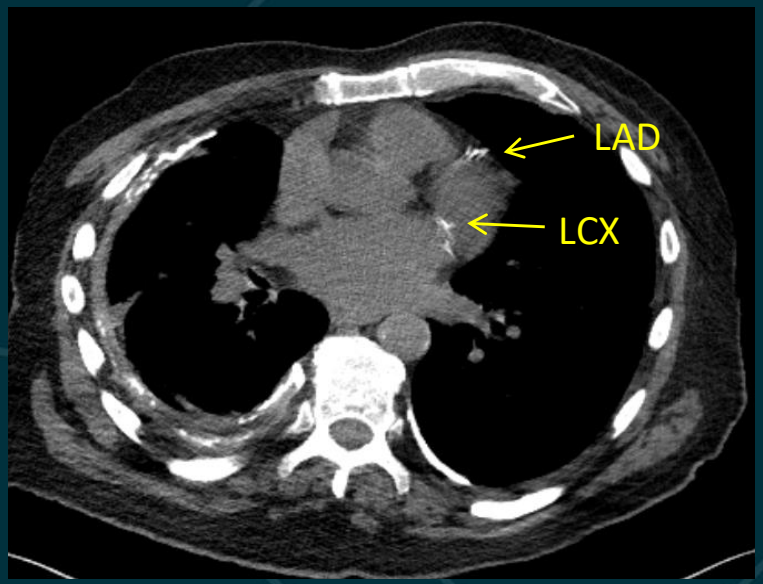
[+] Based on MESA demographic data.

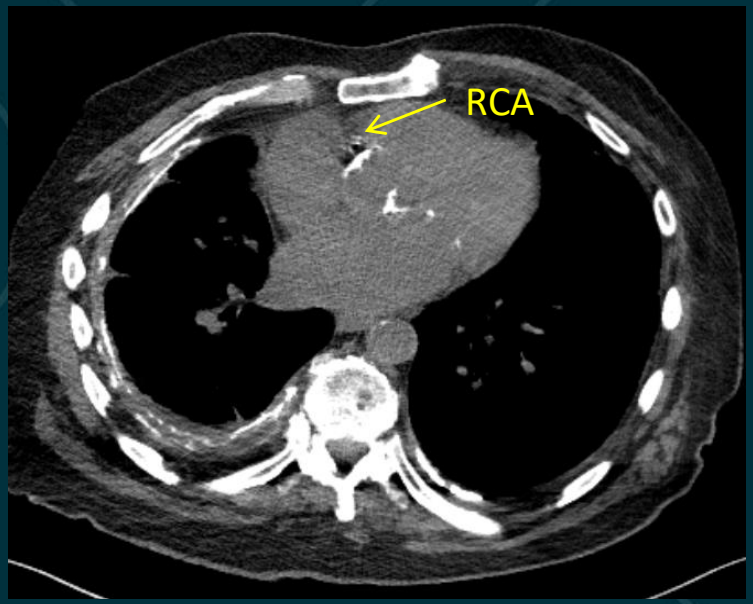
**Table 2**
Ordinal score ranges as a correlate to Agatston scores.

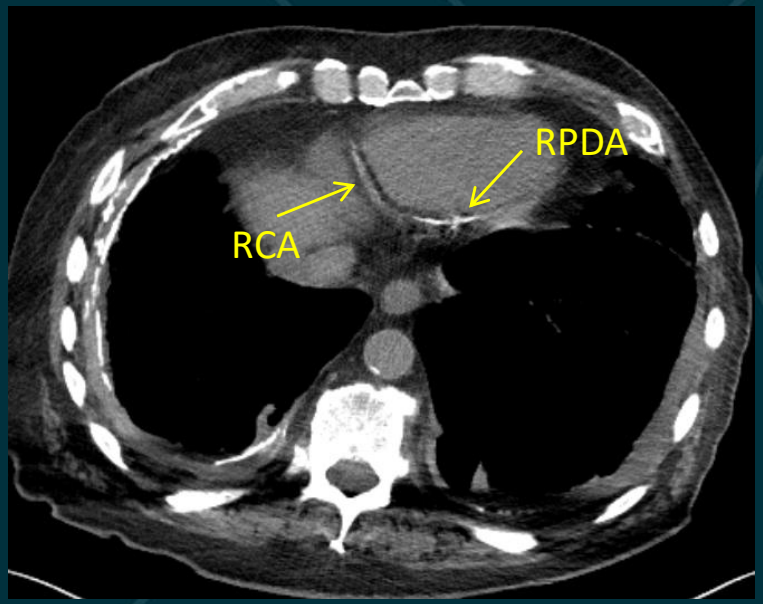
| Ordinal score | Median Agatston score | Mean Agatston score | Standard deviation |
|---|---|---|---|
| 0 | 0 | 0.5 | 2.3 |
| 1–3 | 81 | 98.7 | 108.4 |
| 4–5 | 313.5 | 350.6 | 151.4 |
| ≥6 | 1673 | 1925.4 | 1075.8 |

# NonGated CT Example



# Added Benefits

- Lung masses/nodules
- NASH
- PAD
- Aortic Aneurysm
- Pericardial fat and thickening