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#### Recommended Citation

Graziano, Alexandra, "Cardiac Scoring in Preventing Myocardial Infarction" (2024). *Medical Imaging Senior Posters*. 50.

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# Cardiac Scoring in Preventing Myocardial Infarction

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## Introduction

- Myocardial Infarctions (MI) occur when blood flow to the heart muscle is blocked.
- Males have a higher incidence of myocardial infarctions, accounting for about 70% of cases.
- Women often exhibit "atypical" MI symptoms, unlike the more "typical" chest pain experienced by men.
- Females generally present to the hospital later after symptom onset compared to males, which may be due to a lack of awareness of their unique symptoms or the severity of MIs in females. (Schulte & Mayrovitz, 2023)
- A Coronary Artery Calcium Score (CACs) is done to "measure risk assessment in people 40-75 years with low density lipoprotein levels between 70-190 mg/dl without diabetes mellitus and indeterminate risk for Atherosclerotic cardiovascular disease (ASCVD) (Manapragada et al., 2021, p. 1).

## Myocardial Infarction (MI)

- Leads to tissue damage or death in the heart muscle due to lack of oxygen.
- Two types of Myocardial Infarctions
  - Type I: infarct related to plaque erosion or rupture
  - Type II: infarct related to ischemia also known as a reduction in blood flow

## Symptoms in Males

- Chest pain, discomfort, tightness, pain radiating to the left arm, neck, jaw, back, shortness of breath, sweating, nausea, lightheadedness.

## Symptoms in Females

- Chest discomfort, pain in the neck, jaw, shoulder, upper back, or abdomen, shortness of breath, nausea, vomiting, or dizziness, unusual or extreme fatigue (without exertion), sleep disturbances in the days or weeks leading up to the event, General feeling of unease or anxiety (Schulte & Mayrovitz, 2023)

## Computed Tomography

- "Computed Tomography is an X-ray based imaging technique that produces trans axial images of the human body" (Qian et al., 2021, p. 64).
- With computed tomography, an image is generated using a rotating gantry that captures hundreds of images during a full 360-degree rotation.
- The use of computed tomography helps to eliminate superimposition of the structures of the body (Wright & Johnson, 2019, p. 206).
- Contrast which is the difference between two tones is shown through numbers given to each voxel, also known as Hounsfield units.
- A Hounsfield units is the number used to describe the average density of a tissue (Wright & Johnson, 2019, p. 243).
- A Coronary Artery Calcium score is "a non contrast enhanced CT study that aims to detect and quantify calcium deposits in the coronary arteries" (Qian et al., 2021, p. 64).
- Scans are obtained using an ECG—gated electron beam CT taking images from the carina to the bottom of the heart (Manapragada et al., 2021, p. 13).
- This study should be done at 2.5 mm slice thickness, 120 kVp, and mAs depending on the patient body habitus (Manapragada et al., 2021, p. 13).

## About the Exam

- Patient should be aware that the scoring is not a diagnostic exam because only the heart is being assessed for coronary calcification.
- Contraindications for the exam include:
  - Pregnancy
  - Unable to lay down flat for 5-10 minutes
- An ECG will be placed on the patient so that the technologists can monitor the heart rate during the scan (Cleveland Clinic, 2022).
- Once the exam is completed, sagittal and coronal reformats are made to help the radiologist visualize the calcium in the patient's heart.
- The radiologist then uses the Agatston scoring system to determine the risk the patient has for a MI.

## Coronary Artery Calcium Score (CACs)

- The most accurate visualization of the presence or absence of CAC is achieved in scans with a slice thickness of less than 3 mm (Manapragada et al., 2021, p. 15).
- Each score is obtained using one of three methods which include:

### Volume Scoring Method

- Calculates the volume of calcification by multiplying the volume of a single voxel by the number of voxels associated with the calcified area (Bernardini et al., 2023, p. 7).
- More resistant to variations in noise but can overestimate the CAC score in regions with high attenuation (Bernardini et al., 2023, p. 7).

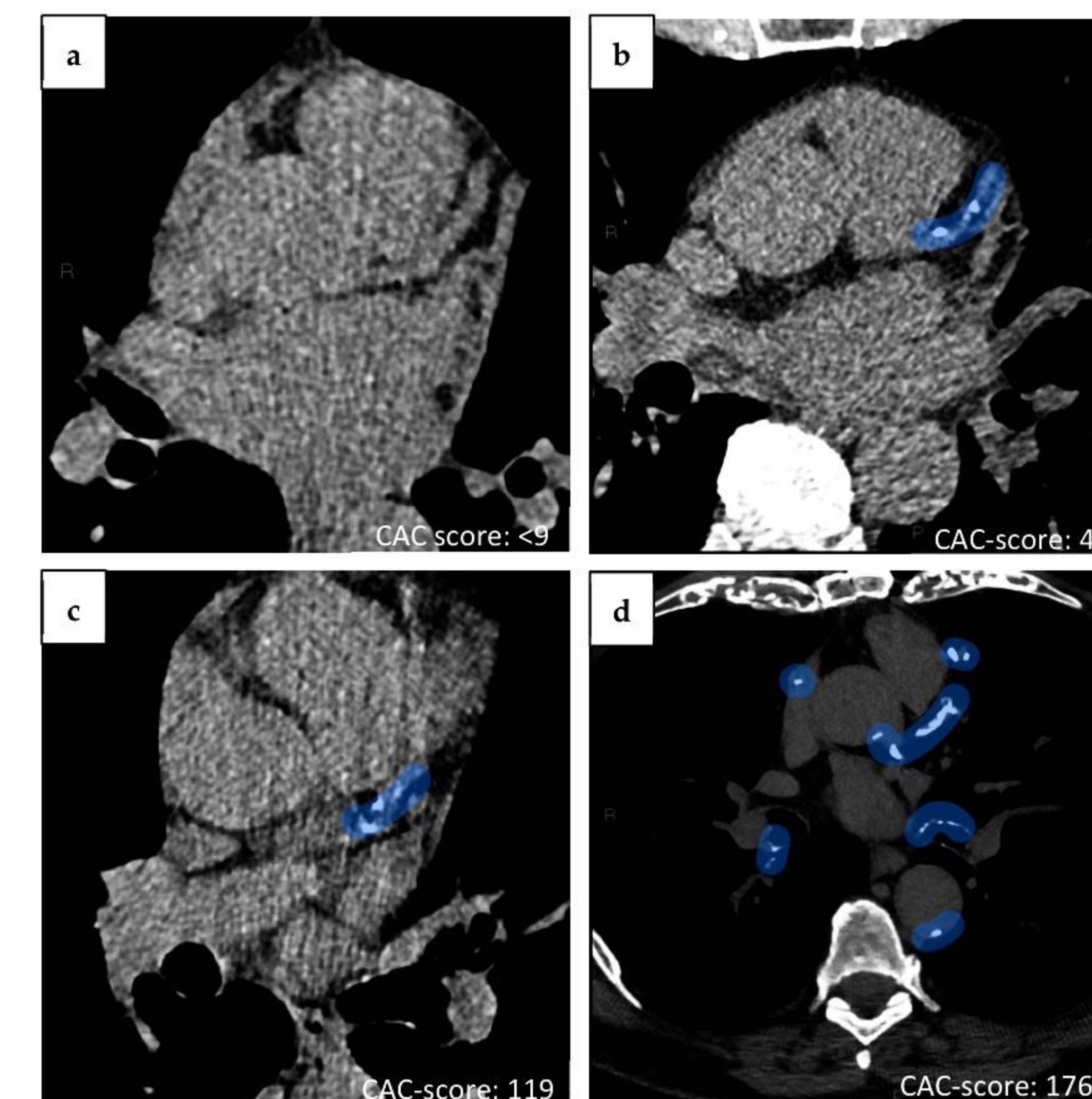
### Mass Scoring Method

- Considers the volume of calcification, plaque attenuation, and a calibration factor based on water attenuation, aiming to measure the actual mineral mass of calcium hydroxyapatite in the plaques (Bernardini et al., 2023, p. 7).
- Provides a measure closer to the true calcium mass in plaques but requires complex postprocessing (Bernardini et al., 2023, p. 7).

### Agatston Scoring Method

- Most used scoring method
- The total value of all calcified coronary lesions is determined by both the total area and the maximal density of coronary calcification.
- "The CT attenuation threshold of 130 Hounsfield units is used for the detection of calcium."
- To obtain the score use the equation: Automated Measurement of Lesion Area multiplied by the Density Weighting Factor (DWF).
- The Density Weighting Factor per Hounsfield Unit:
  - 130 to 199 HU = 1
  - 200 to 299 HU = 2
  - 300 to 399 HU = 3
  - > 400 HU = 4

(Manapragada et al., 2021, p. 13)



## Example of the Agatston Scoring Method

The images above represent the use of the Agatston method, and the score given to each patient. Highlighted in blue is the amount of calcium in each heart.

- The patient is at minimal risk with a CACS of <9
- The patient is at mild risk with a CACS of 46
- The patient is at moderate risk with a CACS of 119
- The patient is at maximum risk with a CACS of 1768

(Bernardini et al., 2023, p. 8)

## Conclusion

- Utilizing Agatston Scoring to assess calcium aids in early detection of myocardial infarctions.
- Early identification of coronary artery disease using CACS can guide preventive measures and treatment.
- Educating healthcare professionals and patients about gender-specific symptoms can improve outcomes for patients experiencing MIs.