



## Screening For Heart Disease

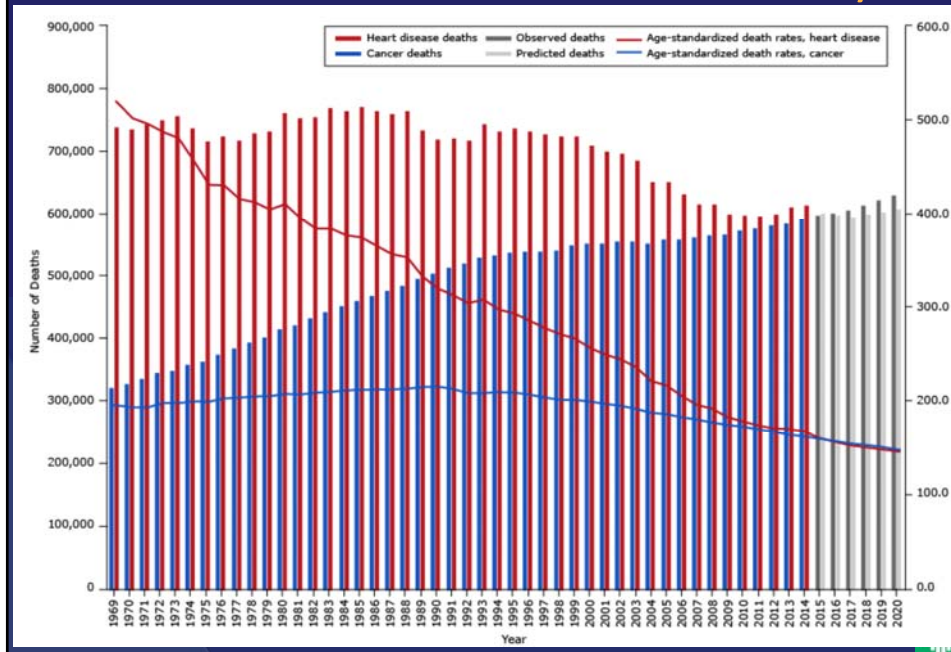
Charles R. Caldwell, MD, FACC  
Arkansas Cardiology- North Little Rock



Disclosures: iHeartDoc, Inc.



## Heart Disease and Cancer Mortality



## Cancer Mortality Gains

- Advances in treatment
- Early Detection
  - Asymptomatic Patients
  - Screening Programs in Breast, Prostate, GI Cancers
    - Driven by Insurance Coverage



## Coronary Heart Disease Mortality Gains

- Driven by More Aggressive Treatment of MI and CHF
  - CCU
  - Emergent PCI
  - ICD
  - Advances in Drug Therapy of MI, CHF
- Improved Safety and Mortality of PCI
- Improved Safety and Mortality of CABG and Valve Surgery
  - TAVR
- Improve Treatment of CHD Risk Factors
  - Statin
  - Hypertension Treatment



## Recommendations of the “Early Detection Model” of Coronary Heart Disease Treatment

- Screening Asymptomatic Patients
  - The Role is “Uncertain”
  - In 2018 US Preventive Services Task Force (USPSTF) Recommendations
    - Against routine screening with resting or exercise electrocardiography (ECG) in adults at low risk for CHD events
    - Insufficient evidence to recommend **for or against** screening with resting or exercise ECG in adults at intermediate or high risk for CHD events
  - Not covered by most insurance
- At least 25% of patients experiencing nonfatal acute myocardial infarction or sudden death had no previous symptom



## So, How Do You Define Risk of Coronary Heart Disease in Asymptomatic Patients?

- Traditional CHD Risk Factors
  - Diabetes
  - Smoking
  - Obesity
  - Hypertension
  - Hyperlipidemia
  - Sedentary Lifestyle
  - Family History of Premature CHD



## The Asymptomatic Patient With A Strong Family History of CHD

- What is the response to the patient with a strong family history of coronary heart disease who wants to reduce their chance of having a heart attack?
  - History and Exam: Are they truly “asymptomatic”
  - Risk Factor Modification
  - Testing to determine low vs high risk of CHD



## Patient Selection Is Critically Important

- Low Risk Patient
  - Asymptomatic
  - Young
  - Few if any risk factors for CHD
    - Testing adds to cost of care
    - Positive tests are most likely “False Positives”
      - Leads to unnecessary further testing



## Patient Selection Is Critically Important

- High Risk Patient
  - Older
  - Symptomatic
  - Risk Factors for CHD
  - Already candidates for guideline-directed primary prevention therapy
  - Negative testing is more likely to be “False Negative” and give inappropriate reassurance.



## “Special Situations”

- Screening of Asymptomatic Patients is **Required** in High Risk Occupations and Avocations
  - Pilots
  - Bus and Truck Drivers
  - Scuba Divers
  - Competitive Athletes
  - Public Safety Personnel



## Lab Testing

- Indicated
  - Lipids
  - CRP: Some controversy about the additive effect to lipids
- Controversial
  - Brain Natriuretic Peptide (BNP)
    - NT-proBNP levels above the 80th percentile (more than 655 pg/mL) in asymptomatic patients without heart failure in the Framingham Study had significantly higher 5 year risk for mortality (24.5% increase) and higher risk of a first major cardiac event (adjusted risk hazard ration of 3.24)
  - Genetic Testing



## Resting Electrocardiogram

- Largely ineffective screening tools for CHD in asymptomatic patients without a prior CHD history.
  - Poor sensitivity and specificity
  - Asymptomatic patients with resting EKG ST depression, T wave inversion, strain, PVCs, or LVH have a 2-10 fold higher risk of CHD compared to patients with a normal ECG
  - 30-50% of patients with a normal coronary angiogram have resting ECG abnormalities
  - 30% of patients with angiographically proven CHD have a normal resting ECG
  - Most coronary events occur in patients without resting ECG abnormalities prior to the event.



## Exercise Stress Testing

- Stress ECG
  - Very helpful with symptomatic patients with appropriate risk
  - A wide variation of sensitivity and specificity in published trials reflective of differing criteria for a “positive” test and patient selection criteria.
  - Multiple Risk Factor Intervention Trial (MRFIT) and the Lipid Research Clinic’s Coronary Primary Prevention Trial (LRCPPPT) enrolled 10,000+ asymptomatic patients
    - Positive ischemia on TMST (12.2% and 6.3% respectively) predicted a 6 fold higher risk of CHD, MI and mortality combined in a 7-10 year follow up.
    - Findings were especially high in patients with highest risk factors.

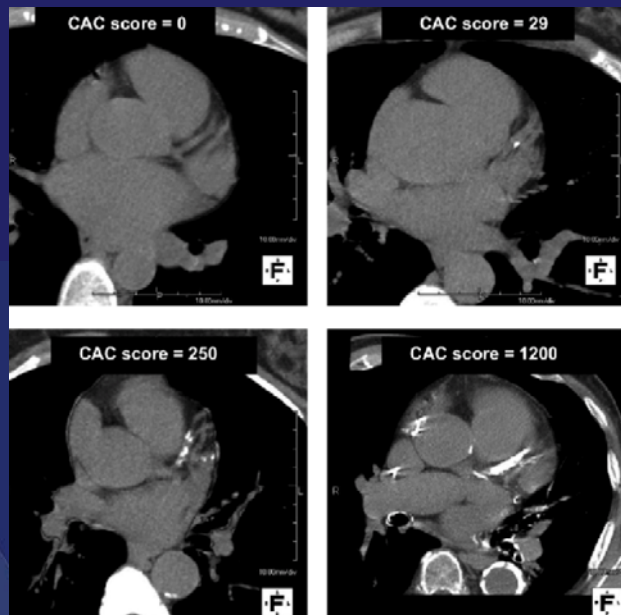


## Coronary Calcium CT

- Detects the presence of calcium in the epicardial coronary arteries and localizes the findings to a specific artery distribution.
- Detects the presence of atherosclerosis and its repair process
- High levels correlate to greater risk for CHD events
- Misses “soft plaque” that is the most vulnerable and likely to cause MI



## Coronary Calcium CT Scoring





## Coronary Calcium CT

- Agatston Scoring System
  - The Agatston method uses the weighted sum of lesions with a density above 130 HU, multiplying the area of calcium by a factor related to maximum plaque attenuation: 130-199 HU, factor 1; 200-299 HU, factor 2; 300-399 HU, factor 3; and  $\geq 400$  HU, factor 4
  - Scoring takes into account the size and density of coronary calcium deposits.



## Coronary Calcium CT

- Aggregated data of 6 trials with 27,622 asymptomatic patients
- Coronary Artery Calcium (CAC) Score
  - 100-400-relative risk of 4.3 (95% CI:3.1-6.1)
  - 401-999-relative risk of 7.2 (95% CI:5.2-9.9)
  - 1000-relative risk of 10.8 (95% CI:4.2-27.7)



## Coronary Calcium CT

- The CAC score is additive to traditional Framingham risk factors
- Coronary CT Calcium Scoring is not indicated for “low risk” patients
  - Indicated for Low risk + Family history of premature MI
  - Indicated for Low risk + Diabetes
  - Indicated for Intermediate Risk patients
- Not Indicated for High Risk patients. Those have indications for traditional screening tests.



## Multi-Ethnic Study of Atherosclerosis (MESA)

- 6814 initially asymptomatic patients, 45-84 years of age
- Wide variation in ethnic background and locale
- Adds Coronary Artery Calcium scoring to traditional and non-traditional risk factors Age, Gender, Race, Hypertension, Diabetes, Lipid, and Smoking risk.
- MESA Risk Calculator: <https://www.mesa-nhlbi.org/MESACHDRisk/MesaRiskScore/RiskScore.aspx>



Terms:  
 Age x 0.0172  
 +  
 Gender (Male = 1, Female = 0) x 0.4079  
 +  
 Race/Ethnicity: White = 1 x 0  
 Chinese-American = 1 x -0.3475  
 African American = 1 x 0.0353  
 Hispanic = 1 x -0.0222  
 +  
 Diabetes: Yes = 0.3892, No = 0  
 +  
 Smoking: Yes = 0.3717, No = 0  
 +  
 Total Cholesterol (in mmol/L x 0.0043) - (HDL cholesterol in mmol/L x 0.0114)  
 +  
 Lipid Medications: Yes = 1 x 0.1206, No = 0  
 +  
 Systolic Blood Pressure x 0.0066  
 +  
 Hypertension Medication: Yes = 1 x 0.2278, No = 0  
 +  
 Family History of Myocardial Infarction (Heart Attack): Yes = 1 x 0.3239, No = 0  
 +  
 (Math.log(CAC + 1) \* 0.2743).

$$\text{MESA CHD 10 Year Risk} = 100 \times (1 - \text{power}(0.99963, e^{\text{TERMS}}))$$



The Multi-Ethnic Study of Atherosclerosis

**MESA 10-Year CHD Risk with Coronary Artery Calcification** [Back to CAC Tools](#)

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 (History in parents, siblings, or children) Yes  No

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



## Coronary CTA In Chest Pain Evaluation: What's The Best Test?

- CORE-320 (Combined Non-invasive Coronary Angiography and Myocardial Perfusion Imaging Using 320 Detector Computed Tomography)
  - Sensitivity to identify patients with stenosis  $\geq 50\%$  on ICA.
    - Coronary CTA 92%
    - Single-photon emission computed tomography (SPECT) myocardial perfusion imaging 62% ( $p < 0.001$ )
- EVINCI (Evaluation of Integrated Cardiac Imaging in Ischemic Heart Disease)
  - Detection of significant CAD ( $>50\%$  left main,  $>70\%$  non-left main or fractional flow reserve [FFR]  $< 0.80$ ) on ICA
    - coronary CTA 91% Sensitive, 92% Specific
    - myocardial perfusion imaging with SPECT/ positron emission tomography (PET) 74% Sensitive, 73% Specific

## Coronary CTA In Chest Pain Evaluation

- Accurate: The **ACCURACY** (Assessment by Coronary Computed Tomographic Angiography of Individuals Undergoing Invasive Coronary Angiography) trial showed a sensitivity of 94% and 89% for a stenosis  $\geq 70\%$  and  $\geq 50\%$ , respectively
- The UK National Institute for Health and Care Excellence (NICE) made coronary CTA the first test for **ALL patients without established CAD** who present with typical or atypical angina or with non-anginal chest pain plus an abnormal resting electrocardiogram (ECG) in 2016.
  - Stress imaging studies were recommended in patients **with known CAD**
  - Exercise stress ECG testing was **not recommended** for the diagnosis of CAD due to its low accuracy and high rates of subsequent testing.
  - Estimated that broad adoption of this strategy would save the UK National Health Service £16 million annually.

## Coronary CTA Major Trials

- PROMISE (Prospective Multicenter Imaging Study for Evaluation of Chest Pain; n = 10,003)
  - Coronary CTA vs functional testing (68% nuclear stress imaging)
    - In symptomatic patients without known CAD
    - Major adverse cardiac events (death, MI, unstable angina, and major procedural complications)
    - Median of 25 months
    - No significant difference in the primary endpoint between coronary CTA and functional testing (3.3 vs. 3.0%, p = 0.75)
    - No significant difference in cost
    - Coronary CTA is a valid alternative to more established functional testing strategies
    - More CTA patients were referred to ICA (12.1 vs. 8.1%)
    - More patients underwent revascularization (6.2 vs. 3.2%) following CTA
      - patients with obstructive CAD on ICA was markedly higher in the CTA arm (72.1 vs. 47.5%),
- SCOT-HEART (Scottish Computed Tomography of the Heart; n = 4,146)

## Coronary CTA Major Trials

**Table 1: Proportion of Obstructive CAD on ICA**

	Coronary CTA Strategy	Standard of Care or Stress Testing Strategy
PROMISE (4)	72% (of 609)	48% (of 406)
SCOT-HEART (5)	69% (of 409)	57% (of 401)

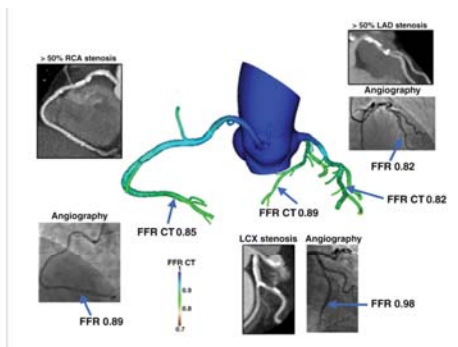
## Coronary CTA

- Coronary CTA Improves Important Patient Outcomes Compared With Functional Testing
  - The Value of Non-obstructive CAD to Guide Post-Test Management: 4x more likely to be on Aspirin and Statin
- Coronary CTA: High Diagnostic Accuracy; Rarely Misses Severe, High-Risk CAD
- Coronary CTA Slightly Increases Catheterization Rates (by almost 50% compared to routine testing) But May Better Select Patients Who Might Benefit From Revascularization
- CTA is “The Test Of Choice” in most symptomatic patients without known CAD

## Coronary CTA: An Anatomic Test...

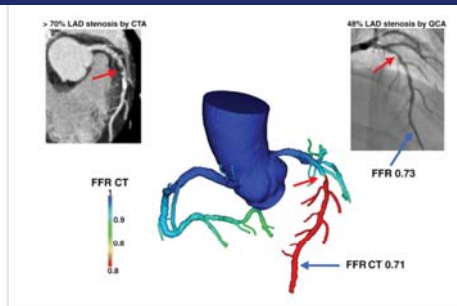
- PACIFIC (Prospective Comparison of Cardiac PET/CT, SPECT/CT Perfusion Imaging and CT Coronary Angiography With Invasive Coronary Angiography).
  - 208 patients with suspected CAD underwent coronary CTA, SPECT, PET, and ICA with FFR of all coronary arteries
  - Detection of **Significant** CAD (FFR <0.80)
    - 90% Sensitivity for coronary CTA
    - 57% for SPECT
    - 87% for PET
  - Specificity
    - Coronary CTA 60%
    - SPECT 94%
    - PET 84%

## Coronary CTA: An Anatomic Test... Or Is It? FFR CTA



**Fig. 1**—69-year-old man with atypical angina. Calcium scoring CT and CT angiography (CTA) reveal Agatston score of 785 with calcified plaque and > 50% stenosis in left anterior descending artery (LAD) and right coronary artery (RCA) with nonobstructive atherosclerosis in left circumflex artery. Noninvasive fractional flow reserve (FFR) CT computational model suggests that identified lesions are not functionally significant with FFR CT values > 0.80. Invasively measured FFR confirms absence of ischemia-causing lesions with FFR > 0.80 in each coronary vessel. LCX = left circumflex artery.

## Coronary CTA: An Anatomic Test... Or Is It? FFR CTA



**Fig. 2**—65-year-old Asian female with stable symptoms of typical angina pectoris. Patient is current smoker with 45-year history of smoking two packs per day. She has hyperlipidemia but no hypertension, diabetes, or history of cardiovascular disease. She takes no medication and leads active lifestyle. Left ventricular ejection fraction is 64%, and she has family history of premature atherosclerosis. Coronary CT angiography (CTA) image shows > 70% left anterior descending artery (LAD) stenosis, and computational analysis of CTA data reveals ischemia-causing stenosis with fractional flow reserve (FFR) CT = 0.71. Coronary angiography shows intermediate LAD stenosis of 48% by quantitative coronary angiography (QCA) (red arrows). Measured FFR confirms that LAD lesion is functionally significant with FFR = 0.73.

# Baptist BHeart Healthy Screening

- CT Calcium Score
- Laboratory Blood tests:
  - Lipid Panel: Total Cholesterol, HDL, LDL, Triglycerides
  - Diabetes Testing: Hemoglobin A1C
- Electrocardiogram (ECG)
- Carotid Artery Ultrasound Screening
- Abdominal Aorta Aneurysm Ultrasound Screening
- Blood Pressure Evaluation
- Body Mass Index (BMI)
- Overview of results with Baptist Health Cardiovascular Specialist
- Must be between the ages of 30 and 85 without a previous diagnosis for coronary artery disease.
- Find out if your heart is at risk. To schedule your BHeart Healthy screening, or for more information, call 501-227-8478.
  - Baptist Health Medical Center-Conway  
2nd and 4th Friday each month.
  - Baptist Health Medical Center-North Little Rock  
2nd and 4th Thursday each month.
- Cost is \$99 (not covered by insurance)

Thank You

