

NASA Screening and Clinical Practice for the Monitoring and Mitigation of Coronary Artery Disease: Application to Terrestrial Practice

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Introduction: Coronary artery disease (CAD) surveillance has led to the development of risk stratification tools that drive clinical mitigation efforts for CAD risk. As common risk assessment tools, including the Framingham Risk Score (FRS) or Pooled Cohort Risk Equations, have insufficient accuracy on an individual level to meet NASA's stringent screening guidelines, NASA has required new approaches to address the risk of catastrophic cardiovascular (CV) medical events among astronauts. Coronary artery calcium (CAC) scanning has emerged as the current best tool to enhance CV risk assessment in asymptomatic individuals, with risk information incremental to FRS data.

Methods: The Bellagio II Summit sought to identify current methods of risk stratification for CAD in high-performance operational environments, including military and spaceflight populations, to identify potential terrestrial applications of such tools. We reviewed NASA risk stratification tools and clinical mitigation strategies, comparing techniques with generalized and military terrestrial approaches and guidelines.

Results: Current NASA screening and monitoring techniques have led to the development of the astronaut CV health and risk modification (ASTRO-CHARM) model, a risk assessment tool developed specific to the astronaut population for comprehensive assessment of atherosclerotic CV (ASCVD) disease. To develop ASTRO-CHARM, Khera et al. combined participant level data from three population-based cohorts: the Dallas Heart Study, Multiethnic Study of Atherosclerosis (MESA), and the Prospective Army Coronary Calcium (PACC) study. Cox proportional hazard models were created with traditional risk factors as the independent variables (age, sex, race, total cholesterol, HDL, systolic blood pressure, use of antihypertensive medications, smoking history, and glucose). Family history of myocardial infarction, C-reactive protein, and statin use were also tested to determine if they were independently associated with the outcome and improved model-fit statistics. This risk model has been internally and externally (from Framingham CAC cohort) validated.

Discussion: The ASTRO-CHARM tool is the first integrated ASCVD risk calculator to incorporate risk factor and CAC data. While developed for specific application in the astronaut population, clinical assessment tools and associated mitigation techniques provide a comprehensive understanding of CV risk and subsequent clinical interventions. These tools can be implemented for terrestrial applications to augment current clinical practice in patients of similar age and sex.

LEARNING OBJECTIVES:

- 1 Understand the development of ASTRO-CHARM cardiac risk assessment.
- 2 Understand the use of AC for assessing astronaut risk for a 6 month to 1 year mission to the ISS.
- 3 Understand how this risk assessment tool can be translated to the terrestrial environment for clinical utilization.

MOC QUESTIONS:

Question 1

The use of ASTRO-CHARM to assess 10 year risk for predicting myocardial infarction, non-fatal stroke, and cardiovascular death includes coronary calcium scoring and is more accurate than the Framingham Risk Score for an astronaut population. (True/ False)

Answer: True

Question 2

The use of ASTRO-CHARM for predicting a 1 year cardiovascular risk in a population similar to astronauts has been validated. (True/ False)

Answer: True

Question 3

Which of the following health parameters are utilized in the ASTRO-CHARM risk model.

- a. Age
- b. Cholesterol
- c. Smoking history
- d. Hypertension
- e. Family History
- f. Inflammatory marker (CRP) level
- g. Coronary Artery Calcium score
- h. all of the above

Answer: all of the above