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Coronary Artery Disease in Master Endurance Athletes: Limitations of Conventional Preparticipation Screening and the Emerging Role of Hypertension Phenotyping and Selective Coronary Imaging

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Background

Coronary artery disease (CAD) has emerged as the leading substrate for exercise-related cardiovascular events in athletes aged ≥35–40 years.[1] However, CAD in masters endurance athletes is frequently underrecognized because conventional preparticipation evaluation (PPE) pathways primarily target electrical and structural disorders associated with sudden cardiac arrest in younger athletes.[1,2] Furthermore, traditional cardiovascular risk scores may underestimate lifetime atherosclerotic burden in endurance-trained individuals.[1,11]

Keywords: *Masters athletes; Coronary artery disease; Sports cardiology; Coronary artery calcium; Coronary CT angiography; Hypertension; Exercise-induced hypertension; Cardiovascular screening; Preparticipation evaluation; Atherosclerosis.*

Introduction

Participation in endurance sports among middle-aged and older adults has increased substantially over the past decades. Although regular physical activity is associated with major cardiovascular benefits, coronary artery disease (CAD) becomes the predominant substrate for exercise-related cardiovascular events and sudden cardiac death in athletes older than 35 years [1].

Conventional preparticipation evaluation (PPE) strategies were originally designed to identify inherited electrical and structural disorders in young athletes [2,12,13]. Consequently, their ability to detect silent coronary atherosclerosis in masters athletes remains limited. History and physical examination demonstrate poor sensitivity for occult cardiovascular disease [2,14], while resting ECG primarily improves detection of arrhythmogenic and cardiomyopathic disorders rather than coronary atherosclerosis [2]. Even exercise ECG testing shows modest diagnostic performance for obstructive CAD and limited predictive value for plaque rupture-related events [1,4].

At the same time, accumulating evidence suggests that masters endurance athletes may develop substantial subclinical coronary atherosclerosis despite low estimated cardiovascular risk according to conventional risk scores [1,5,11]. This discrepancy has generated increasing interest in athlete-specific risk modifiers, including lifelong exercise exposure, vascular mechanical stress, recovery patterns, and occult hypertension phenotypes [6,7].

This review summarizes current evidence regarding CAD underdetection in masters endurance athletes, critically discusses limitations of conventional sports screening pathways, and explores the emerging role of hypertension phenotyping and selective coronary CT imaging for individualized cardiovascular prevention.

Why CAD Is Frequently Missed in Masters Athletes

Limitations of conventional PPE

Standard PPE pathways are inherently limited for CAD detection because they primarily focus on symptoms, family history, physical examination, and resting ECG findings [1,2]. CAD in masters athletes is frequently asymptomatic and may remain electrically silent until advanced disease or acute plaque instability occurs [1].

Resting ECG improves identification of cardiomyopathies and channelopathies but has limited value for detecting coronary atherosclerosis [2]. Similarly, exercise ECG demonstrates relatively low sensitivity and specificity for obstructive CAD and may fail to identify vulnerable plaque phenotypes responsible for exertional acute coronary syndromes [1,4].

Underperformance of traditional risk scores

Traditional ASCVD risk scores may underestimate lifetime coronary risk in endurance athletes because they inadequately capture cumulative exercise exposure, exercise-induced hemodynamic stress, recovery patterns, and occult hypertension phenotypes [1,11].

Several CT-based observational studies have demonstrated the presence of significant CAC burden and coronary plaque in asymptomatic masters athletes categorized as low-risk by standard clinical algorithms [5,7].

The Emerging Role of Occult Hypertension

One of the most clinically actionable findings emerging from recent studies is the high prevalence of masked ambulatory hypertension and exercise-induced hypertension in masters endurance athletes [6].

In contemporary cohorts of male masters athletes without known hypertension and with low Framingham-estimated risk, ABPM-defined hypertension was highly prevalent, while many

athletes additionally demonstrated hypertensive blood pressure responses during exercise testing [6].

Importantly, these hypertension phenotypes were independently associated with:

- CAC ≥100,
- obstructive coronary stenosis,
- and high-risk plaque features on CCTA [6].

These findings suggest that occult hypertension may represent a major mechanistic and modifiable driver of coronary atherosclerosis in this population [6].

Potential Mechanisms Linking Endurance Exercise and CAD

Current evidence does not support the conclusion that endurance exercise is intrinsically harmful. However, several mechanistic hypotheses have been proposed to explain why high-volume exercise may contribute to coronary calcification in susceptible individuals [7].

Potential mechanisms include:

- repetitive elevations in blood pressure and heart rate,
- increased coronary shear stress,
- exercise-induced inflammation,
- oxidative stress,
- and endothelial injury [7].

These mechanisms may interact synergistically with conventional cardiovascular risk factors, particularly hypertension and dyslipidemia [6,7].

Importantly, higher cardiorespiratory fitness continues to confer substantial prognostic benefit even in athletes with coronary calcification [1,11].

Role of CAC and Coronary CT Angiography

Routine CAC screening is not currently recommended in asymptomatic low-risk masters athletes [1,8].

- Nevertheless, selective CAC/CCTA-based risk stratification may be clinically appropriate in:
- symptomatic athletes,
- athletes with intermediate or high estimated risk,
- abnormal exercise blood pressure responses,
- unexplained exercise intolerance,
- strong family history,
- or uncertainty regarding preventive pharmacotherapy intensity [1,4,8,9].

Coronary CT imaging may provide additional information regarding plaque burden, plaque morphology, and obstructive disease that can influence:

- statin therapy decisions,
- exercise counseling,
- and sports eligibility discussions [4,9].

However, indiscriminate imaging may increase downstream testing, costs, and incidental findings without proven outcome benefit [2].

Clinical Implications

The available evidence supports a pragmatic prevention-oriented approach centered on: 1. Systematic assessment of traditional ASCVD risk factors; 2. Aggressive detection of occult hypertension using ABPM and exercise BP monitoring [6]; 3. Guideline-directed preventive pharmacotherapy when indicated [4,9]; 4. Shared decision-making regarding sports participation [1,9,10]; 5. Selective use of CAC/CCTA rather than routine imaging screening [1,8].

Importantly, high fitness levels should not lead clinicians to underestimate cardiovascular risk once atherosclerotic disease is established [1,11].

Conclusions

CAD in masters endurance athletes is likely underestimated because current sports screening paradigms have limited sensitivity for silent coronary atherosclerosis. Emerging evidence suggests that masked hypertension and exercise-induced hypertension may represent major and modifiable contributors to coronary plaque development in this population.

Future cardiovascular prevention strategies in athletes should move beyond simplistic “fit equals protected” assumptions and instead incorporate individualized risk-factor phenotyping, longitudinal follow-up, and selective coronary imaging when clinically meaningful.

Conflicts of interest

The author declares no conflicts of interest.

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