Background

Both the age and number of endurance Masters athletes is increasing; this coincides with increasing cardiovascular risk. The vast majority of sports-related sudden cardiac deaths (SCDs) occur among athletes >35 years of age. Coronary artery disease (CAD) is the most common cause of SCD amongst Masters athletes.

Case summary

In our prospective screening trial, six asymptomatic Masters athletes with ischaemia on electrocardiogram exercise stress testing had their coronary anatomy defined either by cardiac computed tomography or coronary angiography. Three patients underwent coronary angiography, with fractional flow reserve (FFR) testing performed when indicated. Subsequent percutaneous revascularization was performed in one patient after a shared-decision making process involving the patient and the referring cardiologist. All six athletes identified with obstructive CAD were male. The mean age and Framingham risk score was 61.8 years (±9.5) and 22.7% (±6.1), respectively. The mean metabolic equivalent of task achieved was 14.4 (±3.8). All athletes were treated with optimal medical therapy as clinically indicated. No cardiac events occurred in 4.3 years of follow-up.

Discussion

Guidelines recommend revascularization of Masters athletes to alleviate the ischaemic substrate despite a paucity of evidence that revascularization will translate into a reduction in myocardial infarct or sudden cardiac arrest/death. Herein, although a limited study population, we demonstrate a lack of clinical events after 4.3 years of follow-up whether or not revascularization was performed. A prospective multicentre registry for asymptomatic Masters athletes with documented obstructive CAD is needed to help establish the role of revascularization in this population.

Keywords

Sports cardiology • Case series • Masters athletes • Sudden cardiac death • Coronary artery disease • Exercise stress testing

Learning points

• Masters athletes (≥35 years) can exhibit high cardiovascular risk, significant coronary artery disease (CAD), and silent ischaemia despite high cardiorespiratory fitness and the number of athletes with this presentation is expected to grow as the number of older competitive athletes continues to increase.

• Aggressive risk factor modification should be paramount in asymptomatic Masters athletes when obstructive CAD is discovered, and a shared informed decision to revascularize should be considered.

• The optimal approach to managing ischaemia in asymptomatic Masters athletes is uncertain, and further studies are warranted to establish the role of revascularization in this population.
Introduction

There is no disputing the tremendous health benefits of moderate intensity exercise. However, regular habitual exercise lessens this risk and results in an overall marked reduction in the risk of MI and SCD compared with sedentary counterparts. The vast majority of sports-related SCDBs occur among Masters athletes (those ≥35 years of age). In a prospective population study, sports-related SCD in the young competitive athlete comprised only 6% of the total SCDBs. Similarly, in a prospective study from Denmark, sports-related SCD was significantly higher among athletes aged 36–49 (6.64 per 100 000 person-years) compared with athletes aged 12–35 years (0.47 per 100 000 athlete person-years).

Both the age and number of endurance athletes is increasing. This is paralleled with increasing levels of cardiovascular risk (primarily driven by age). Coronary artery disease (CAD) is the most common cause of SCD amongst Masters athletes. As demonstrated by Marijon et al., CAD was identified as the cause of SCD in 84% of sports-related SCDB. Moreover, 56% (20) of athletes who experienced a sports-related SCD had a prior history of CAD with 12 of 20 having a prior MI and two athletes with prior revascularization procedures.

The American Heart Association/American College of Cardiology guidelines on sport participation in athletes with CAD permit participation in all competitive sporting activities provided no ischaemia is present. The European Association of Preventive Cardiology (EAPC) guidelines explicitly recommend revascularization if ischaemia is present. The evidence for both recommendations is lacking. When obstructive CAD is discovered in middle-aged athletes who exercise at high intensities (and frequently push their ischaemic thresholds), should more aggressive revascularization strategies be pursued in addition to optimal medical therapy (OMT) vs. OMT alone? For athletes who exercise at a high intensity, is any ischaemia tolerable? Herein, we report a case series that helps focus attention on this clinical uncertainty/question.

Timeline

| Timing | Relevant data |
|--------|---------------|
| Screening | Seven hundred and ninety-eight recreationally competitive and high-performance Masters athletes screened |
| Initial screen included history and personal symptoms questionnaire, physical exam, and Framingham Risk Score (FRS) |
| Investigations | Athletes with a positive screen (i.e. concerning history and/or personal symptoms questionnaire, abnormal physical exam, ≥65 years of age or FRS ≥10%) underwent exercise stress testing (EST) |
| Treatment | All six athletes received OMT |
| Follow-up | Annual clinical follow-up with EST |
| No cardiac events over a period of 4.3 years |
| Secondary prevention targets achieved |

Case presentation

We screened 798 recreationally competitive and high-performance Masters athletes as part of the Masters Athlete Screening Study, designed to assess cardiovascular risk and ascertain the prevalence of cardiovascular disease in athletes ≥35 years of age in British Columbia, Canada. Those athletes with a Framingham risk score (FRS) ≥10%, symptoms, abnormal electrocardiogram, family history, or abnormal physical examination underwent exercise stress testing (EST). This case series includes six of the athletes screened who were asymptomatic with no angina, anginal equivalents, or decreases in performance despite demonstrating ischaemia on EST.

Athletes that demonstrated ST depression on EST were counselled regarding OMT and further evaluation procedures. Athletes were educated about OMT with or without revascularization in a shared decision-making approach. Coronary anatomy was initially defined either by coronary computed tomography angiography and/or invasive coronary angiography. Ultimately, three patients underwent coronary angiography with fractional flow reserve (FFR) testing performed when indicated; subsequent percutaneous revascularization with drug-eluting stents were performed after consultation with both the patient and referring cardiologist in one patient. Descriptive results were presented as absolute numbers, means, and standard deviations.

All of the athletes identified with obstructive CAD were male. Their mean age and FRS was 61.8 years (±9.5) and 22.7% (±6.1), respectively. Their mean metabolic equivalent of task (METs) achieved on EST was 14.4 (±3.8). All were able to achieve >85% maximum METs. Six asymptomatic athletes demonstrated ischaemia on electrocardiogram EST. Five of six patients underwent coronary computed tomography angiography as their initial follow-up test. One patient went directly to coronary angiogram. Ultimately, three of the six patients underwent coronary angiography and two underwent fractional flow reserve testing. Athletes were educated about revascularization and optimal medical therapy (OMT) for coronary artery disease (CAD). Two of six athletes demonstrated a moderate amount of psychological distress from their diagnosis of asymptomatic CAD.
Ischaemia in the Masters athlete

Table 1

| Patient | Age (y) | Gender | FRS Score (%) | METS | DTS (min) | CCTA | MIBI | IMPACT score summary |
|---------|---------|--------|---------------|------|-----------|------|------|----------------------|
| 1       | 67      | Male   | 29.4          | 13.4 | 5         | -3   | NA   | No impact            |
| 2       | 55      | Male   | 21.0          | 18.7 | 8.5       | 90%  | NA   | No DES—shared decision-making DES to LAD No impact Moderate impact No impact NA NA NA IMPACT score summary 70% (FFR 0.77) OM 60% Moderate impact No impact NA NA NA IMPACT score summary 60% (FFR 0.79) OM 60% No DES—shared Moderate impact No impact NA NA NA IMPACT score summary 70% (non-dominant) Distal RCA 60% Moderate impact No impact IMPACT score summary 80% (non-dominant) Proximal RCA NA NA No DES—shared |
However, revascularization may favourably alter flow dynamics and lessen supply demand disparities and reduce a susceptible substrate thereby decreasing the potential for ventricular arrhythmia. This dilemma is further complicated by the suggestion that current FFR cut-off values may not be appropriate to assess for a flow-limiting lesion at the extremes of physiologic stress endured by high-level athletes. Considerations for revascularization are presented in Table 2.

Regardless of the decision to revascularize or not, aggressive risk factor modification is paramount, and a shared-informed decision with the athlete should take place. Despite recommendations by the EAPC supporting revascularization in individuals with CAD experiencing continued ischaemia, one must acknowledge and disclose to the athlete that the clinical benefit to revascularize an asymptomatic athlete with high fitness has not been demonstrated. The question remains: Do athletes play by different rules when it comes to revascularization? Are they at higher risk than the non-athlete COURAGE patient and we should empirically suggest revascularization? Or should we take comfort in the fact that an athletes’ superior cardiorespiratory fitness affords them a favourable prognosis irrespective of revascularization?

The athletes who made the decision not to have a stent placed have not experienced any cardiac events to date, nor has the athlete who underwent left anterior descending artery stenting. The small numbers of athletes included in this case series, and the duration of follow-up limits our ability to make firm conclusions. Rather, the intent of this case series is to shine light on this emerging clinical situation and re-focus our attention on whether or not we should be empirically revascularizing these fit asymptomatic athletes without firm evidence that revascularization procedures will translate into a reduction of morbidity and mortality.

**Conclusion**

Despite high cardiorespiratory fitness Masters athletes are not immune to elevated cardiovascular risk and cardiac disease. In addition to aggressive risk factor modification, the optimal approach to manage their ischaemia is uncertain. Providing clarity to this clinical dilemma is a challenging endeavour. A randomized control trial would likely not be feasible given the low number of patients currently fulfilling the above criteria, and the expected low number of cardiac events in this population with high cardiorespiratory fitness. Given the interest in this expanding population, a prospective multicentre registry for asymptomatic competitive endurance Masters athletes with documented obstructive CAD is needed to help answer these crucial unresolved questions.

## Lead author biography

Dr James McKinney is a Clinical Assistant Professor in the Division of Cardiology at the University of British Columbia. Dr McKinney obtained his degree in medicine from the University of Toronto. He subsequently completed internal medicine and cardiology fellowship at the University of British Columbia. Dr McKinney then completed subspecialty fellowships in cardiac rehabilitation and sports cardiology. Presently, he is the director of research at SportsCardiologyBC. Dr McKinney’s clinical and research interests focus on pre-participation screening of young and Masters athletes and improving the safety of exercise in persons with underlying cardiac conditions.

## Supplementary material

Supplementary material is available at European Heart Journal - Case Reports online.

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**Slide sets**: A fully edited slide set detailing this case and suitable for local presentation is available online as Supplementary data.
Conflict of interest: none declared.

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