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**VIEWPOINT**
*Ischaemic heart disease*

# Physical activity and exercise in patients with spontaneous coronary artery dissection and fibromuscular dysplasia

**Marysia S. Tweet [1]*, Jeffrey W. Olin[2], Amanda R. Bonikowske[1], David Adlam [3], and Sharonne N. Hayes [1]**

[1]Department of Cardiovascular Medicine, Mayo Clinic, Rochester, 200 First St SW, MN 55905, USA; [2]IMarie-Josée and Henry R. Kravis Center for Cardiovascular Health at Mount Sinai, Icahn School of Medicine, Zena and Michael A. Wiener Cardiovascular Institute, One Gustave L. Levy Place, Box 1030 New York, NY 10029, USA; and [3]Department of Cardiovascular Sciences and Leicester NIHR Biomedical Research Centre, Glenfield Hospital, Groby Road University of Leicester, Leicester LE3 9QP, UK

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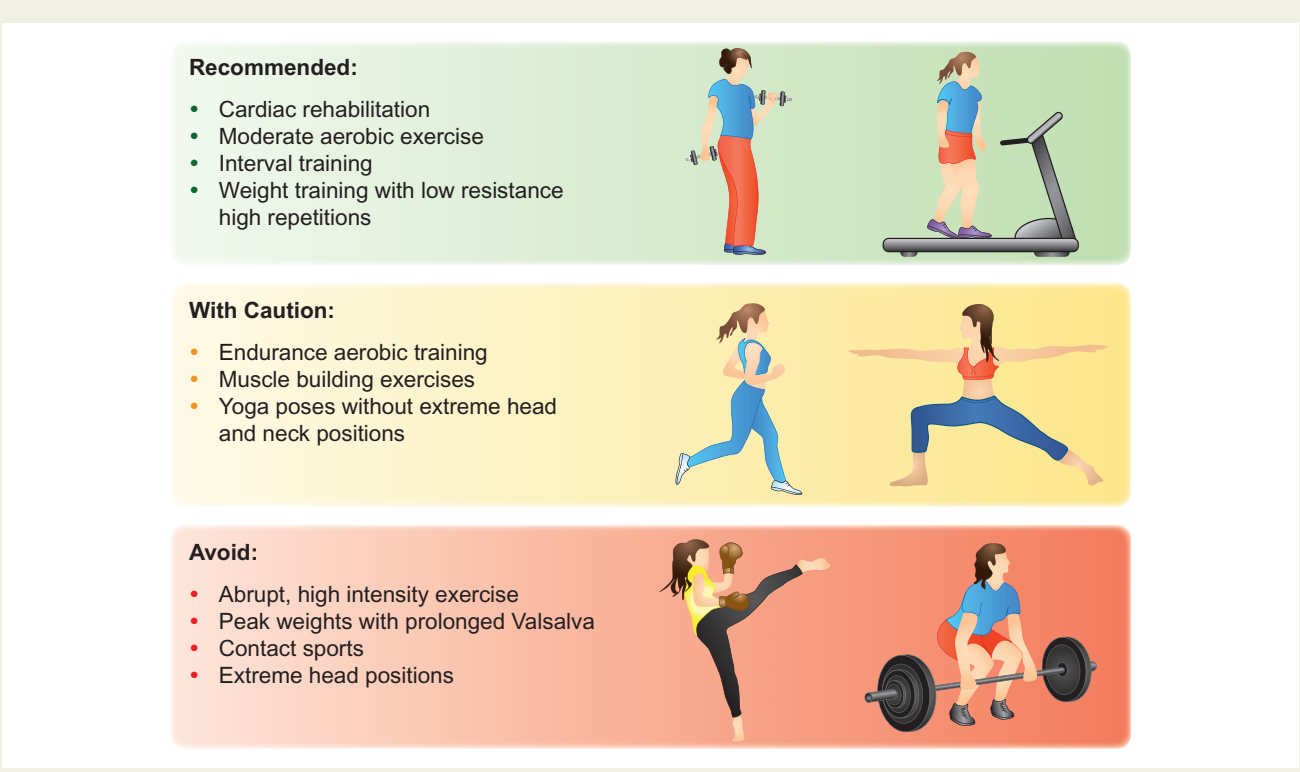


**Graphical abstract** Physical activity considerations for patients after spontaneous coronary artery dissection or with fibromuscular dysplasia. Physical activities and exercises that are recommended, should be performed with caution, and should be avoided among patients with a diagnosis of spontaneous coronary artery dissection or fibromuscular dysplasia. Goal for duration of aerobic training is at least 30–40 min of moderate intensity physical activity 5–7 days/week (150 min/week).

* Corresponding author. Tel: +1 507 284 9601, Fax: +1 507 538 6915, Email: tweet.marysia@mayo.edu

## Introduction

Spontaneous coronary artery dissection (SCAD) is a nonatherosclerotic aetiology of acute myocardial infarction and sudden cardiac arrest[1,2] for which research, awareness, and diagnosis have increased substantially over the past 5 years. Coexistent in 45–86% of SCAD patients, fibromuscular dysplasia (FMD) is a nonatherosclerotic and noninflammatory disease of the medium and small calibre arteries that is associated with arterial aneurysms, dissections, and stenoses. SCAD recurs in about 10–29% of SCAD patients,[1,2] arterial dissections are reported in up to 28% of FMD patients,[3] and cervical FMD is associated with recurrent spontaneous cervical artery dissections.[4] Risk for future arterial dissections and the safety of physical activity/exercise after a diagnosis of SCAD or FMD is poorly understood. Physical activity refers to any kind of movement that may burn calories, whereas exercise refers to structured and repetitive movement with the intention of improving fitness, muscle strength, and tone. It is currently unknown whether avoidance of certain physical activity/exercise types or curtailing intensity affects the risk of recurrent dissections among SCAD and FMD patients.

Most SCAD and FMD patients are women with mean age in the 40–50 s with few or no atherosclerotic risk factors.[1–3] Extracoronary vascular abnormalities such as aneurysm, ectasia, dissection, and arterial tortuosity are common in both SCAD and FMD.[1,2] For some, SCAD may represent coronary FMD,[5] and SCAD patients with coronary artery tortuosity frequently have coexistent FMD.[6] Peripheral arterial tortuosity is also observed in patients with FMD and SCAD.[1–3] The common genetic susceptibility locus (*PHACTR1*) of SCAD and FMD support the premise of a shared pathophysiology.[7]

## Risks of exercise in spontaneous coronary artery dissection and fibromuscular dysplasia: causation or association?

It has been proposed that SCAD and FMD patients have an underlying vulnerable vasculature theoretically predisposed to a risk of dissection in the presence of a mechanical precipitant. In this pathophysiological mechanistic hypothesis, increases in cardiac contractility and heart rate during exercise affect focal shear stress and strain at high-risk segments of the coronary arteries. For example, severe arterial tortuosity including coronary tortuosity, as is common in patients with SCAD, FMD, and cervical artery dissection,[1–3,6] disrupts laminar blood flow with subsequent energy loss, reduced perfusion pressure, and potentially harmful alterations in haemodynamics and perfusion pressure.[8] This concept implies a continuous predisposition in SCAD/FMD patients to dissections if a threshold of coronary mechanical and shear stresses is exceeded during exercise.

Extreme or unusual physical activity has been reported as an inciting factor in 15–29% of SCAD.[1,2] In a recent series of 750 SCAD patients, 29% reported intense physical stress associated with SCAD symptom onset; 12% reported a Valsalva-type stress; and 9.8% reported an isometric stress of >22.7 kg.[9] However, there has been no control population to determine if there is an actual vs. incidental association, and even if associated, that would not equate to causation.

## Benefits of exercise in spontaneous coronary artery dissection and fibromuscular dysplasia: evidence of safety

Any concerns regarding risk of certain physical activities and dedicated exercise in patients with SCAD and FMD must be balanced by the well-established benefits of both aerobic and resistance exercise. The transient but significant haemodynamic changes with exercise do not cause dissection in most persons or indeed in most SCAD/FMD patients most of the time. Arguably, therefore, other factors must be the key determinants of vulnerability. Furthermore, exercise-induced laminar flow-related shear within the endothelium is considered beneficial leading to the release of anti-inflammatory cytokines, vascular remodelling, and angiogenesis; increased cardiac storage of nitric oxide metabolites; and enhanced beta-2 adrenergic receptor sensitivity.[10] Therefore, while exercise limitations may reduce the theoretical mechanistic risks, the inherent trade-off is lack of receiving these known benefits.

Most studies regarding SCAD and physical activity/exercise are focused on cardiac rehabilitation. Both the Vancouver and Mayo experiences have found that patients receive mental and physical health benefits from participation in cardiac rehabilitation.[1,2] In a survey of 354 SCAD patients, over 3/4 of patients who underwent cardiac rehabilitation perceived physical and mental health benefits, and the most common reason for not participating was lack of referral.[11] Another study of 950 SCAD patients found that only 40% of SCAD patients were achieving current exercise recommendations prior to SCAD,[12] even though they may have a higher than average patient functional capacity.[13]

## Exercise recommendations for spontaneous coronary artery dissection and fibromuscular dysplasia patients

Since there are no good data to support specific exercise recommendations, one could argue that the greatest disservice is to be so cautious that patients become sedentary as severe restrictions to exercise may also lead to emotional distress, weight gain, deconditioning, and hypertension. A cardiac rehabilitation session expends ~300 kcal per session and, if participating 3 days/week, is still below the recommended minimum of 1,000 kcal expenditure/week for general health, fitness, and weight management.

Acknowledging the paucity of data, in our collective practice caring for patients with the history of SCAD, aerobic training is advised for a goal of 30-40 min of moderate intensity physical activity 5–7 days/week (150 min/week) similar to recommendations for the general public for health-related benefits (*Graphical abstract*). Patients are encouraged to stop or slow down if becoming extremely exhausted

or feeling uncomfortable. Resistance training is encouraged with focus on a proper breathing and lifting technique; use of lower resistance and higher repetitions during training; and avoidance of the Valsalva maneuver/straining. The level at which individuals strain against a load varies widely depending on fitness, muscle mass, age, gender, and other factors. Upper limits of 9 kg for women and 23 kg for men have been observed as safe,[1,2] but many patients may find these limits too restrictive. There is no evidence that heavier loads with proper technique (no straining or Valsalva) are harmful. Patients are also encouraged to warm up with the avoidance of abrupt high-intensity activities; prolonged high intensity or highly competitive/contact sports, exercises in extreme environmental conditions or performed to exhaustion,[1,2] and professional athletes with SCAD are advised to refrain from future competitive sports.

In regard to FMD, there is no content regarding exercise in the AHA Scientific statement[2] or in the recently published international consensus document on FMD.[3] Therefore, current recommendations regarding exercise in patients with FMD are based on expert opinion or 'common sense'. Patients with carotid or vertebral artery dissections should avoid resistance training including body weight exercises such as push-ups and sit-ups during the first 8–12 weeks after the acute dissection after which the recommendations would be similar as for SCAD. Although no data exist, patients with aneurysms should avoid activity that causes straining or Valsalva including sit-ups, push-ups, planks, or other activities that acutely have the capacity to dramatically increase blood pressure.

## Additional leisure-time activities

There are other activities such as roller coasters, skydiving, or scuba diving that some clinicians advise SCAD and FMD patients to avoid, but there are even less data to support these recommendations, which are based on the potential harm of rapid changes in pressure or increases in G-forces. Safety studies on roller coasters find that peak acceleration, which also causes a peak G-force, is often below those predicted for head injuries. Roller coasters can induce a rapid and sustained increase of heart rate comparable to a stress study, but there is considerable variation between subjects.[14] Recommendations regarding sexual activity among patients with SCAD and FMD also do not exist in the published literature. Most studies that assess the haemodynamics of sexual activity are among males and observe that sexual activity is below the threshold for concern and comparable to 3–5 metabolic equivalents.[15]

## Gaps in knowledge and future directions

As current recommendations are based on clinical 'gestalt' and often an abundance of caution, there is a need for future attention to this topic in research, and clearly distinguishing between physical activities vs. structured exercise will help to refine recommendations. There is a need to study the effects beyond cardiac rehabilitation in this patient population with a focus on mental and physical health outcomes and differences among patients who are sedentary vs. active after SCAD. Further mechanistic research is also needed regarding safe cardiorespiratory fitness and strength training thresholds in this patient population. While increased cardiopulmonary fitness is anticipated to be associated with better outcomes, this is not known for SCAD/FMD due to the concern of recurrent arterial dissection or rupture at high exercise intensity levels. As exercise strategies within cardiac rehabilitation continue to be refined, randomized controlled trials of restricted and non-restricted/facilitated exercise assessing for differences in outcomes such as vascular events, mental health status, and physiological fitness would greatly inform clinical practice. Ultimately, such work will help to better understand, treat, and counsel the unique, often otherwise healthy and young, group of patients.

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