# Exercise Prescription for Spontaneous Coronary Artery Dissection

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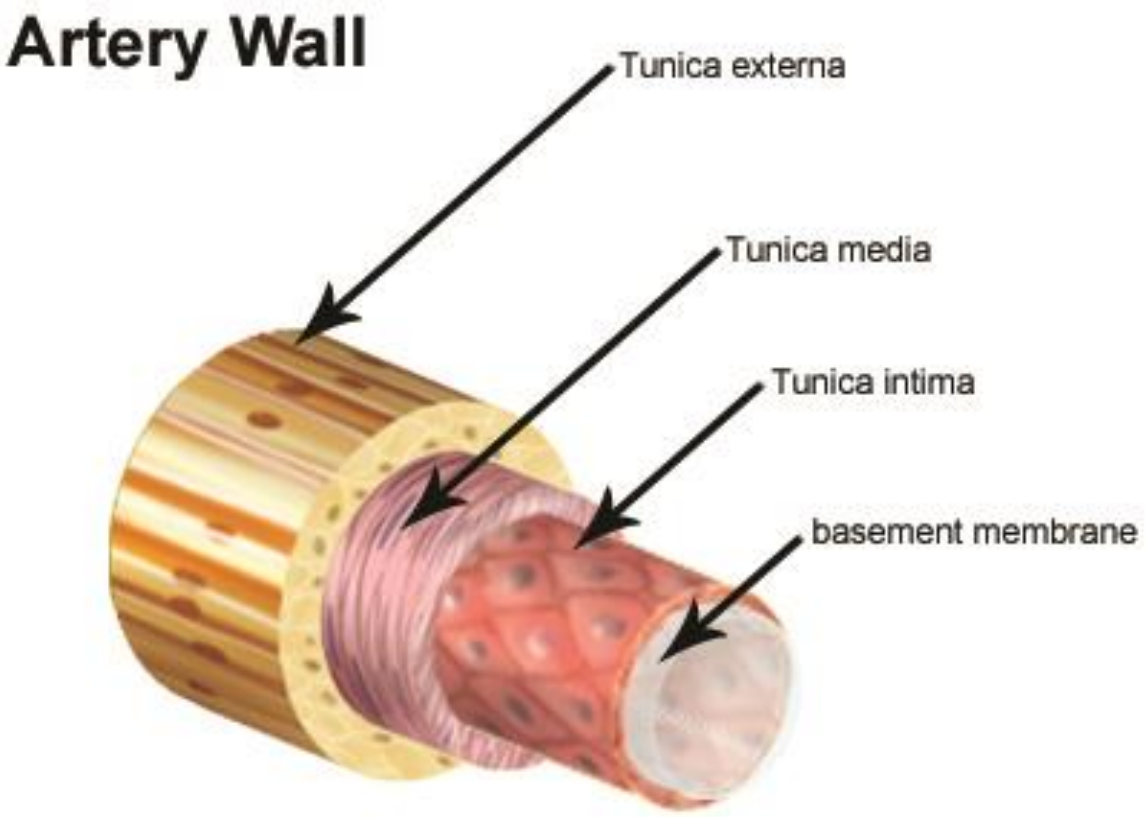
# No disclosures

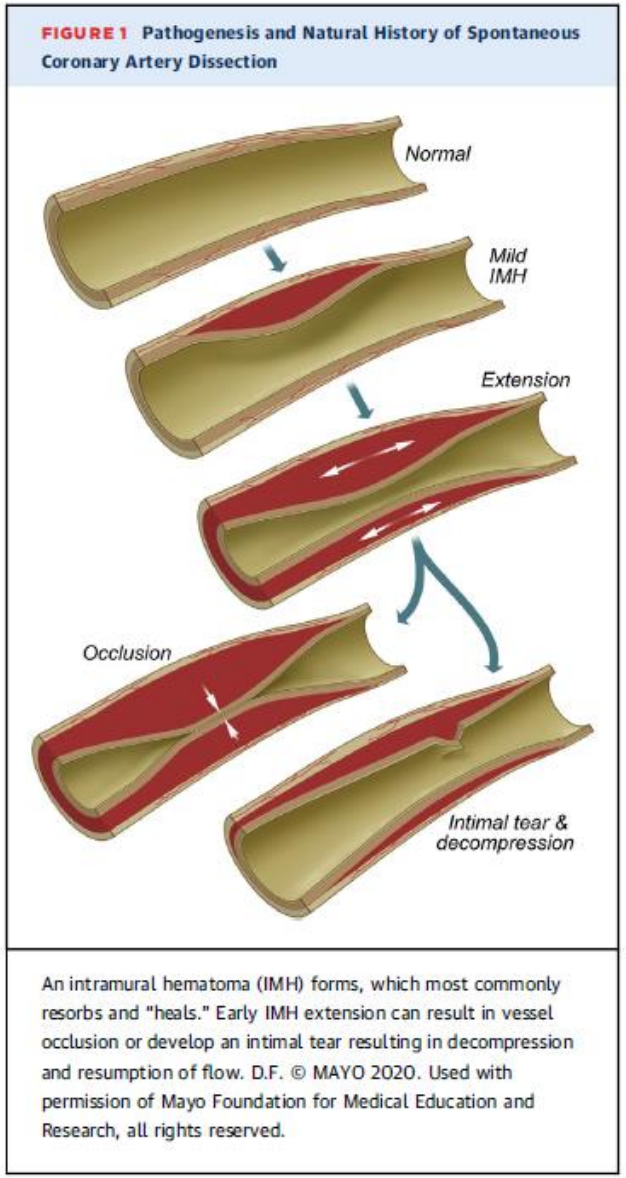
# Our Objectives

- **Review pathophysiology, prevalence, triggers and treatments of spontaneous coronary artery dissection (SCAD).**
- **Review exercise recommendations for SCAD patients from various organizations, including Mayo Clinic and Cleveland Clinic.**
- **Present a case study of a SCAD patient who completed a phase II cardiac rehabilitation program.**
- **Discuss the future of SCAD patients in cardiac rehab.**

# Pathophysiology

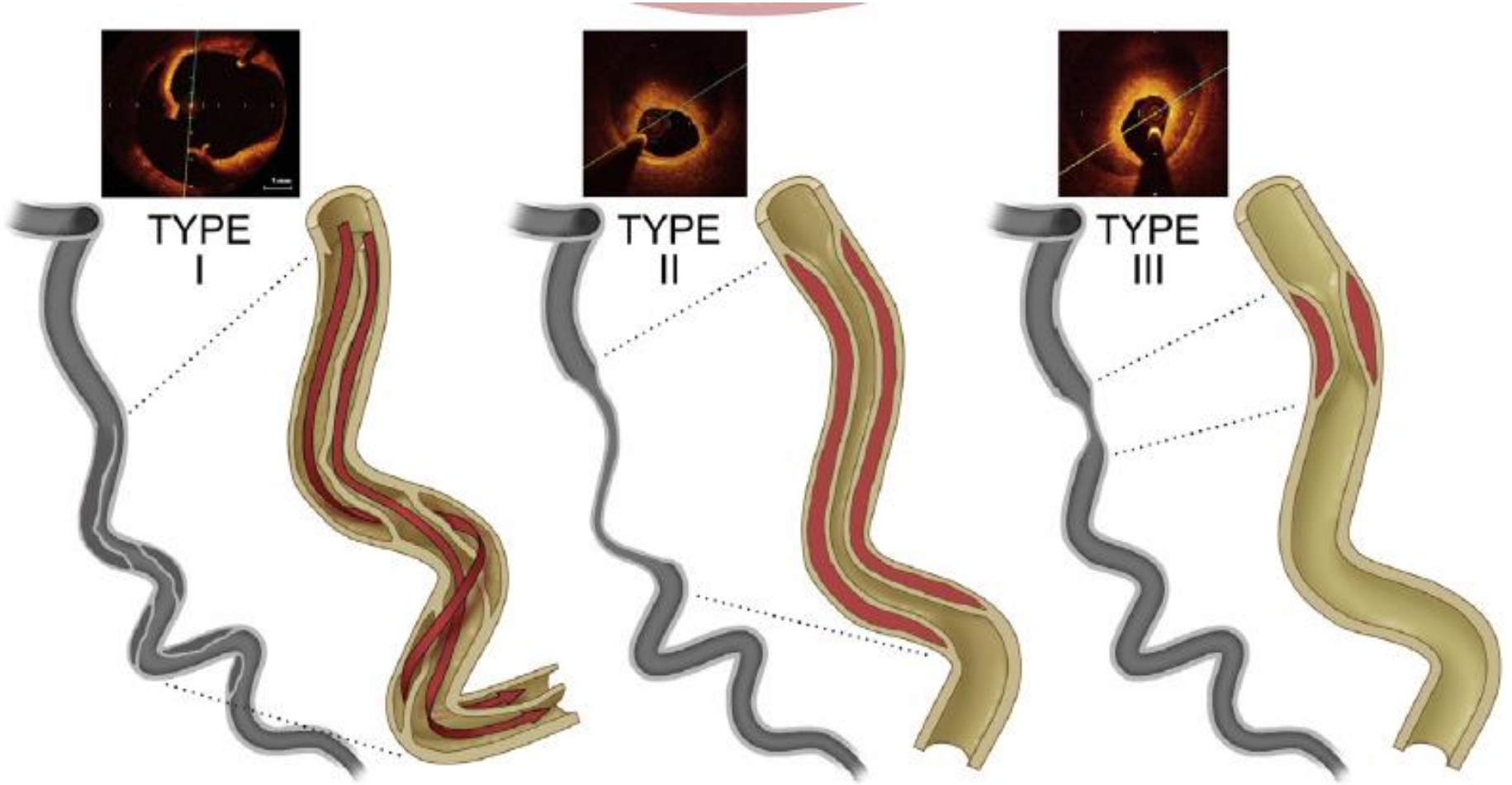



Classification & Structure of Blood Vessels | SEER Training (cancer.gov)




- Acute coronary event w/ development of hematoma within tunica media
- compresses lumen and causes ischemia/AMI
- Inside-out vs. outside-in hypothesis

# Pathophysiology




Hayes, S.N. et al. J Am Coll Cardiol. 2020;76(8):961-84.



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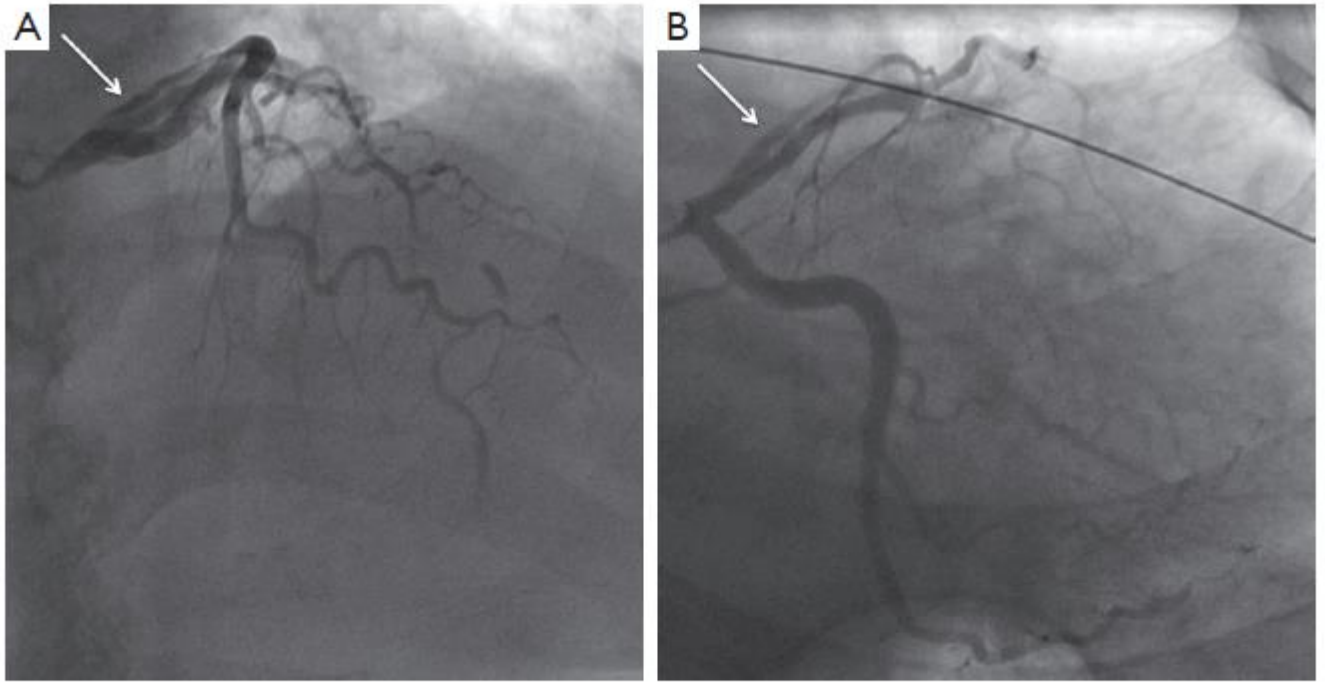



**Figure 3** Type 1 SCAD. (A) Cranial projection showing double-lumen (arrow) with contrast dye hang-up in the proximal LAD, and occluded mid LAD from SCAD; (B) caudal projection showing double-lumen (arrow) of proximal LAD from SCAD. SCAD, spontaneous coronary artery dissection; LAD, left descending artery.

Yip, A., & Saw, J. (2015). Spontaneous coronary artery dissection-A review. *Cardiovascular diagnosis and therapy*, *5*(1), 37–48. https://doi.org/10.3978/j.issn.2223-3652.2015.01.08

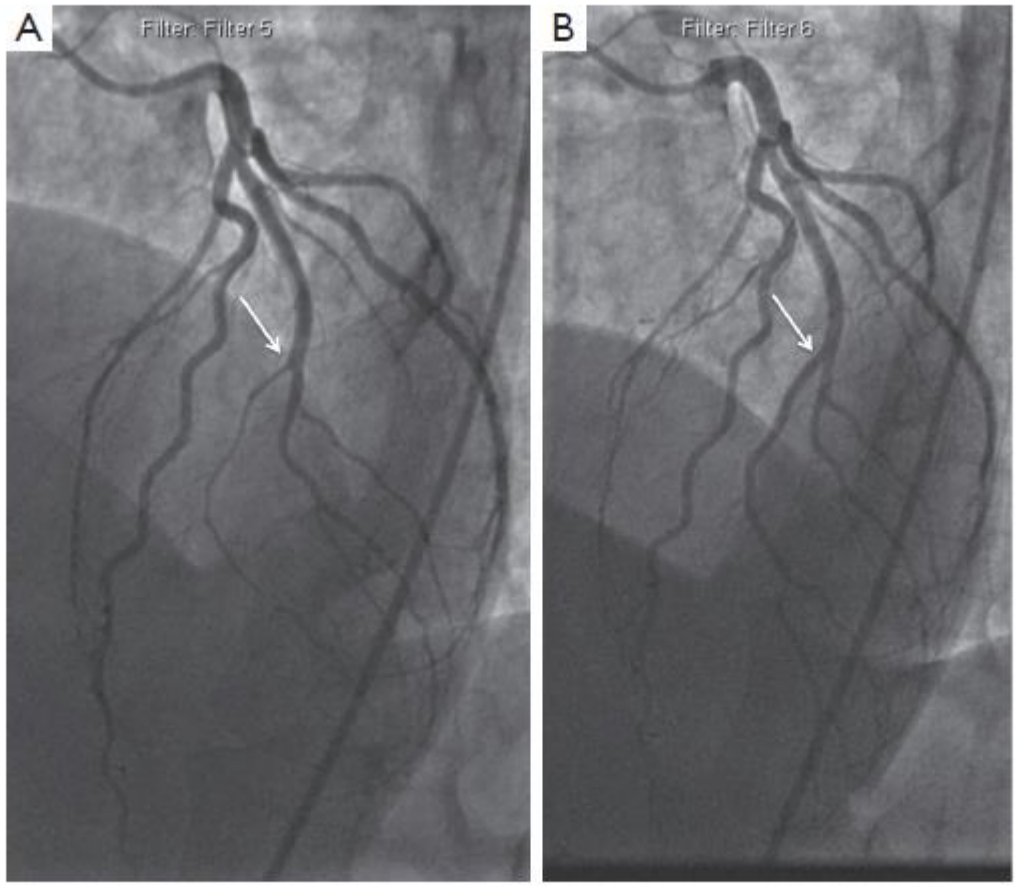



**Figure 4** Type 2 SCAD. (A) Diffuse narrowing of ramus (arrow) from mid to apical segment due to intramural hematoma; (B) healed ramus artery (arrow) 1 year later on repeat coronary angiography. SCAD, spontaneous coronary artery dissection.

Yip, A., & Saw, J. (2015). Spontaneous coronary artery dissection-A review. *Cardiovascular diagnosis and therapy*, *5*(1), 37–48. https://doi.org/10.3978/j.issn.2223-3652.2015.01.08

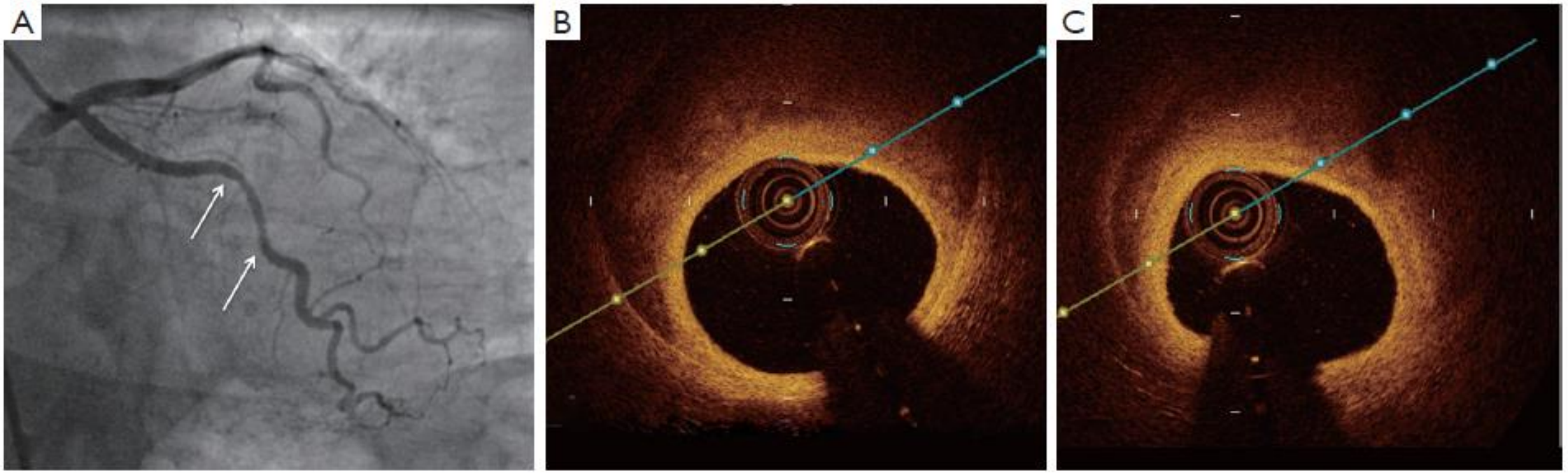


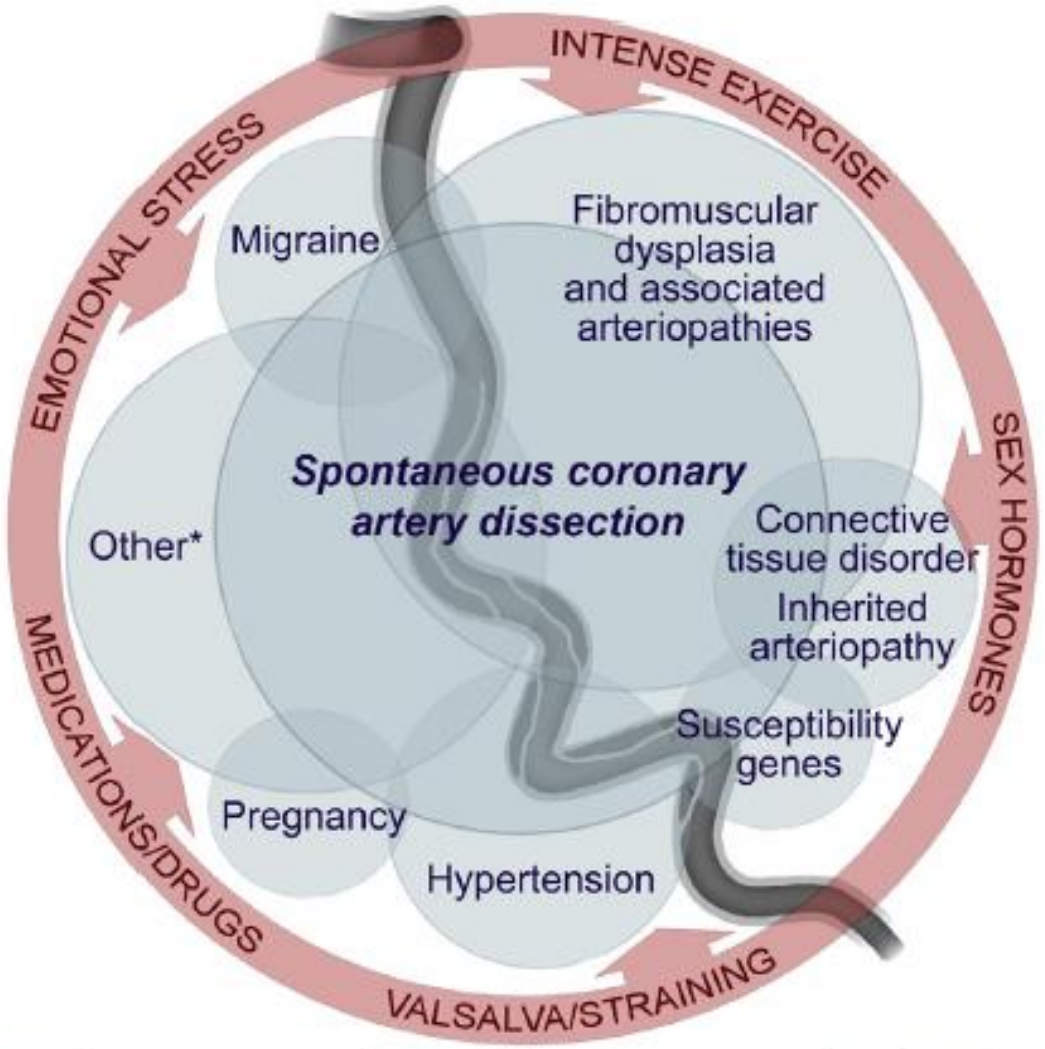

**Figure 5** Type 3 SCAD. (A) Moderate stenosis of the mid circumflex artery (between arrows) due to SCAD; (B,C) intramural hematoma in the false lumen on OCT in this lesion. SCAD, spontaneous coronary artery dissection; OCT, optical coherence tomography.

Yip, A., & Saw, J. (2015). Spontaneous coronary artery dissection-A review. *Cardiovascular diagnosis and therapy*, *5*(1), 37–48. https://doi.org/10.3978/j.issn.2223-3652.2015.01.08

# Prevalence

- Accounts for 2-4% all ACS cases
- Underlying cause of up to 35% all ACS cases in women ≤50 years old
- 87-95% SCAD patients are women; mean age 44-53 years, most with few or no atherosclerotic risk factors
- 18-25% cases are peripartum
- LAD most commonly affected vessel
- 10-29% recurrence rate

**CENTRAL ILLUSTRATION** Associated Conditions, Inciting Factors, and Angiographic Diagnosis of Spontaneous Coronary Artery Dissection

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# Treatment

- **Medical management**
  - Most cases recover normal coronary architecture

- **PCI: less predictable outcomes, higher complication rates**
  - 62% success rate
  - Dissection may get bigger

- **Varied opinions on exercise recommendations**

## Individualized exercise prescription and cardiac rehabilitation following a spontaneous coronary artery dissection or aortic dissection

Erik H. Van Iterson [1,*], Luke J. Laffin[1], Lars G. Svensson[2], and Leslie Cho [1]

[1]Section of Preventive Cardiology and Rehabilitation, Robert and Suzanne Tomsich Department of Cardiovascular Medicine, Miller Family Heart, Vascular and Thoracic Institute, Cleveland Clinic, 9500 Euclid Ave., Desk JB-1, Cleveland, OH 44195, USA; and [2]Department of Thoracic and Cardiovascular Surgery, Miller Family Heart, Vascular and Thoracic Institute, Cleveland Clinic, 9500 Euclid Ave., Desk J4-1, Cleveland, OH 44195, USA

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- Avoid quick, impulsive, and high-intensity exercises in the weeks-to-months following SCAD
- Prescription features: 50-70% VO2 peak, avoid training to exhaustion, greater precision with VT1-VT2 from CPET data
- Exercise BP <150/90 mmHg. Avoid 10mmHg rise in DBP
- Low intensity warm up and cool down periods lasting 8-10 minutes
- Avoid: rowing, HIIT, Valsalva maneuver, plyometrics, explosive and power movements, CrossFit, P90X style training, minimize upper body involvement on elliptical
- Initial low intensity phase (4 weeks): below VT1, ≤40% VO2R or HRR
- Moderate intensity phase: VT1-VT2, ≤70% VO2R or HRR
- Don’t use predicted maximal HR equations. Use clinical exercise testing data

## Cardiac Rehabilitation After Spontaneous Coronary Artery Dissection

Taryn C. Silber, BS; Marysia S. Tweet, MD; Melissa J. Bowman, BS; Sharonne N. Hayes, MD; Ray W. Squires, PhD

- Baseline cardiorespiratory assessments: CPET or 6MWT
- Prescription features: 60-70% HRR and/or 12-14 on 6-20 scale
- No set exercise BP limitations
- 5 minute warm up and cool down (track walking)
- Once able to do 20 minutes continuous exercise, HIIT introduced
- HIIT: 3-5 high intervals (RPE 15-17) for 60-120 sec alternating with moderate intervals (RPE 12-4)
- Modalities: TM walking, jogging, cycle ergometry, elliptical
- Strength training: 10-20 min, 8-15 reps, 1-2 sets (upper, lower, core)



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# Our Cardiac Rehab Patient

Medical History

54-year-old female with history of gallstones and migraines

Hospital Course:

Pt presented to ED with sudden chest pressure, lump in throat, nausea

NSTEMI

LHC: Single-vessel obstructive coronary artery disease of the distal LAD, most likely spontaneous coronary artery dissection (SCAD)

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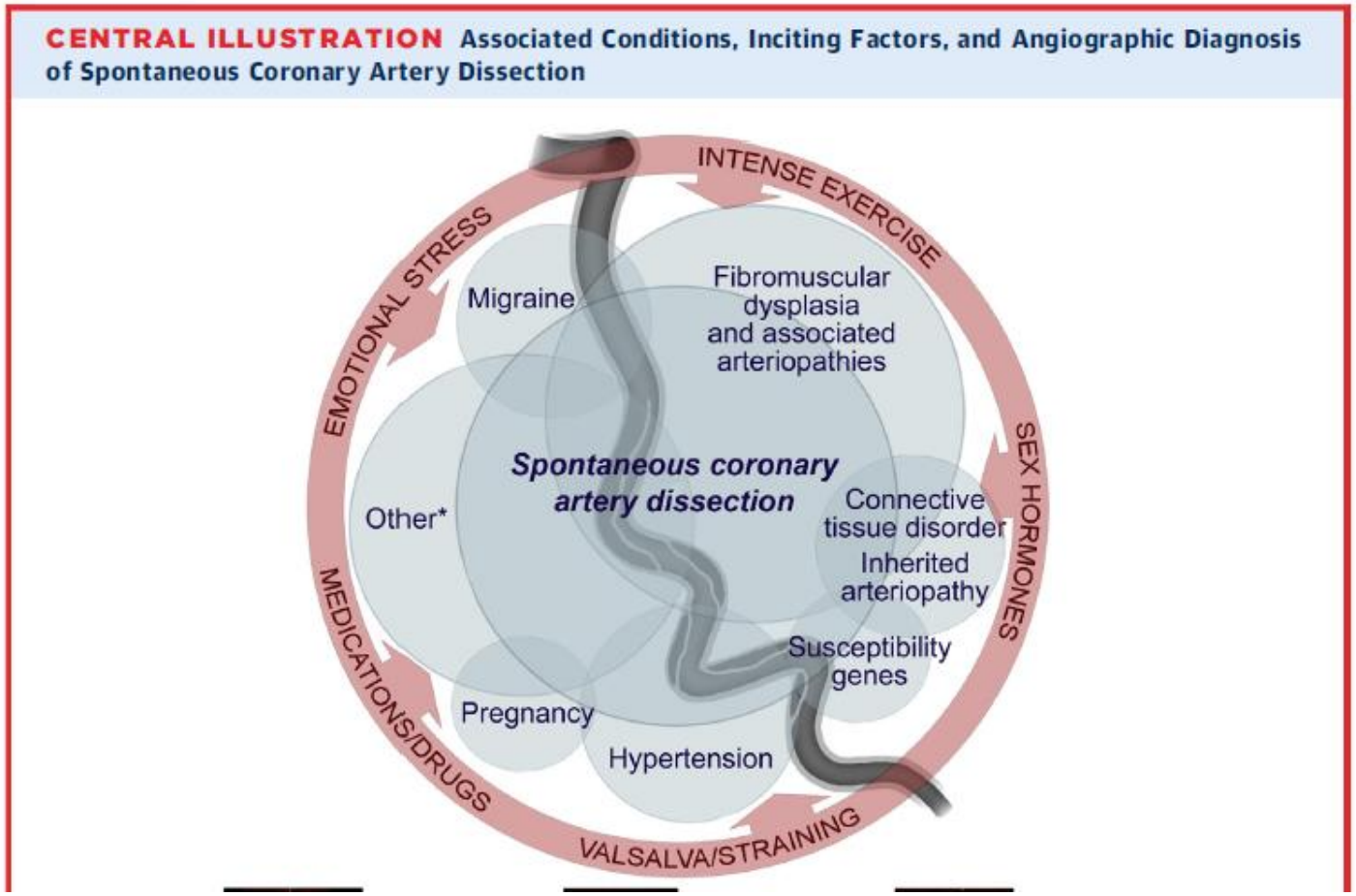


# Additional considerations:

history of migraines

recently stopped OC

resistance training prior to SCAD event

later testing revealed possible fibromuscular dysplasia (FMD)

Hayes S, Tweet M, Adlam D, et al. Spontaneous Coronary Artery Dissection. J Am Coll Cardiol. 2020 Aug, 76 (8) 961–984. https://doi.org/10.1016/j.jacc.2020.05.084



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# Cardiac Rehab Assessment

EKG: NSR

EF: 64%

No orthopedic limitations

Current exercise: walking on TM, 30 min daily. Local gym membership

Patient goals: monitored exercise, lose weight, gain muscle mass

Continued to have occasional chest pain

Nervous to push herself during exercise

# Cardiopulmonary Exercise Testing

**Exercise Test Data**

| Cardiovascular | Baseline | Anaerobic Threshold | Peak Exercise | % Predicted |
|---|---|---|---|---|
| HR (BPM) | 72 | 119 | 166 | 101 |
| SBP (mm Hg) | 122 | 154 | 184 | |
| DBP (mm Hg) | 80 | 84 | 82 | |
| O2 Pulse | 3.8 | 8.4 | 10.6 | 110 |
| **Metabolic** | | | | |
| VO2 (ml/kg/min) | 3.5 | 12.8 | 22.3 | 80 |
| VO2 (L/min) | 0.272 | 1.004 | 1.753 | 95 |
| METs | 1.0 | 3.6 | 6.4 | |
| RER | 0.95 | 1.04 | 1.21 | |
| VE/VO2 | 42 | 30 | 37 | |
| VE/VCO2 | 45 | 29 | 30 | |
| Power Output (watts) | | 73 | 136 | |
| **Respiratory** | | | | |
| Resp. Rate (br/min) | 21 | 26 | 32 | |
| Tidal Volume (L/br) | 0.546 | 1.172 | 1.982 | 136 |
| Ve (L/min) | 11.4 | 30.2 | 64.4 | 69 |
| VD/Vt Est (%) | 0.35 | 0.25 | 0.19 | 106 |
| PETO2 | 109.0 | 103.0 | 112.7 | |
| PETCO2 | 36.7 | 45.7 | 40.9 | |

[redacted] was referred to this laboratory for a metabolic exercise study for the purpose of determining a safe and effective exercise intensity.

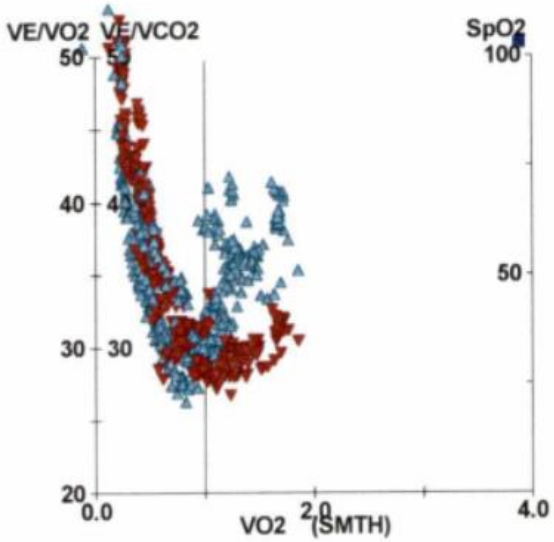
EXERCISE TEST PROCEDURE: The exercise study was performed on a cycle ergometer using a 10 watt/min ramp protocol.

EXERCISE TEST DATA: [redacted] cycled for 14:30 min:sec and achieved a peak HR of 166 BPM, a peak blood pressure of 184/82 mmHg and a peak oxygen consumption (VO2) of 22.3 mL/kg/min. The ventilatory anaerobic threshold (VAT) was determined to occur at 12.8 mL/kg/min, representing 57 % of the peak VO2 corresponding to a heart rate of 119 BPM. Based on observed performance and recorded data, patient did provide a maximal effort. The test was terminated by the technician due to patient's inability to maintain pedal cadence.

Interpreting Physician: Richard Tamisiea, MD

Technician: Colby Jolly, MS, CEP

J. Richard Tamisiea, MD
Medical Director
Cardiac Rehab Services



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# Exercise Prescription

**F: 3 days/week in CR**

**I: HR corresponding to VT1-VT2:**

**119-159 bpm**

**T: 30 minutes aerobic exercise**

**T: Treadmill, Recumbent bike, progression to elliptical and ArcTrainer (no arms)**

**Continue to titrate exercise for BP <150/90**

**Workloads: 60-80% VO2R**

**Treadmill: 3.0 mph, 3-6% incline**

**Recumbent Bike: lv. 8-10, 70-80 rpm (56-84 watts)**

**Home Exercise:**

**Continue TM at local gym, 30 minutes 2-3 days/week at similar intensity to CR**

**Hold strength training, personal training and kickboxing classes**

**Strength training in rehab: Introduced at session 12. 3x week, 12-15 reps**

# Progression Through Cardiac Rehab

**Attendance percentage: 97%. Completed 33 sessions in 12 weeks**

**Modality progression: TM 2.4/0 to TM 3.1/6%, RB lv. 7 to lv. 10, introduced elliptical (no arms) at session 16, introduced AT at session 28**

**MES at session 10 and 33**

**Introduction of strength training at session 12**

**Resuming independent strength training and pilates class. Continue to hold kickboxing class**

**Chest pain progression:**

**Assessment day: reported occasional discomfort under L breast (similar to prior SCAD episode).Took NTG over weekend with resolution of symptoms.**

**Session 5: 2.5/10 on TM.  MD notified and cardiac rehab continued.**

**No chest pain during MES**

**No chest pain noted after session 5**

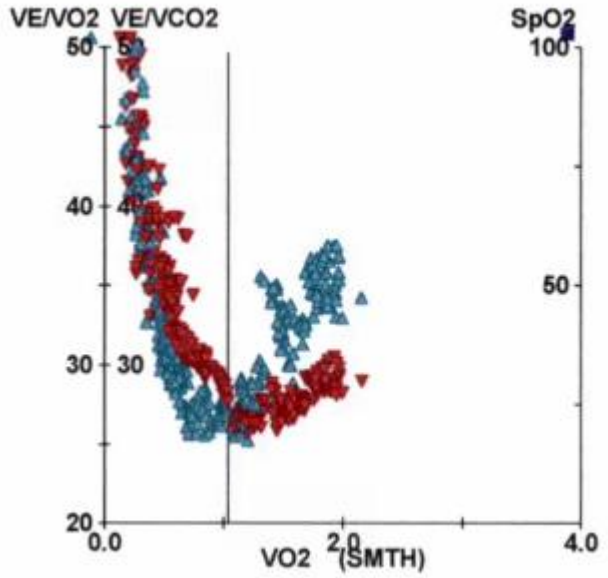
# Post Program Cardiopulmonary Exercise Testing

Exercise Test Data

| Cardiovascular | Baseline | Anaerobic Threshold | Peak Exercise | % Predicted |
|---|---|---|---|---|
| HR (BPM) | 68 | 122 | 171 | 104 |
| SBP (mm Hg) | 118 | 134 | 170 | |
| DBP (mm Hg) | 72 | 74 | 74 | |
| O2 Pulse | 4.4 | 8.6 | 12.1 | 124 |
| **Metabolic** | | | | |
| VO2 (ml/kg/min) | 3.7 | 13.1 | 26.0 | 93 |
| VO2 (L/min) | 0.296 | 1.045 | 2.070 | 112 |
| METs | 1.1 | 3.8 | 7.4 | |
| RER | 0.95 | 0.96 | 1.20 | |
| VE/VO2 | 43 | 27 | 35 | |
| VE/VCO2 | 45 | 28 | 29 | |
| Power Output (watts) | | 80 | 171 | |
| **Respiratory** | | | | |
| Resp. Rate (br/min) | 23 | 25 | 38 | |
| Tidal Volume (L/br) | 0.546 | 1.113 | 1.910 | 128 |
| Ve (L/min) | 12.7 | 28.2 | 72.1 | 77 |
| VD/Vt Est (%) | 0.31 | 0.20 | 0.13 | 75 |
| PETO2 | 114.5 | 102.0 | 113.8 | |
| PETCO2 | 33.0 | 43.7 | 39.6 | |

EXERCISE TEST PROCEDURE: The exercise study was performed on a cycle ergometer using a 15 watt/min ramp protocol. A 3 minute warm-up period of unloaded cycling was performed.

EXERCISE TEST DATA: [redacted] cycled for 11:36 min:sec and achieved a peak HR of 171 BPM, a peak blood pressure of 170/74 mmHg and a peak oxygen consumption (VO2) of 26.0 mL/kg/min. The ventilatory anaerobic threshold (VAT) was determined to occur at 13.1 mL/kg/min, representing 50 % of the peak VO2 corresponding to a heart rate of 122 BPM. The respiratory compensation threshold was determined to occur at 22.6 ml/kg/min, representing 87% of peak VO2 corresponding to a heart rate of 165 BPM. Based on observed performance and recorded data, patient did provide a maximal effort. The test was terminated by the technician due to patient's inability to maintain pedal cadence.




Updated THRR: 120-150 bpm



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# Cardiac Rehab Outcomes

| Variable | Pre-Program | Post-Program | Percent Change |
|---|---|---|---|
| Weight | 173 lbs | 174 lbs | 0.58% |
| Systolic BP | 112 mmHg | 100 mmHg | -1.79% |
| Diastolic BP | 72 mmHg | 70 mmHg | -2.78% |
| Average Ex Mets | 2.84 (TM) | 5.94 (TM) | 109.15% |
| Average Ex HR | 95 bpm | 122 bpm | 28.42% |
| Peak VO2 | 22.3 (8/1/23) | 26.0 (9/27/23) | 16.59% |
| Volume: Leg Press | 1050 lbs (8/4/23) | 2400 lbs (8/28/23) | 128.57% |
| Volume: Chest Press | 30 (8/4/23) | 600 (8/28/23) | 1900.00% |

# What will cardiac rehab for SCAD patients look like in the future?

Canadian Journal of Cardiology 32 (2016) 554–560

Clinical Research

# The First Dedicated Cardiac Rehabilitation Program for Patients With Spontaneous Coronary Artery Dissection: Description and Initial Results

Annie Y. Chou, MD,[a] Roshan Prakash, MD,[a] Jennifer Rajala, MD,[b] Taira Birnie, BSc,[a] Saul Isserow, MD,[a] Carolyn M. Taylor, MD,[c] Andrew Ignaszewski, MD,[c] Sammy Chan, MD,[c] Andrew Starovoytov, MD,[a] and Jacqueline Saw, MD[a]

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[c] *Division of Cardiology, St Paul's Hospital, University of British Columbia, Vancouver, British Columbia, Canada*

**Table 1.** Description of the VGH SCAD-CR protocol

| VGH SCAD-CR protocol |
|---|
| 1. Weekly classes of SCAD survivors with targeted participation of 6 months |
| 2. One-hour weekly exercise class consisting of 15-minute warm-up, 30-minute cardiovascular exercise on aerobic machines, and 15-minute cool-down |
| 3. To reduce arterial shear stress, target exercise heart rate is 50%-70% of heart rate reserve on the basis of the entrance exercise treadmill test, and systolic blood pressure during exercise is limited to < 130 mm Hg |
| 4. Exercise is adjusted to upper heart rate target to achieve rating of perceived exertion of "moderate" to "somewhat difficult" |
| 5. Resistance training with 2- to 12-pound free weights to increase muscle strength, starting with lighter weights and progressing with strength gain |
| 6. Patients are advised to avoid lifting weights > 20 pounds |
| 7. A 20-minute educational session per week on heart-healthy nutrition, risk factors, and treatment of heart disease, and stress management, emphasizing women's heart disease |
| 8. Counselling, mindful living sessions, and peer-support from other SCAD survivors |
| 9. Outside of formal sessions, participants can exercise in the supervised open gymnasium |
| 10. Regular review of cardiac medications (eg, aspirin, β-blocker, angiotensin-converting enzyme inhibitor, statin) and coordination with the VGH SCAD clinic |

CR, cardiac rehabilitation; SCAD, spontaneous coronary artery dissection; VGH, Vancouver General Hospital.



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# Mayo: 2021 Recommendations

"The greatest disservice is to be so cautious that patients become sedentary…"

**150 min aerobic exercise/week at moderate intensity**

**RT: encouraged with focus on proper breathing and technique; low weight, higher reps; avoid Valsalva**

**Avoid:**

- **Abrupt, intense activity**
- **Prolonged high intensity**
- **Highly competitive/contact sports**
- **Exercise in extreme environmental conditions**
- **Professional athletes: refrain from competition**




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# Other considerations for the future…

**More uniform exercise prescription recommendations**

**Development of peer support for patients**

**Implementation of CPET testing for more precise ExRx**

**Individualizing and progressing the ExRx to keep the patient engaged, challenged and safe**

# References


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# Thank You!

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