What is Spontaneous Coronary Artery Dissection (SCAD) & Why is Cardiac Rehabilitation Important?

Marysia Tweet, MD
25th Annual MNACVPR State Conference
October 3rd, 2015
Goals:

- Learn about SCAD
- Review current SCAD research, patient resources, and recommended care
- Describe the role of cardiac rehabilitation
SCAD

- Causes myocardial infarction (MI) & sudden death
- Reported prevalence 0.07-1.1%
- Prevalence likely higher due to ↑ awareness & improved diagnostic techniques
  - We will see this more often!

- MI etiology in 10-30% F <50 yo
- Most common MI etiology during or shortly after pregnancy

Tweet et al. Circ 2012
Saw et al. Can Jour of Cardiol 2014
Elkayam et al. Circ 2014
SCAD
Spontaneous coronary artery dissection (SCAD)

- Acute coronary syndrome without atherosclerosis
- Intramural hematoma +/- intimal dissection flap
- Diagnosed via:
  - Coronary angiography
  - Intravascular ultrasound (IVUS)
  - Optical coherence tomography (OCT)
Case 1: 37 yo F

• Delivered a baby 5 days ago
• Presents with CP and nausea
• STEMI on electrocardiogram
37 yo F with postpartum STEMI
Optical coherence tomography (OCT)
Case 2: 42 yo F with V. Fib Arrest
Intramural hematoma on OCT

*
Myocardial injury on cardiac MRI
Conservatively managed, Healing on follow-up
SCAD retrospective analysis 1979-2011
Baseline characteristics (N = 87)

- Mostly female (82%)
- Young (mean age 43 yrs)
- No or minimal typical risk factors
- Potential risk factors: postpartum/pregnancy, extreme emotion or **extreme exercise**, connective tissue disease, fibromuscular dysplasia, **coronary tortuosity**, family history

Tweet et al., Circulation 2012
SCAD presentation (n = 87)

STEMI n=43
- Single-vessel (34)
- Multi-vessel (9)
- V fib/tach (10)

NSTEMI n=38
- Single-vessel (29)
- Multi-vessel (9)
- V fib/tach (2)

Unstable angina n=6
- Single-vessel (4)
- Multi-vessel (2)

Tweet et al., Circulation 2012
# Affected vessels (%)

<table>
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<th>Distribution</th>
<th>Male</th>
<th>Female</th>
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Tweet et al., Circulation 2012
SCAD N=87

PCI n=39
  - Conservative n=24
  - CABG n=5
  - Death n=1
CABG n=4
  - CABG n=3
  - PCI n=4
Fibrinolytics n=13
  - CABG n=3
  - PCI n=6
No Revascularization n=31
  - Conservative n=31

Tweet et al., Circulation 2012
Long-Term Outcomes

Major Adverse Cardiac Events

Survival free of MACE (%)

Years after index event

No. at risk

Major Adverse Cardiac Events (MACE) = Death, Recurrent SCAD, MI, CHF

Tweet et al., Circulation 2012
Recurrence of SCAD

- Recurrence in 15/71 females, 0/16 males (p = 0.023)
- Median 2.8 yrs (3 days - 12 yrs)
- 3rd episode SCAD (n = 2) at 1 and 11 mos after prior event

Tweet et al., Circulation 2012
Fibromuscular Dysplasia (FMD)

- FMD of external iliac artery on 8 of 16 femoral angiograms
- Carotid FMD (n = 2), both with dissection
- All female
- FMD prevalence likely underestimated since no routine vascular screening
- 4/10 pts with FMD recurred including both carotid dissection pts

Tweet et al., Circulation 2012
Long-Term Survival
SCAD vs Matched ACS Controls

Survival (%)

Years after index event

Tweet et al., Circulation 2012
Survival Free of MI
SCAD vs Matched ACS Controls

Survival free of MI (%)

Years after index event

Tweet et al., Circulation 2012
WHEN PATIENTS BAND TOGETHER

Using Social Networks To Spur Research for Rare Diseases: Mayo Clinic Signs On

BY RON WINSLOW

When Katherine Leon began feeling crushing chest pain six weeks after the birth of her second child, doctors were perplexed about what was causing her symptoms.

Ms. Leon was then 38 years old and healthy, and doctors didn’t believe she was having a heart attack. She saw her physician and made two visits to the emergency room. Finally, doctors decided to perform an X-ray angiogram to check for arterial blockages. What they found was so serious, she was whisked to the operating room within 30 minutes for bypass surgery.

The diagnosis: Ms. Leon had spontaneous coronary artery dissection, or SCAD, a mysterious condition in which the internal layer of an artery separates from the outer wall, creating a fissure where blood clots can form and potentially block blood flow. SCAD is so rare that little research has been done into what causes it, who is at risk and what treatments are most effective. It mainly affects women and can be fatal.

Ms. Leon, now 45, survived her ordeal, but fears it may occur again, although data don’t exist to know whether certain people may be prone to the condition. Like many people with rare diseases, the Alexandria, Va., resident set out to connect via an online network with other SCAD survivors, one as far away as New Zealand. What distinguishes this group of patients, however, is that they succeeded in persuading researchers at a major medical center to launch a research program to learn more about SCAD.

Tuesday, results of a pilot study conducted by researchers at the Mayo Clinic are being published online by the journal Mayo Clinic Proceedings. The study, which involved 12 SCAD patients from the message board, found that it is feasible to collect data and medical records from patients with different doctors and from far-flung locales. The study is a precursor to a much larger trial the clinic is planning.

See full image on back.
Prompted the Mayo Clinic SCAD Virtual Registry and DNA Registry

ORIGINAL ARTICLE

Spontaneous Coronary Artery Dissection: A Disease-Specific, Social Networking Community-Initiated Study

MARYSIA S. TWEET, MD; RAJIV GULATI, MD, PhD; LEE A. AASE, BS; AND SHARONNE N. HAYES, MD

OBJECTIVE: To develop and assess the feasibility of a novel method for identification, recruitment, and retrospective and prospective evaluation of patients with rare conditions.

PATIENTS AND METHODS: This pilot study is a novel example of “patient-initiated research.” After being approached by several members of an international disease-specific support group on a social networking site, we used it to identify patients who had been diagnosed as having at least 1 episode of spontaneous coronary artery dissection and recruited them to participate in a clinical investigation of their condition. Medical records were collected and reviewed, the original diagnosis was independently confirmed by review of imaging studies, and health status (both interval and current) was assessed via specially designed questionnaires and validated assessment tools.

RESULTS: Recruitment of all 12 participants was complete within 1 week of institutional review board approval (March 18, 2010). Data collection was completed November 18, 2010. All participants completed the study questionnaires and provided the required medical records and coronary angiograms and ancillary imaging data.

CONCLUSION: This study involving patients with spontaneous coronary artery dissection demonstrates the feasibility of and is a successful model for developing a “virtual” multicenter disease registry through disease-specific social media networks to better characterize an uncommon condition. This study is a prime example of patient-initiated research that could be used by other health care professionals and institutions.


patients undergoing angiography in most registries and series. Among reported case series ranging from 3 to 47 cases, there is an approximate 2:1 female predominance. About one third of the cases in women occur in the peripartum period. SCAD may present as sudden death, angina, or myocardial infarction and may be responsible for as many as 1 of 10 episodes of acute coronary syndrome in women younger than 50 years. Despite hundreds of published case reports and small case series, to our knowledge only 1 SCAD patient registry has been developed, and no data from multicenter clinical trials are available to guide treatment. Because of the paucity of clinical data and inconsistent follow-up and reporting, the prevalence, recurrence rate, and long-term prognosis after SCAD remain uncertain, and the underlying etiology and optimal short- and long-term management are ambiguous. As with other poorly understood conditions, many survivors are highly active in seeking information from any available source and seek to learn from experiences of others similarly affected.

PATIENTS AND METHODS

For editorial comment, see page 836
1. Identify subjects via a disease-specific support group on a social networking site

2. Confirm disease status

3. Obtain detailed records and surveys for data collection

4. Follow-up

Advance Rare Disease Research through Social Networking

Prospective research, DNA studies, multicenter registry

Mayo Clinic SCAD Virtual and DNA Registry

United States
Mayo Clinic SCAD Virtual and DNA Registry

World

Nearly 500 enrollees with confirmed SCAD
Mayo SCAD Clinic

- Approximately 10 SCAD patients each month
Patient Engagement

Spontaneous Coronary Artery Dissection

Overview

Spontaneous coronary artery dissection (SCAD) occurs when a split or separation suddenly develops between the layers of the wall of one of the blood vessels (artery) that provides blood flow to the heart. The space between the layers of the artery's wall may fill with blood, which may reduce or block blood flow through the artery. Spontaneous coronary artery dissection may lead to a heart attack, sudden cardiac arrest or other complications if not diagnosed and treated quickly. SCAD often affects women, but men also may have the condition. Read more about spontaneous coronary artery dissection.

Why choose Mayo Clinic for spontaneous coronary artery dissection

- Experience. Mayo Clinic doctors trained in heart and blood vessel conditions (cardiologists) and heart and blood vessel surgery (cardiovascular surgeons) have experience evaluating and treating spontaneous coronary artery dissection and other cardiovascular conditions.
- Team approach. Mayo Clinic cardiologists and cardiovascular surgeons work together with doctors trained in hereditary conditions (medical genetics) to diagnose and treat your condition. Doctors trained in pregnancy and female reproductive conditions (obstetrics and gynecology) also may help evaluate women who have SCAD.

Related News

Mayo Clinic Begins to Unveil Rare Heart Condition that Strikes Young, Healthy Women

See more news releases related to Spontaneous Coronary Artery Dissection.

See all news

Medical Edge

Spontaneous Coronary Artery Dissection (SCAD)

See all stories.
The Mayo Clinic Spontaneous Coronary Artery Dissection (SCAD) Research Program is part of an innovative multidisciplinary collaborative research and clinical practice initiative formed in 2010. The goal of the program is to advance the understanding of the underlying causes and risk factors for SCAD and develop solutions for optimal diagnosis, treatment and prevention.

The Mayo Clinic SCAD Research Program takes a novel approach to patient-initiated rare disease research, utilizing registries, comprehensive review of participant data, genetic analyses, advanced medical imaging and other collaborative studies. The research is based on a novel database registry and a DNA and plasma biobank. This approach, involving research colleagues from across Mayo and at select organizations, has already had an impact.
Original Research Article

A novel application of CT angiography to detect extracoronary vascular abnormalities in patients with spontaneous coronary artery dissection

Jackson J. Liang DO\textsuperscript{a}, Megha Prasad MD\textsuperscript{a}, Marysia S. Tweet MD\textsuperscript{b}, Sharonne N. Hayes MD\textsuperscript{b}, Rajiv Gulati MD, PhD\textsuperscript{b}, Jerome F. Breen MD\textsuperscript{c}, Shuai Leng PhD\textsuperscript{c}, Terri J. Vrtiska MD\textsuperscript{c,*}

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ABSTRACT

Background: Spontaneous coronary artery dissection (SCAD) is associated with extracoronary vascular abnormalities, which depending on type and location may warrant treatment or provide additional diagnostic or prognostic information about this uncommon entity. Fibromuscular dysplasia (FMD), aneurysms, and dissections have been detected in multiple vascular territories by magnetic resonance angiography, CT angiography (CTA), and catheter angiography. The optimal modality to detect extracoronary vascular abnormalities is unknown. We highlight the technique and feasibility of a novel CTA protocol to detect extracoronary vascular abnormalities in these
Extracoronary Vascular Imaging Consecutive Series

- 115 Mayo Clinic SCAD outpatients

Vascular abnormalities:
- Fibromuscular dysplasia
- Dissection
- Aneurysm
- Dilatation
- Tortuosity
- Undulating aorta

Overall Vascular Abnormalities 66%
Overall FMD 45%

Prasad et al., Am J Cardiol, 2015
Iliac FMD
SCAD Coronary Tortuosity

A. Intravessel symmetry
B. Multivessel symmetry
C. Corkscrew sign
D. Coronary artery microaneurysm
E. Coronary fibromuscular dysplasia

Eleid et al., Circ Cardiovasc Interv 2014
Prevalence of SCAD Coronary Tortuosity

P<0.0001 for all

- LAD tortuosity
- LCX tortuosity
- RCA tortuosity

Eleid et al., Circ Cardiovasc Interv 2014
SCAD Coronary Tortuosity

- Recurrent SCAD (n=40) usually occurred in segments of tortuosity (80%)
- ↑ recurrence risk if severe tortuosity
- Vascular abnormalities & FMD associated with corkscrew & multivessel symmetrical tortuosity (P<0.05 for both)

Eleid et al., Circ Cardiovasc Interv 2014
How Should Acute SCAD Be Managed?

AHA/ACC Guidelines for ACS

• Revascularization by balloon and/or stent
  • Class I, Level of Evidence A

• Atherosclerotic ACS

• Revascularization outcomes for SCAD are unknown
- 45 consecutive SCADs
- Included pts with associated CAD (40%)
- 35% required early PCI/CABG due to ischemia
- 54% (7/13) complete healing

Alfonso et al., JACC Imaging, 2012
SCAD Acute Management
Retrospective review (N = 189)

• 95 treated with balloon, stent(s) or bypass
• 94 conservatively managed

• Mean age 44 yrs, 95% female

• Presentation:
  • STEMI 49%, NSTEMI 44%, UA 7%

Tweet et al., Circ Cardiovasc Interv 2014
SCAD Acute Management
Retrospective review (N = 189)

- Treated with balloon and/or stent(s):
  - 53% failure rate
  - 50% failure rate in those with preserved distal coronary flow, 6 (13%) emergency CABG

- Conservative therapy:
  - Uneventful hospital course
  - 73% of 59 with repeat CA showed healing
  - 9 (10%) early SCAD progression requiring stent or bypass surgery (mean 4 days, 2-7)

*Tweet et al., Circ Cardiovasc Interv 2014*
Final loss of flow
Target Vessel Revascularization

Revascularization vs Conservative Management

Free of target vessel revascularization (%)

Years

No. at risk 189 105 85 70 52 45

P=0.06

Conservative Revascularization

Tweet et al., Circ Cardiovasc Interv 2014
Recurrent SCAD
Revascularization vs Conservative Management

Free of recurrent SCAD (%)

Years

No. at risk

189

123

92

72

56

46

P = 0.70

Tweet et al., Circ Cardiovasc Interv 2014
Proposed Algorithm for Acute SCAD Management

1. Acute SCAD on angiography
   - No
   - OCT/IVUS: False lumen or intramural hematoma?
     - Yes
     - TIMI flow assessment
       - TIMI 0-1 OR clinically unstable
         - Revascularize
       - TIMI 2-3 AND clinically stable
         - Conservative management inpatient monitoring for 5 days
     - No
   - Yes

Tweet et al., Circ Cardiovasc Interv 2014
Outpatient SCAD Clinic Standard Evaluation

- Detailed history of SCAD, risks
- Extensive review of records & imaging
- Routine labs, CRP, Lpa, homocysteine, TSH
- Exam – added focus on extracoronary findings
- CTA protocol- base of skull to pelvis (FMD, aneurysms)
- Other testing as indicated-Stress, CCTA
- Medical Genetics consultation
Why Medical Genetics?

- 5 familial cases among 412 patient enrollees
  - Mother-Daughter
  - Identical twin sisters
  - Sisters
  - Aunt-niece
  - First cousin pairs

- Implicates both recessive and dominant modes of inheritance

Goel et al., JAMA IM, 2015
Monogenic disorders associated with SCAD

- Vascular Ehlers Danlos syndrome (Type IV) – *COL3A1*
- Marfan Syndrome – *FBN1*
- Loeys-Dietz Syndrome – *TGFBR1, TGFBR2, SMAD3, TGFB2*
- Pseudoxanthoma Elasticum (PXE) – *ABCC6*
Moving Beyond Known Disorders: Mayo Clinic SCAD DNA biorepository

• Pilot study: 28 unrelated SCAD patients
• Whole exome sequencing & comparative variant filtering of proband-parent trios
• Ruled out a common disease gene but identified 8 plausible candidate genes

Theis et al., presented at the Individualized Medicine Conference and the American Society of Human Genetics, 2014
Anxiety and Depression

Prevalence and Predictors of Depression and Anxiety Among Survivors of Myocardial Infarction Due to Spontaneous Coronary Artery Dissection

Jackson J. Liang, DO; Marysia S. Tweet, MD; Sarah E. Hayes, BA; Rajiv Gulati, MD, PhD; Sharonne N. Hayes, MD
Cardiac Rehabilitation (CR) and SCAD

- Young
- Predominantly women
- Minimal risk factors
- Current CR studies & guidelines following MI primarily based on atherosclerosis pts
Baseline Functional Capacity in SCAD

- Treadmill stress testing for 18 female SCAD pts vs female all-comers <55 yrs

- SCAD pts:
  - Mean age 46 yrs
  - Mean duration 9.8 min
  - Mean METs 10.6

- Controls:
  - Mean age 49 yrs (p=0.19)
  - Mean duration 6.2 min
  - Mean METS 6.8 (p value <0.001)

Naderi et al., presented as poster at ACC, 2015
CR in SCAD: Mayo Clinic SCAD Registry Data

- Reviewed 412 enrollees in the ongoing Mayo Clinic SCAD Registry (2010-2013)
- 354 (86%) completed CR survey questions
- Mean age at time of SCAD 46 ± 10 yrs
- 95% female

Krittanawong et al., presented as poster at AHA QCOR, 2015
CR in SCAD: Mayo Clinic SCAD Registry Data

• 76% participated in at least one cardiac rehab session

• Those users averaged $18 \pm 12$ sessions
Perceived CR Benefits

Emotional benefits: 75%
Physical health benefits: 82%

Today I am still experiencing the benefits of participating in cardiac rehab

Krittanawong et al., presented as poster at AHA QCOR, 2015
Reasons for Not Participating in CR

- Too little energy to engage in a rehab program: 2%
- Too ill to do any physical activities: 2%
- My healthcare providers did not recommend rehab program: 67%
- No insurance coverage for rehab program: 8%
- Too expensive: 2%
- Too far to travel or no way to get to rehab facility: 12%

Krittanawong et al., presented as poster at AHA QCOR, 2015
## Regular Exercise

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<th>CR n=269</th>
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<td>Aerobic exercise &gt;30 min (duration)</td>
<td>54%</td>
<td>40%</td>
<td>0.01</td>
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<td>Aerobic exercise at &gt; 1/wk (frequency)</td>
<td>80%</td>
<td>66%</td>
<td>&lt;0.01</td>
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Krittanawong et al., presented as poster at AHA QCOR, 2015
Mayo Clinic SCAD CR Experience

- Nine SCAD pts in Mayo Clinic CR
- Average of 12.3 days (7-21) after SCAD
- Completed average of 28 CR sessions (5-39)

- Standard CR program:
  - Supervised & independent flexibility, stretching, aerobic, strength training
  - Counseling regarding nutrition, weight & stress management

Silber et al., JCRP, 2015
Mayo Clinic SCAD CR Experience

• CR was well received
• No reported cardiac symptoms or adverse events during exercise testing or training
• Peak O2 uptake ↑18% (n=4)
• 6-min walk distance ↑22% (n=4)
• Depression & stress scores ↑ 2.3 & 1.3 pts, respectively

Silber et al., JCRP, 2015
CR Summary

- Most SCAD pts find CR to be beneficial
- Lack of referral most common reason for no CR
- Standard CR 1 to 2 wks after SCAD seems feasible and safe
- CR observed to improve aerobic capacity, body composition, measures of depression & stress in SCAD
CR Summary

• Recommend CR for SCAD pts
• May have high functional ability so need to tailor CR to the patient
• Continue to study SCAD & determine appropriate recommendations as much remains uncertain!
SCAD Take Home Points

- SCAD primarily affects young women
- Presentation is heart attack, unstable angina, cardiac arrest
- No atherosclerosis
- Associated conditions: extreme emotion or extreme exercise, peripartum status, connective tissue disease, non-CAD vasculopathy & FMD, coronary tortuosity, genes
- Will see more (↑awareness, intravascular imaging)
- Important to diagnose because management is different than guidelines!!!
- Cardiac rehab is important!!!
- Study referrals remain significant to the Mayo Clinic SCAD Virtual and DNA registries (thank you)!
Thank you!
Questions & Discussion

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