In the name of God

SCAD

Dr. Morteza Safi
SCAD

Definition: Epicardial coronary artery dissection not associated with atherosclerosis or trauma and is not iatrogenic

Leads to myocardial injury due to coronary artery obstruction caused by intramural hematoma or intimal disruption
SCAD: Facts and Figures

Prevalence: unknown, but likely underdiagnosed

- May cause up to 1-4% of ACS cases overall
- 90% are in women
- Cause of 35% of MIs in women <50 years old
- Most common cause of pregnancy-related MI (43%)
- Average age 45-53 years (second through 8th decade)
SCAD: Facts and Figures

- Any coronary artery may be involved
  - LAD and diagonal branches 45-61%
  - Circumflex, ramus, OMBs 15-45%
  - RCA, marginal, PDA, PLV 10-30%
  - LM in 4%
- Typically involves mid and distal coronary artery segments
- <10% are proximal LAD or LCx
- Multivessel SCAD occurs in 9-23% of cases

Hayes SN et al. Circulation 2018
The cause of SCAD is unknown, but considered to be multifactorial with contributions from:

- Arteriopathies
- Genetic factors
- Inflammatory conditions
- Hormonal influences
- Inherited or acquired arteriopathies
- Environmental precipitants/stressors
SCAD: Pathogenesis

Arteriopathies

underlying fibromuscular dysplasia (FMD)
  - extracoronary FMD present in 17-86% of cases
  - 2.7% of patients with FMD experienced SCAD
  - intracranial aneurysms in 14-23%
  - arterial tortuosity (78%)

Hayes SN et al. Circ 2018
Fig. 1. Coronary angiographic types of spontaneous coronary artery dissection. Type 1 has the pathognomonic appearance with contrast media staining of arterial wall. Type 2A shows long coronary stenosis bordered by normal artery segments. Type 2B has long coronary stenosis that extends to the tip of the artery. Type 3 shows focal or tubular stenosis that is challenging to distinguish from atherosclerosis.
Figure 2 Young woman presenting with chest pain and anterior ST-segment changes on the ECG. (A) Coronary angiogram of a patient with SCAD demonstrating a diffuse narrowing (arrows) in the mid segment of a tortuous left anterior descending coronary artery. The image remained unchanged after the administration of intracoronary nitroglycerin; (B,C,D) optical coherence tomography images depicting a long intramural hematoma [yellow asterisk (*)] with a relatively preserved coronary lumen. White asterisk (*) denotes wire artifact. SCAD, spontaneous coronary artery dissection.
Figure 3 Patient presenting with ACS. (A) Coronary angiography of a patient with SCAD showing a relative focal lumen narrowing at the mid segment of the left anterior descending coronary artery; (B,C,D,E) optical coherence tomography images demonstrating a normal vessel wall at the edges of the stenosis (B,E) and a severe lumen compromised caused by an intramural hematoma [yellow asterisk (*)] (C,D). White asterisk (*) denotes wire artifact. SCAD, spontaneous coronary artery dissection; ACS, acute coronary syndrome.
Locations Where Arterial Abnormalities* May Be Found in Patients with History of Spontaneous Coronary Artery Dissection

*Arterial abnormalities include fibromuscular dysplasia, coronary tortuosity, aneurysm, dilatation, and dissection.

Figure 2. Common locations of arterial abnormalities in association with SCAD. Used with permission from Tweet MS, Kok SN, Hayes SN: Spontaneous coronary artery dissection in women: what is known and what is yet to be understood. Clin Cardiol. 2018 Feb 4; 41 (2):203-210; used with permission of Mayo Foundation for Medical Education and Research. All rights reserved.
Systemic Vasculopathies
- Fibromuscular dysplasia
- Inherited connective tissue disorders
  - Ehlers Danlos syndrome
  - Loeys-Dietz syndrome
  - Marfan syndrome

Pregnancy
- Changes in cardiac output and blood volume
- Rapid ↓ hormone levels postpartum

SCAD Associations

Inflammatory Conditions
- Systemic lupus erythematosus
- Polyarteritis nodosa
- Sarcoidosis
- Celiac disease
SCAD: Pathogenesis

Hormonal influences

**Pregnancy-associated SCAD**

- 1.8 per 100,000 pregnancies up to 6 weeks postpartum (most commonly in 1st 1-2 weeks postpartum)
- Left main or LAD more common
- Related to hormonal changes affecting the arterial wall, advanced maternal age and multiparous women at higher risk?
- May have worse prognosis: more proximal dissections, more multivessel SCAD, larger infarcts, shock in 24%
SCAD: Pathogenesis

Inherited or acquired arteriopathies

Inflammatory conditions

rarely associated with SCAD (SLE, IBD, polyarteritis nodosa, sarcoidosis, coronary vasculitis)
SCAD: Pathogenesis

Genetic arteriopathies and SCAD

<5% of cases

Vascular EDS
Marfan syndrome
Loeys-Dietz syndrome
polycystic kidney disease

familial in 1.2% of cases

other genes or locus: TLN1, PHACTR1/EDN1
Environmental precipitants/stressors

Extreme emotional (40%) or physical (24%) stressor reported

Catecholamine surge in susceptible individuals
SCAD: Clinical Presentation

Wide range of clinical presentation from “atypical chest pain” in a young otherwise healthy woman to STEMI with cardiogenic shock.

STEMI in 26-87%
NSTEMI in 13-69%
Cardiac arrest in 3-11%
SCAD: Clinical Presentation

Wide range of clinical presentation from “atypical chest pain” in a young otherwise healthy woman to STEMI with cardiogenic shock.

STEMI in 26-87%
NSTEMI in 13-69%
Cardiac arrest in 3-11%

Initial troponin often normal and may peak at low levels
Initial LVEF often normal or without significant WMA

Patients at risk for misdiagnosis or DC from ER due to lack of typical symptoms and risk factors for ASCVD.
SCAD: Coronary Angiography

Traditional description of SCAD emphasized angiography demonstrating multiple radiolucent lumens and extraluminal contrast staining c/w spiral dissection.

Present in the minority of cases
SCAD: Coronary Angiography

Traditional description of SCAD emphasized angiography demonstrating multiple radiolucent lumens and extraluminal contrast staining c/w spiral dissection.

Present in the minority of cases

Coronary CTA is of limited value in most cases of SCAD.
SCAD: Coronary Angiography

Type 1: multiple radiolucent lumens (arrow) or arterial wall contrast staining (29%)

Type 2: diffuse or focal stenosis due to IMH (arrow), that can be of varying severity and length >20 mm (67%)

Type 3: focal or tubular stenosis (IMH) (arrow), usually <20 mm in length, that mimics CAD

Optical coherence tomography in type 3
SCAD: Coronary Angiography

Type 1, multiple radiolucent lumens (arrow) or arterial wall contrast staining (29%)

Type 2, diffuse stenosis due to IMH that can be of varying severity and length >20 mm (67%)

Type 3: focal or tubular stenosis (IMH) (arrow), usually <20 mm in length, that mimics CAD

Optical coherence tomography in type 3
SCAD: Coronary Angiography

Type 1, multiple radiolucent lumens (arrow) or arterial wall contrast staining (29%)

Type 2, diffuse stenosis due to IMH that can be of varying severity and length >20 mm (67%)

Type 3: focal or tubular stenosis (IMH) (arrow), usually <20 mm in length, that mimics CAD

Optical coherence tomography in type 3
SCAD: Initial Management

Observational data have indicated angiographic “healing” of SCAD lesions in the majority of cases (70-97%) who were selectively re-cathed weeks to months after conservative management.

Time course for angiographic “healing” of dissection variable, but often within several weeks.
SCAD: Initial Management

Conservative therapy is recommended for the majority of patients with SCAD.

5-10% of cases develop early complications of recurrent MI, typically due to extension of dissection in 1st 7 days.

- majority of these require emergency revascularization
  no clear predictors of recurrent MI

Because of risk of recurrent events early, inpatient monitoring for more extended period is recommended when conservatively managed SCAD
SCAD: Initial Management

Clinical High-Risk Features?

- Yes
  - Consider PCI/CABG
    - Left Main
      - CABG
      - PCI* if:
        - No emergency CABG
        - Cardiogenic shock, VT/VF
        - Technically feasible (e.g., not extensive into LAD/Circ)
    - Non Left Main
      - PCI* if:
        - No emergency CABG
        - Cardiogenic shock, VT/VF
        - Technically feasible (e.g., not extensive into LAD/Circ)
  - Conservative Therapy*
    - High-Risk Anatomy?
      - Yes
        - Ischemia on Stress Test or Lifestyle-limiting angina?
          - Yes
            - Consider Repeat Angiogram
          - No
            - Consider testing & Treatment for non-ischemic pain
      - No
        - Recurrent Chest Pain Post-SCAD?
          - Yes
            - High-Risk Anatomy:
              - Left main
              - Proximal LAD, circ, and/or RCA
              - Multivessel SCAD
          - No
            - Options for PCI* (if feasible):
              - POBA \pm stent
              - Cutting balloon \pm stent
              - Stenting:
                - Single long stent
                - Either edges first, then middle
                - Proximal first (to avoid retrograde extension)
                - Sequential stenting

- No
  - Clinical High-Risk Features:
    - Ongoing ischemia
    - Cardiogenic shock
    - Sustained ventricular arrhythmia
    - Left main dissection
  - Options for PCI* (if feasible):
    - POBA \pm stent
    - Cutting balloon \pm stent
    - Stenting:
      - Single long stent
      - Either edges first, then middle
      - Proximal first (to avoid retrograde extension)
      - Sequential stenting
  - Conservative Therapy*:
    - Aspirin
    - Beta-blocker
    - ADP antagonist, ACEi/ARB, statin, nitroglycerin, CCB

Hassan S et al. JACC Card Inter 2019; j.cin.2018.12.011
SCAD: Percutaneous Coronary Artery Intervention

PCI associated with increased risk of complications and suboptimal outcomes

<table>
<thead>
<tr>
<th>Series</th>
<th>Cases</th>
<th>PCI failure</th>
<th>Emergency CABG required due to PCI failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mayo</td>
<td>189</td>
<td>53%</td>
<td>13%</td>
</tr>
<tr>
<td>Vancouver</td>
<td>168</td>
<td>36%</td>
<td>12%</td>
</tr>
<tr>
<td>European</td>
<td>134</td>
<td>27%</td>
<td>9%</td>
</tr>
</tbody>
</table>
SCAD: Percutaneous Coronary Artery Intervention

PCI associated with increased risk of complications and suboptimal outcomes

- underlying arteriopathy
- diffuse dissection
- technical issues
  -- guidewires may enter false lumen and occlude true lumen
  -- balloon dilatation and stent placement may lead to propagation of the dissection or IMH
  -- long lesion length
  stent thrombosis/late restenosis
  -- distal arteries/branch arteries
SCAD: Percutaneous Coronary Artery Intervention

PCI associated with increased risk of complications and suboptimal outcomes

- underlying arteriopathy
- diffuse dissection
- technical issues
  -- guidewires may enter false lumen and occlude true lumen
  -- balloon dilatation and stent placement may lead to propagation of the dissection or IMH
  -- long lesion length
  -- stent thrombosis/late restenosis
  -- distal arteries/branch arteries

Optimal PCI requires meticulous angiographic and instrumentation techniques.

Worse outcomes with radial angiography
(3-fold higher catheter-associated iatrogenic dissection)
Evidence limited to case reports, small series and retrospective observational studies

CABG: treatment strategy for LM or proximal dissections, after technical failure/complications of PCI, or refractory ischemia/shock.

High-rate of venous and arterial conduit occlusions
11/16 graft failures (probably due to spontaneous healing)
SCAD: Early Outcomes in Hospital

Up to 14% of patients require urgent in-hospital revascularization.

“Prolonged” hospitalization of at least 3-5 days is recommended for patients with SCAD.

Recurrent CP is common and may be due to recurrent ischemia or dissection or may be due to the dissection itself.
SCAD: Medical Therapy

**Anticoagulation:** no role in the absence of other indications, risk of accentuating bleeding into IMH

**Glycoprotein IIb/IIIa inhibitors:** no data to guide use

**Oral antiplatelet agents:**
- DAPT after PCI with stenting
- Treatment for conservatively managed patients is controversial and no data to guide management.
  - Some suggest DAPT for 1-year, then aspirin
  - Many use DAPT for 1-3 months, then aspirin alone
  - Others suggest aspirin alone

Hayes SN et al. Circ 20
SCAD: Medical Therapy

Beta blockers:

- Vancouver experience: 327 patients
  Use of beta blockers associated with lower risk of recurrent SCAD (hazard ratio 0.36)

- Use for other typical indications (LV dysfunction, arrhythmias)

ACE-inhibitors and statins:

Use for typical indications
No data to support the use in SCAD alone
Contraception and Pregnancy

- discuss birth control importance and pregnancy risks/concerns (P-SCAD recurrence, higher risk)

- hormonal contraception:
  - no direct evidence linking estrogen/progesterone with recurrent SCAD
  - avoid if possible, unless no other good options

- discuss vasectomy for partner, IUD, tubal ligation after DAPT stopped
SCAD: Screening for SCAD-Associated Conditions

SCAD is often associated with an underlying vascular or genetic condition

Careful history and examination:

Features suggesting FMD:
- HTN, TIA/stroke, h.o. aneurysm, headaches
- carotid, renal bruits

Features suggesting CTD:
- PTX, tendon or muscle rupture, hollow organ rupture,
- joint dislocation, skeletal deformities, abnormal scars,
- translucent skin, abnormal bruising, ectopia lentis, retinal
- detachment, BAV, MVP, bifid uvula

Hayes SN et al. Circ 2018
SCAD: Screening for SCAD-Associated Conditions

Vascular imaging from brain to pelvis recommended to evaluate for FMD and aneurysm disease

- FMD: 17-86%
- intracranial aneurysm in 14-23%

Routine genetic testing has low yield for genetic arteriopathy

- lower threshold for vascular EDS evaluation (COL3A1)
- when findings suggest inherited disorder may be present, genetic testing recommended (TGFBR1, TGFBR2, COL3A1, FBN1, SMAD3, TGFBR2, TGFBR3, PLOD1, COL5A1)
Cardiac rehabilitation

Very important for physical, psychological and social well-being

Exercise and physical activity long-term

- Concern about safety of various forms of physical activity after SCAD
- Individuals with SCAD may be highly motivated to return to previous high levels of exercise
- Prudent approach is recommended low to moderate aerobic and low resistance training
SCAD: Post-Discharge Care

Many have recurrent chest pain after discharge.

- Often atypical
- Often treated with nitrates, CCB

Repeat angiography when benefits outweigh risks:

- recurrent symptoms, esp. with elevated troponin/EKG changes
- abnormal functional tests
- high-risk anatomy
Psychosocial Concerns:

- Anxiety and depression are common after SCAD, especially when pregnancy-related SCAD

- Higher psychological distress, depression, anxiety, worry, and tension than people with non-SCAD MI.
SCAD: Risk of Recurrence

Recurrent SCAD rates highly variable in the literature ranging from 0-37%.

When limited to de novo recurrent SCAD (not propagation or extension of initial SCAD) >30 days after initial case, in large series the recurrence rate was 11-17%.

Severe coronary artery tortuosity may be a risk factor for recurrence.
SCAD: Top 10 Take Away Points

1. SCAD is a common cause of ACS, especially in younger women and in pregnancy-associated MI

2. Typically involves mid and distal coronary segments and branch vessels

3. Conservative initial therapy is recommended with invasive therapy for high-risk lesions and ongoing ischemia/injury or hemodynamic instability

4. Antiplatelet therapy and beta blocker recommended

5. Screen for FMD with imaging from brain to pelvis
SCAD: Top 10 Take Away Points

6. Angiographic “healing” of SCAD is common within several weeks of the acute event

7. Enroll SCAD patients in cardiac rehabilitation programs

8. Discuss birth control, pregnancy and family planning

9. Recurrent SCAD occurs in 11-17% of patients

10. Discuss psychosocial, mental health and exercise concerns and encourage participation in registries and support groups
Thanks a lot for your attention