Objectives

1. Recognize early complications of acute coronary syndrome.

2. Identify other etiologies of acute coronary syndrome

3. Restate the rule of myocardial biopsy in patients presenting with acute coronary syndrome.
Case #1

- 53 year female old patient presented to the ED with four days of substernal chest discomfort and shortness of breath.

- Left hip replacement complicated by infection treated with Vancomycin

- DRESS syndrome

- History of eosinophilia

EKG

[Image of EKG chart]
Allergies

- Daptomycin: rash, diarrhea
- Vancomycin: renal failure, eosinophilia
- Adhesive tap

Physical exam:

- BP 89/59 mmHg
- HR: 105
- Mild distress
- Rest of the exam unrevealing
Laboratory data

- HB 8.5
- Platelets 346
- WBC 12.3
- Troponin 33.6 mcg/L
- NA 126
- Pro BNP 30000

Coronary angiogram
Coronary angiogram

- Non obstructive CAD
- LVEDP 30 mmHg
- LVEF 35%

Echocardiogram
Home medications:
- Prednisone 10 mg daily
- Dilaudid 4 mg Q4 PRN pain
- ASA
- Omeprazole
- Doxepin 10mg daily
- Diazepam
- Gabapentin

Social history
- No smoking
- No illicit drug use
- No heavy drinking
Review of systems

- Loss of appetite
- Nausea
- Diarrhea

Assessment

- 53 year old female presenting with chest pain, elevated troponin (33) Lateral ST segment elevation
- Coronary angiogram non-obstructive disease
- Echo moderate LV dysfunction with pericardial effusion no signs of tamponade
Working diagnosis

- Vasospasm
- Myocarditis (viral, eosinophilic, sarcoidosis or giant cell)
- Stress induced cardiomyopathy
- Transient embolic coronary occlusion

Plan:

- Admit to MICU
- Supportive care
- Consider IABP in continues to deteriorate
- Cardiac MRI
Hospital Course

- Respiratory distress/ hypoxemia intubated
- AKI and shocked liver
- Improved was extubated
- Treated with high doses steroids for DRESS syndrome

Hospital Course Cont.

- Hypotension, recurrent VT s/p multiple shock
- Repeat CA LAD no disease, LVEDP 20 mmHg. Underwent myocardial biopsy and dialysis catheter placement.
- VF and asystole s/p resuscitation. ECMO Was placed by CTS patient was transferred to ANW
EKG

Troponin 176

H&E from Endomyocardial Biopsy
H&E from Endomyocardial Biopsy

Pathology Report

- Eosinophilic and lymphohistiocytic myocarditis with associated myocyte necrosis

- Findings are consistent with acute necrotizing eosinophilic myocarditis (ANEM), a more severe form of DRESS-associated hypersensitivity myocarditis
Discussion

- **DRESS**: drug reaction with eosinophilia and systemic symptoms

- Severe idiosyncratic reaction with long latency period

- Symptoms start anywhere between 2-8 weeks of initiation of the offending drug


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**DRESS**

- A genetic deficiency of detoxifying enzymes leading to an accumulation of drug metabolites

- Common features consist of fever, rash, LAP, eosinophilia, leukocytosis, and abnormal liver function tests

- Visceral involvement (hepatitis, pneumonitis, myocarditis, pericarditis, nephritis, and colitis) is the major cause of morbidity and mortality
## Diagnostic Criteria

**Table 4. Japanese group’s criteria for diagnosis of DRESS/DHS**

- Maculopapular rash developing >3 weeks after starting with the suspected drug
- Prolonged clinical symptoms 2 weeks after discontinuation of the suspected drug
- Fever >38°C
- Liver abnormalities (alanine aminotransferase >100 U/L)
- Leucocyte abnormalities
- Leucocytosis (>11 x 10^9/L)
- Abnormal lymphocytosis (>5%)
- Eosinophilia (>1.5 x 10^9/L)
- Lymphadenopathy
- Human Herpes 6 reactivation

The diagnosis is confirmed by the presence of the 7 criteria (typical DHS).

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### Table 1. Characteristics and management of reported cases of DRESS syndrome with cardiac involvement

<table>
<thead>
<tr>
<th>Case</th>
<th>No. of patients</th>
<th>Drug</th>
<th>Dose</th>
<th>Pulmonary Hypertension</th>
<th>Cardiac Hypertrophy</th>
<th>Cardiac arrhythmias</th>
<th>Area of skin rash</th>
<th>Time of rash onset</th>
<th>Time of symptoms onset</th>
<th>Diagnosis</th>
<th>Therapy</th>
<th>Outcome</th>
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</thead>
<tbody>
<tr>
<td>Hening et al. (1994)</td>
<td>1</td>
<td>Ampicillin</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>2 weeks</td>
<td>Postmortem autopsies</td>
<td>Amyloidosis, pericarditis, attempted pericardiocentesis</td>
<td>Hypertension</td>
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<td>De Gruttola et al. (1993)</td>
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<td>+</td>
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<td>Postmortem</td>
<td>Hypertension, pericarditis, attempted pericardiocentesis</td>
<td>Hypertension</td>
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<tr>
<td>Garty et al. (1994)</td>
<td>1</td>
<td>Penicillin</td>
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<td>+</td>
<td>+</td>
<td>4 days</td>
<td>N/A</td>
<td>Corticosteroids</td>
<td>Cardiac function improved to normal 17 days after admission</td>
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<td></td>
<td></td>
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<tr>
<td>Parmalee-Banks et al. (1995)</td>
<td>1</td>
<td>Minocycline</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>2 weeks</td>
<td>Postmortem</td>
<td>Corticosteroids</td>
<td>Cardiac function improved to normal 17 days after admission</td>
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<tr>
<td>Bigheriti et al. (1998)</td>
<td>1</td>
<td>Cefalexin</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>1-2 weeks</td>
<td>Endomyocardial biopsy</td>
<td>N/A</td>
<td>Cardiac function improved to normal 17 days after admission</td>
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<tr>
<td>Arnott et al. (1993)</td>
<td>1</td>
<td>Phenobarbital</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>3 mo</td>
<td>Endomyocardial biopsy</td>
<td>N/A</td>
<td>Cardiac function improved to normal 17 days after admission</td>
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<tr>
<td>Argenzio et al. (2001)</td>
<td>1</td>
<td>Cimetidine</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>At presentation</td>
<td>Endomyocardial biopsy</td>
<td>N/A</td>
<td>Cardiac function improved to normal 17 days after admission</td>
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<tr>
<td>Chan et al. (2002)</td>
<td>2</td>
<td>Allopurinol</td>
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<td>+</td>
<td>+</td>
<td>2 mo</td>
<td>N/A</td>
<td>Corticosteroids</td>
<td>Cardiac function improved to normal 17 days after admission</td>
<td></td>
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<tr>
<td></td>
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<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
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<td>N/A</td>
<td>Corticosteroids</td>
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<td>Lee et al. (2003)</td>
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<td>Minocycline</td>
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<td>17 days</td>
<td>Endomyocardial biopsy</td>
<td>N/A</td>
<td>Cardiac function improved to normal 17 days after admission</td>
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</table>

![Image of the page](image-url)
<table>
<thead>
<tr>
<th>Case</th>
<th>No. of patients</th>
<th>Drug</th>
<th>Endocardial Disease</th>
<th>Hypertension</th>
<th>Chf</th>
<th>Prior Anticoagulation</th>
<th>LV Dysfunction</th>
<th>Time of onset of symptoms after rash</th>
<th>Diagnosis</th>
<th>Treatment Strategy</th>
<th>Outcome</th>
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<tbody>
<tr>
<td>Ziad7 (2005)</td>
<td>1</td>
<td>Phenylalanine, carbenicillin, or penicillin</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>2 wk</td>
<td>N/A</td>
<td>Controversial</td>
<td>Full cardiac recovery</td>
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<tr>
<td>Tao et al.4 (2006)</td>
<td>1</td>
<td>Penicillin</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>18 days</td>
<td>N/A</td>
<td>Controversial</td>
<td>Full cardiac recovery</td>
<td></td>
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<tr>
<td>Chilvers et al.4 (2006)</td>
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<td>Penicillin</td>
<td>+</td>
<td>+</td>
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<td>+</td>
<td>At presentation</td>
<td>No</td>
<td>Immunosuppression</td>
<td>Died 4th day of hospitalization</td>
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<tr>
<td>Sallusto et al.7 (2011)</td>
<td>1</td>
<td>Penicillin</td>
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<td>+</td>
<td>+</td>
<td>2 wk</td>
<td>Endomyocardial biopsies and pericarditis</td>
<td>Controversial</td>
<td>Died 6th day of ICU admission</td>
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<tr>
<td>Edlin et al.5 (2009)</td>
<td>1</td>
<td>Minocycline</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>2 mo</td>
<td>Endomyocardial biopsies</td>
<td>Controversial</td>
<td>Died 6th day of ICU admission</td>
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<td>Punyani et al.4 (2009)</td>
<td>1</td>
<td>Azithromycin</td>
<td>+</td>
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<td>+</td>
<td>+</td>
<td>3 mo</td>
<td>Endomyocarditis and biopsies</td>
<td>Controversial</td>
<td>Died 2 wk</td>
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<tr>
<td>Bey et al.2 (2009)</td>
<td>1</td>
<td>Vancomycin</td>
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<td>+</td>
<td>+</td>
<td>1 day</td>
<td>Cardiac MRI</td>
<td>Controversial</td>
<td>Died 2 wk</td>
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<td>Minocycline</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>2 wk</td>
<td>Endomyocardial biopsies</td>
<td>Controversial</td>
<td>Died 2 wk</td>
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<tr>
<td>Anacona et al.3 (2012)</td>
<td>1</td>
<td>Carbamazepine</td>
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<td>+</td>
<td>+</td>
<td>+</td>
<td>9 days</td>
<td>Postmortem</td>
<td>Rhabdomyolysis</td>
<td>Died within 24 hr of admission</td>
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<td>1</td>
<td>Trimethoprim-sulfamethoxazole or penicillin</td>
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<td>+</td>
<td>+</td>
<td>4 mo</td>
<td>Postmortem</td>
<td>Controversial</td>
<td>Died 3 days after admission</td>
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<tr>
<td>Saffold et al.2 (2011)</td>
<td>1</td>
<td>Sulfadiazine</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>3 mo</td>
<td>Endomyocardial biopsies</td>
<td>Controversial</td>
<td>Died 3 days after admission</td>
<td></td>
</tr>
</tbody>
</table>

Management

- Early withdrawal of the offending agent
- Supportive care
- Corticosteroids and other immune suppressant agent
- Relapse is common long taper recommended
- IV IG
- ventricular assist devices, heart transplant
Take home message

- DRESS associated myocarditis is relatively common and under recognized
- It can happen months after the initial DRESS diagnosis
- Patients diagnosed with DRESS should undergo cardiac evaluation and close monitoring
- Myocardial biopsy will confirm the diagnosis
- Treatment include: High dose steroids with long tapers, other immune suppressant, mechanical ventricular support, heart transplant

Case #2

- 57 year old female presented to outside ER with crushing chest pain
- Lateral ST segment depression and elevated troponin (5.8)
- D dimer elevated was sent for CT chest became hypotensive intubated and transferred with Cardiogenic shock
• One week prior to presentation she had chest pain treated for upper respiratory tract infection

• Patient had respiratory failure requiring multiple pressers

Coronary angiogram
HEMODYNAMICS

- RA=19
- RV=51/20
- PW=52
- PA=71/49, mean 56
Echocardiogram

TEE
Hospital Course

- Underwent emergent mitral valve replacement (27 mosaic porcine valve)

- DES to LAD (2.75 x12)
Coronary angiogram
Papillary muscle rupture

- Mechanical complications has decrease with revascularization. However mortality still high

- First case reported in 1948 by Davison

- First successful mitral valve replacement was reported by Austent et al 1965

Papillary muscle rupture

- The posteromedial papillary muscle is 6-12 times more likely to rupture, it is solely supplied by PDA

- The anterolateral papillary muscle is relatively protected, it is supplied by LAD and LCX.

- Papillary muscles are subendocardial structures, small endocardial infarcts can cause papillary muscle ruptures

- Mean interval between acute MI and PMR is 6 days
PMR

- Typical presentation: inferior MI, tachycardia, hypotension, shock and pulmonary edema

- The murmur of an acute MR may be loud and holosystolic

- Often soft and short

- Absent with complete papillary muscle rupture where the left atrium and left ventricle become a common chamber and no gradient to create a murmur

- Overall 42% with PMR had murmur
PMR

- Early recognition (MI, Shock and pulmonary edema with or without murmur)
- Both subendocardial and transmural infarction
- TTE and TEE
- Hemodynamic support and surgical intervention

Case#3

- 27 year old female history tobacco abuse, grand multipara
- Presented to ED with crushing chest pain radiating to her jaw
- Recent delivery and tubal ligation one week prior to presentation
EKG

Coronary angiogram
Coronary angiogram
Echocardiogram
Hospital Course

- Polymorphic VT, Resuscitated
- Repeat coronary angiogram, patent stents
- Discharged after one week on life vest
- Follow up echo LVEF 35%
Spontaneous Coronary Artery Dissection

- Affect young healthy females
- Unrecognized cause of MI and sudden death
- Dissection and hematoma formation in the vessel media resulting in luminal compression
- Bleeding vasa vesorum my start intramural hematoma
- Intimal dissection is not universal

Tweet MS et al, Circ Cardiovasc Interv. 2014;7:777-786

SCAD

- Retrospective study 189 patients between 1984 and 2014
- Early and late outcomes in patients revascularized by CABG/PCI vs conservative approach
- Analyze patients based on presenting vessel flow
  - Vessel occlusion treated with PCI
  - Vessel occlusion treated conservatively
  - Preserved flow treated with PCI
  - Preserved flow treated conservatively

Tweet MS et al, Circ Cardiovasc Interv. 2014;7:777-786
## Baseline characteristics

<table>
<thead>
<tr>
<th></th>
<th>Revasc (95)</th>
<th>Cons(94)</th>
<th>P Value</th>
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<tbody>
<tr>
<td>Age</td>
<td>44+9</td>
<td>44+9</td>
<td>0.76</td>
</tr>
<tr>
<td>Sex</td>
<td>92</td>
<td>92</td>
<td>&gt;0.99</td>
</tr>
<tr>
<td>STEMI</td>
<td>51</td>
<td>23</td>
<td>0.0002</td>
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<tr>
<td>TIMI 0-1</td>
<td>48</td>
<td>17</td>
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<td>Mean lesion stenosis</td>
<td>90+14</td>
<td>75+21</td>
<td>&lt;0.0001</td>
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</table>

### Diagrams

#### A Target Vessel Revascularization
Revascularization vs Conservative Management

#### B Target Vessel Revascularization
PF-PCI vs PF-Con

#### C Recurrent SCAD
Revascularization vs Conservative Management

#### D Recurrent SCAD
PF-PCI vs PF-Con
Overall recurrence 27% at 5 years
Early Recurrence

- In the conservative group 9/94 (10%) had recurrent chest pain, ischemia and angiographic findings of SCAD progression

- 2-7 days mean 4 days

- 8/9 were revascularized with PCI/CABG

Challenges with PCI

- Displacement of the hematoma and extending the dissection

- Stent under sizing and late stent malapposition after resorption of the hematoma

- Rule of IVUS and OCT
Acute management

Acute SCAOD on angiography

No

Yes

OCT/IVUS: False lumen or intramural hematoma?

TIMI flow assessment

TIMI 0-1 OR clinically unstable

Revascularize with inpatient monitoring for 5-7 days, consider CABG in high volume surgical centers.

TIMI 2-3 AND clinically stable

Conservative management with inpatient monitoring for 5-7 days.

Figure 6. Proposed algorithm for acute management of initial Spontaneous coronary artery dissection (SCAD). CABG indicates coronary artery bypass grafting; IVUS, intravascular ultrasound; and OCT, optical coherence tomography.

Tweet MS et al, Circ Cardiovasc Interv. 2014;7:7

Questions?