Takotsubo cardiomyopathy

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79 year old woman, pre chemo echo for esophageal cancer
Post chemo, dehydration, nausea, vomiting, tachycardia
ST elevation, sinus tachycardia, troponin peak 0.21 (normal < 0.01)
Right coronary

Left coronary
48 hr later
8 days later
Takotsubo Cardiomyopathy Synonyms

• Apical ballooning syndrome
• Ampulla cardiomyopathy
• Stress induced cardiomyopathy
• “Broken heart” syndrome
Clinical Features

- 90% women about age 70
- ¾ identifiable trigger unless anesthesia, sedation, altered mental status, hypotension, pulmonary edema, hypoxia/intubation etc.
- Chest pain 75%
- ST elevation, but minor in > 50%, other ECG abnormalities
- Troponins usually positive, CK +/-
- Increasingly recognized because of dramatic echo findings which are usually transient
Epidemiology-from Swedish registry of 505 cases

- 88% women
- Lower rates of CAD risk factors
- Increased COPD
- Increased beta-2 agonist use
- Decreased beta blocker use
- ↑ frequency of migraine and anxiety/affective disorders

Tornvall P, JACC 2016;67:1931
Variants of Apical Ballooning Syndrome

Haghi D et al  Int J Cardiol  2007; 120:205
Apical ballooning: Tc sestamibi, rest and stress studies

Acute

Follow up

Alexanderson E, J Nuc Card 2007:14:129
Washout rate is an index of sympathetic activity in relation to the ability to store NE. WR is increased acutely suggesting functional denervation.
Coronary microcirculation

- Subepicardial arteries, 200 µm
- Intramuscular arteries, 30-100 µm
- Pre-capillaries 10-20 µm
- Capillaries 5-8 µm
- venules
Extent of cardiac nerves

- Sympathetic nerves impact intramuscular arteries
- Parasympathetic nerves only distribute to epicardial and subepicardial arteries
- Unapposed vasoconstriction may accompany excessive sympathetic stimulation
Proposed mechanism

STRESS

Sympathetic nervous system activation

? Endothelial or microvascular toxicity

Myocardial NE release

Calcium overload

Microvascular spasm

Transient myocardial ischemia

Myocardial injury

Reversible LV dysfunction

Contraction band necrosis ± reversible
Diagnostic Criteria

- **Tsuchihashi**
  - Acute chest symptoms
  - Characteristic apical ballooning WMA
  - Deep T inversions on ECG
  - Reversibility of WMA
  - No obstructive CAD

- **Mayo**
  - Transient akinesia or dyskinesis > 1 coronary vascular territory
  - Absence of CAD
  - New ST elevation or T wave inversion
  - Absence of head trauma, SAH, pheo, myocarditis, HOCM
Triggers

• Emotional upset, sudden pain, physical stress, tachycardia from any cause

• Sudden hypotension in ICU patient with sedation, intubation, anesthesia etc
67 y/o woman developed chest pain attending KY Derby Cath showed normal coronaries. Initial echo from outside hospital
Follow up one week later
With left heart contrast
Wafarin therapy, INR 2.0-3.0 for one month
Complications – shock ± LV outflow obstruction-10%

• Urgent echo to define since Rx dependent

• Fluid resuscitation

• If no LVOT obstruction dobutamine or dopamine

• If organ dysfunction, pressors and PA catheter

• Intra-aortic balloon if severe shock

• For LVOT obstruction: more fluid
  • Avoid inotropes
  • B blockers
  • Rx phenylephrine if fluid alone does not ↑ BP
Heart Failure – in up to 50%

• Standard HF meds for HFrEF

• Duration of therapy not known since TC is a transient disorder - treat until EF recovers, usually 4 weeks

• Risk factors: age > 70, physical stressor present, EF < 40%

• With 1, 2, 3 RF, heart failure in 28%, 58%, 85%
Thromboembolism

• If thrombus detected, recommend warfarin for 3 months, then stop if LV recovery is seen

• In cases with severe LV apical dyskinesis / akinesis by echo/MRI consider warfarin for up to 3 months or until LV apex function recovers

• Evidence for these recommendations is based on LV apical thrombosis in acute anterior MI, not from trials in takotsubo
Arrhythmias – 12% (35 / 286)

- Half have VT or VF, and half of VT is polymorphic and treated with temp pacer
- About 20% of VT/VF patients die in hospital of cardiogenic shock
- With LV recovery, repeat ventricular arrhythmias are rare – Rx wearable defibrillators
- 1/3 have complete AV block, and it persists after recovery; patients not paced died of unknown causes

Stiermaier T, Heart Rhythm 2016;132:1979
Prognosis

• With shock, mortality rate 19%
• Overall in hospital mortality rate 0-8%
• Expect normalization of EF in < 4 weeks
• Risk of events over 30 days in elderly is 7%
• Risk of recurrent takotsubo 1.8% / patient year
“MINOCA”
Positive biomarker
Clinical symptoms or ECG changes
Absent obstructive CAD on coronary angiography

Table 1 Diagnostic criteria for myocardial infarction with non-obstructive coronary arteries

The diagnosis of MINOCA is made immediately upon coronary angiography in a patient presenting with features consistent with an acute myocardial infarct, as detailed by the following criteria:

1. AMI criteria.¹
   (a) Positive cardiac biomarker (preferably cardiac troponin) defined as a rise and/or fall in serial levels, with at least one value above the 99th percentile upper reference limit.

   and

   (b) Corroborative clinical evidence of infarction evidenced by at least one of the following:
      (i) Symptoms of ischaemia
      (ii) New or presumed new significant ST-T changes or new LBBB
      (iii) Development of pathological Q waves
      (iv) Imaging evidence of new loss of viable myocardium or new RWMA
      (v) Intracoronary thrombus evident on angiography or at autopsy

2. Non-obstructive coronary arteries on angiography:
   • Defined as the absence of obstructive CAD on angiography, (i.e. no coronary artery stenosis ≥ 50%), in any potential infarct-related artery.
   • This includes both patients with:
      o normal coronary arteries (no stenosis > 30%)
      o mild coronary atheromatosis (stenosis > 30% but < 50%)

3. No clinically overt specific cause for the acute presentation:
   • At the time of angiography, the cause and thus a specific diagnosis for the clinical presentation is not apparent.
   • Accordingly, there is a necessity to further evaluate the patient for the underlying cause of the MINOCA presentation.

LBBB, left bundle branch block. RWMA, regional wall motion abnormality.

Agewall S, Eur Heart J 2017;38:143
Elevated cardiac biomarkers

<table>
<thead>
<tr>
<th>Coronary causes:</th>
<th>Non-coronary causes:</th>
<th>Extra-cardiac:</th>
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<tr>
<td>Plaque rupture</td>
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<td>Stroke</td>
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<td>Spasm</td>
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<td>Thrombus, ie APA syndrome</td>
<td>Tachyarrhythmias</td>
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<td>Embolism</td>
<td>Cardiotoxins, ie chemo</td>
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<tr>
<td>Cocaine, amphetamine</td>
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Agewall S, Eur Heart J 2017;38:143
Classic Ap Ballooning with damage (rare)

Anterior MI

Myocarditis
Diagnostic algorithm

Stressful Trigger + Appropriate clinical context (acute chest pain + ECG changes + biomarkers)

Diagnostic Coronary Angiography

1. Invasive or
2. Non-Invasive
   Computed Tomography

Culprit coronary artery

Doubtful culprit coronary artery

No culprit coronary artery

Acute coronary syndrome

Other Anatomical / Functional Tests (IVUS, OCT, FFR, Nuclear imaging)

MINOCA Other diagnosis

Cardiac Magnetic Resonance

Recovery criteria at follow-up (Table 4)

Takotsubo Syndrome

Follow-up (3–6 months)

IVUS: Intravascular ultrasound
OCT: Optical coherence tomography
FFR: Fractional flow reserve
MINOCA: Myocardial infarction with non-obstructive coronary arteries

Placido R, J Cardiac MR, 2016;18:68
Myocarditis: biopsy is the gold standard

• Absence of CAD, other valve / cardiac disorder

• Clinical presentation:
  • ACS-like ± LV or RV dysfunction ± Tn elevation
  • New or worsening unexplained HF
  • Unexplained HF > 3months duration
  • Life threatening dysrhythmia or shock

• Diagnostic criteria
  • New AV block, VT/VF, AF, LBBB, RBBB
  • Elevated cardiac troponins indicating damage
  • New unexplained LV and or RV dysfunction-imaging
  • MRI evidence of edema or late gad enhancement

Agewall S, Eur H J 2017;38:143
Patient resources

• Harvard Health Publications

• Circulation Patient Page – 1000 views / month