Don’t Go Breaking My Heart: Imaging & Prognosis in Takotsubo’s

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with Advice from Andrew Crean, M.D.
Takotsubo: Stress Cardiomyopathy

Japanese octopus fishing pot - a ‘takotsubo’
(artwork by Dr David Northridge, Consultant Cardiologist, Edinburgh Royal Infirmary).
Case History

• 69 yo female, presented with 6 hr of L shoulder and arm pain
  – Long standing hypertension, panic disorder
  – ECG showed ST elevation in leads V2-V5
  – hsTn = 490 ng/L (Nml < 50 ng/L)
  – NTproBNP = 4,300 ng/L (pg/ml)
  – Echo showed hypokinesis of lateral and inferior walls

• Coronary Angiogram = Minor lesions only

• Additional history
  – Brother died 3 days ago – Pt is now the sole survivor of 6 siblings left
ECG: Day 3 post Presentation
LV Gram & Echo: Stress Takotsubo

<table>
<thead>
<tr>
<th>Day 1 LV Angio</th>
<th></th>
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<tbody>
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<table>
<thead>
<tr>
<th>Day 2 Echocardiogram</th>
<th>LAX</th>
<th>SAX</th>
<th>4C</th>
<th>2C</th>
</tr>
</thead>
<tbody>
<tr>
<td>X - Cannot Interpret</td>
<td>1 - Normal</td>
<td>2 - Hypokinetic</td>
<td>3 - Akinetic</td>
<td>4 - Dyskinetic</td>
</tr>
<tr>
<td>WMSI = 1.56</td>
<td>% Normal = 75</td>
<td></td>
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</table>

![Echocardiogram Images]
Did Debbie Reynolds die of broken-heart syndrome?

Medical condition affects those who have recently suffered 'sudden emotional stress'

Positive emotions and Takotsubo syndrome: ‘happy heart’ or ‘Diagoras’ syndrome?

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Ballooning Patterns in Takotsubo

Dawson DK. Heart 2018; 104:96-102.
Figure 1 Overall distribution of takotsubo types in ‘happy heart syndrome’ vs. ‘broken heart syndrome’ (P=0.21). Post hoc P-values for comparison within takotsubo types showed a significantly higher prevalence of the midventricular takotsubo syndrome type in patients with ‘happy heart’ vs. ‘broken heart’ (P = 0.030), while no significant differences were seen in apical (P = 0.15), basal (P = 1.0), or focal (P = 1.0) takotsubo syndromes.
European Heart Failure Association Diagnostic Criteria

• 1. **Transient regional wall motion abnormalities** of left ventricular or right ventricular myocardium, which are frequently, but not always, preceded by a stressful trigger (emotional or physical).
• 2. The regional wall motion abnormalities **usually extend beyond a single epicardial vascular distribution**, and often result in circumferential dysfunction of the ventricular segments involved.
• 3. The **absence of culprit atherosclerotic coronary artery disease** including acute plaque rupture, thrombus formation, and coronary dissection or other pathologic conditions to explain the pattern of temporary left ventricular dysfunction observed (eg, hypertrophic cardiomyopathy, viral myocarditis).
• 4. **New and reversible electrocardiography abnormalities** (ST-segment elevation, ST depression, left bundle branch block, T-wave inversion, and/or QTc prolongation during the acute phase (3 months)).
• 5. **Significantly elevated serum natriuretic peptide** (B-type natriuretic peptide or N-terminal pro B-type natriuretic peptide) during the acute phase.
• 6. **Positive but relatively small elevation in cardiac troponin** measured with a conventional assay (ie, disparity between the troponin level and the amount of dysfunctional myocardium present).
• 7. **Recovery of ventricular systolic function on cardiac imaging** at follow-up (3–6 months).
InterTAK Diagnostic Criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>25</td>
</tr>
<tr>
<td>Emotional trigger</td>
<td>24</td>
</tr>
<tr>
<td>Physical trigger</td>
<td>13</td>
</tr>
<tr>
<td>Absence of ST-segment depression</td>
<td>12</td>
</tr>
<tr>
<td>Psychiatric disorders</td>
<td>11</td>
</tr>
<tr>
<td>Neurologic disorders</td>
<td>9</td>
</tr>
<tr>
<td>QTc prolongation</td>
<td>6</td>
</tr>
</tbody>
</table>

**Our Case**

- 25
- 24
- 12
- 11
- 9
- 6

**Diagnosis (Cutoff Value [Range 0-100])**

- ≥50
- ≤31

Takotsubo (Specificity 95%)  
Acute coronary syndrome (Specificity 95%)  

72
### Table 2: Anatomical Variants of Stress Cardiomyopathy

<table>
<thead>
<tr>
<th>Variant</th>
<th>Prevalence</th>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apical ballooning (typical)</td>
<td>75%-80%</td>
<td>Can be associated with left ventricular outflow tract obstruction and/or apical thrombus formation. Variable prognosis.</td>
</tr>
<tr>
<td>Midventricular</td>
<td>10%-20%</td>
<td>Severe left ventricular dysfunction. Acute heart failure syndrome is common.</td>
</tr>
<tr>
<td>Basal or inverted</td>
<td>5%</td>
<td>Less severe hemodynamic compromise.</td>
</tr>
<tr>
<td>Biventricular</td>
<td>&lt;0.5%</td>
<td>Severe hemodynamic compromise and cardiogenic shock.</td>
</tr>
<tr>
<td>Focal dysfunction</td>
<td>Rare</td>
<td>Benign course, more commonly associated with chest pain.</td>
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</table>
T2 ratio & T2 mapping

**T2 SPAIR**
- Observer dependent
- Ratio based
- Assumes uniform signal correction across image

**T2 mapping**
- Observer independent
- Not ratio based
- Quantitative result of LV T2 relaxation time in milliseconds
Abnormal FA Metabolism: Ischemic Memory & Microvasc Dysf’n
MØ Fe$_2$O$_3$ Uptake in Takotsubo

Monocyte Profiles in Takotsubo Pts

DOES A BROKEN HEART REALLY MEND?
LV Dysfunction

- In the International Takotsubo Registry:
  - 9.9% of patients developed cardiogenic shock,
  - 17.3% of patients required invasive or noninvasive ventilation,
  - 8.6% of patients had cardiopulmonary resuscitation.

The incidence of cardiac arrest among hospitalized patients with TCM was approximately 5%.

Independent predictors of acute heart failure include advanced age, low LVEF at presentation, higher admission and peak troponin levels, and a physical stressor.

It is more common with the apical ballooning pattern and it may be provoked or exacerbated by catecholamine drugs used to treat hypotension.

In a series of 136 patients with TCM, 13 patients developed dynamic obstruction to LVOT.
Arrhythmia

• Arrhythmia is common in patients with SIC.
• New atrial fibrillation has been reported in 5% to 15% of cases.
• Ventricular arrhythmia occurs in 4% to 10% of patients during the acute phase.
• Potentially lethal arrhythmia, including ventricular fibrillation, torsades de pointes, and ventricular tachycardia in less than 5% of patients.
Thrombo-embolism

- In 541 patients German Italian Stress Cardiomyopathy Registry:
  - 12 patients (2.2%) developed LV thrombi
  - all female
  - presenting with an apical ballooning pattern
  - all treated with oral anticoagulation therapy
  - 2 patients suffered a cerebrovascular accident before treatment initiation.

- A high troponin was an independent predictor of LV thrombi.
Normal echo in ‘recovery’

- 2 weeks post admission
- 3 months post admission

Subtle strain abnormalities persist, even at 3 months
Not So Benign a Prognosis

Long Term Follow Up of Takotsubo

Scally 2018. DOI: 10.1161/CIRCULATIONAHA.117.031841
Functional Capacity & QoL in Takotsubo Patients

Figure 2. Cardiopulmonary exercise data in patients with takotsubo cardiomyopathy and matched control subjects. A, Peak VO₂. B, VE/VO₂ slope. Data shown as median, 25th, and 75th percentiles and maximum and minimum (whiskers).
Risk of Recurrence

- TCM may recur in 5% to 22% of cases.

- A recent meta-analysis based on 31 cohorts indicated that
  - cumulative incidence of recurrence was approximately 5% at 6 years
  - annual rate of recurrence was approximately 1% to 2%.

- Nearly all cases of recurrence occurred in women.

- The recurrence rate was inversely correlated with ACEi/ARB prescription, but not with beta-blocker prescription.

- The International Takotsubo Registry reported that the rate of recurrence was 1.8% per patient-year, with a span of 25 days up to 9.2 years after the first event.
Conclusions

• Takotsubo or stress-induced cardiomyopathy is characterized by “reversible” myocardial injury with distinctive regional wall motion abnormalities of the left ventricle.

• It has a strong predilection for postmenopausal women, but men, young women, and children can all be affected.

• Diagnosis made on clinical criteria
THERE IS ALWAYS HOPE
A Takotsubo moment.....