The Broken Heart Syndrome: Physiology, Diagnosis and Management of Takotsubo Cardiomyopathy

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**Objectives:**
- Recognize and diagnose clinical syndrome
- Recognize disease variants
- Identify treatment options and prognosis's
Stress Cardiomyopathy

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Recognition

Initial report Japan 1990
300 publications since 2000
Recognized in all continents, diverse countries
Multiple names

Takotsubo Cardiomyopathy
Transient Ventricular Ballooning Syndrome
Apical Ballooning Syndrome
Stress Cardiomyopathy
Ampulla Cardiomyopathy
Broken Heart Syndrome
Acute presentation mimics MI

Abrupt, unpredictable
CP, SOB triggered by emotional and/or physical stressor
Predilection for post-menopausal women
Ischemic ECG abnormalities
Biomarker release
Table 1. Clinical Characteristics of 19 Patients with Stress Cardiomyopathy on Admission.

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Age (yr)</th>
<th>Sex</th>
<th>Race or Ethnic Origin</th>
<th>Coronary Risk Factors</th>
<th>Emotional Stressor</th>
<th>Time after Symptom Onset† (hr)</th>
<th>Heart Rate (beats/min)</th>
<th>MAP (mm Hg)</th>
<th>Clinical Presentation</th>
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<tbody>
<tr>
<td>1</td>
<td>62</td>
<td>F</td>
<td>B</td>
<td>HTN, smoking</td>
<td>Mother's death</td>
<td>12</td>
<td>71</td>
<td>96</td>
<td>Chest pain</td>
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<td>63</td>
<td>F</td>
<td>AA</td>
<td>HTN, Chol</td>
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<td>86</td>
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<td>48</td>
<td>F</td>
<td>W</td>
<td>HTN, Chol, smoking</td>
<td>Surprise reunion</td>
<td>4</td>
<td>85</td>
<td>88</td>
<td>Chest pain</td>
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<tr>
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<td>60</td>
<td>F</td>
<td>W</td>
<td>HTN</td>
<td>Surprise party</td>
<td>2</td>
<td>109</td>
<td>53</td>
<td>Chest pain; hypotension (IABP)</td>
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<tr>
<td>5</td>
<td>66</td>
<td>F</td>
<td>W</td>
<td>HTN, FH</td>
<td>Father's death</td>
<td>5</td>
<td>65</td>
<td>91</td>
<td>Chest pain</td>
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<tr>
<td>6</td>
<td>77</td>
<td>F</td>
<td>W</td>
<td>HTN, FH</td>
<td>Husband's death</td>
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<td>106</td>
<td>98</td>
<td>Chest pain</td>
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<tr>
<td>7</td>
<td>52</td>
<td>F</td>
<td>W</td>
<td>Smoking</td>
<td>Friend's death</td>
<td>2</td>
<td>92</td>
<td>50</td>
<td>Chest pain; hypotension (IABP)</td>
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<tr>
<td>8</td>
<td>52</td>
<td>F</td>
<td>W</td>
<td>HTN</td>
<td>Father's death</td>
<td>5</td>
<td>88</td>
<td>93</td>
<td>Chest pain</td>
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<tr>
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<td>32</td>
<td>F</td>
<td>W</td>
<td>Chol, FH</td>
<td>Mother's death</td>
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<td>W</td>
<td>Chol</td>
<td>Fear of procedure</td>
<td>1</td>
<td>108</td>
<td>45</td>
<td>Chest pain; shock (IABP)</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>Age</th>
<th>Sex</th>
<th>Marital Status</th>
<th>Risk Factors</th>
<th>Trigger Event</th>
<th>HR</th>
<th>Diastolic</th>
<th>SBP</th>
<th>Diagnosis</th>
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<td>F</td>
<td>W</td>
<td>Smoking</td>
<td>Fierce argument</td>
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<td>66</td>
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<tr>
<td>12</td>
<td>87</td>
<td>F</td>
<td>W</td>
<td>HTN, Chol, DM</td>
<td>Friend’s death</td>
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<td>99</td>
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<tr>
<td>13</td>
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<td>M</td>
<td>W</td>
<td>HTN, Chol</td>
<td>Court appearance</td>
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<td>81</td>
<td>73</td>
<td>Chest pain</td>
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<tr>
<td>14</td>
<td>50</td>
<td>F</td>
<td>W</td>
<td>None</td>
<td>Fear of choking</td>
<td>2</td>
<td>84</td>
<td>100</td>
<td>Chest pain; heart failure</td>
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<tr>
<td>15</td>
<td>71</td>
<td>F</td>
<td>W</td>
<td>None</td>
<td>Public speaking</td>
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<td>67</td>
<td>108</td>
<td>Chest pain</td>
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<tr>
<td>16</td>
<td>76</td>
<td>F</td>
<td>W</td>
<td>HTN, DM, smoking</td>
<td>Husband’s death</td>
<td>2</td>
<td>109</td>
<td>101</td>
<td>Chest pain</td>
</tr>
<tr>
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<td>F</td>
<td>W</td>
<td>HTN, Chol, smoking</td>
<td>Armed robbery</td>
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<td>95</td>
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<td>Chest pain</td>
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<tr>
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<td>F</td>
<td>W</td>
<td>HTN</td>
<td>Son’s death</td>
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<td>66</td>
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<tr>
<td>19</td>
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<td>F</td>
<td>A</td>
<td>None</td>
<td>Tragic news</td>
<td>3</td>
<td>64</td>
<td>52</td>
<td>Chest pain; hypotension</td>
</tr>
</tbody>
</table>

*New England Journal of Medicine 2005;352:539-548*
Stressors reported to trigger ABS

Emotional Stress
Death or severe illness or injury of family member, friend, pet
Receiving bad news - diagnosis of a major illness, daughter’s divorce, spouse leaving for war
Severe argument
Public speaking
Involvement with legal proceedings
Financial loss - business, gambling
Car accident
Surprise party
Move to a new residence

American Heart Journal 2008;155:408-417
Stressors reported to trigger ABS

Physical Stress

Non-cardiac surgery or procedure - cholecystectomy, hysterectomy
Severe illness - asthma or chronic obstructive airway exacerbation, connective tissue disorders, pseudomembranous colitis
Pain - fracture, renal colic, pneumothorax, pulmonary embolism
Recovery from general anesthesia
Cocaine abuse
Opiate withdrawal
Stress testing - dobutamine stress echo, exercise sestamibi
Thyrotoxicosis

American Heart Journal 2008;155:408-417
Pathophysiology

Vascular, endocrine, and CNS systems

Catecholamine excess and hypersympathetic response

- Experiments with epinephrine or dopamine infusions
- Catecholamine serum levels 2-3x in pts with clinical presentation
- Mononuclear cells and contraction band necrosis seen in catecholamine-induced myocardial injury
- Mitigated by a- or b-blockade and estrogen
- Microvascular dysfunction, endothelial dysfunction
<table>
<thead>
<tr>
<th>Table 4: Proposed Mayo criteria for the clinical diagnosis of the transient left ventricular apical ballooning syndrome*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>• Transient akinesis or dyskinesis of the left ventricular apical and mid-ventricular segments with regional wall-motion abnormalities extending beyond a single epicardial vascular distribution</strong></td>
</tr>
<tr>
<td><strong>• Absence of obstructive coronary disease or angiographic evidence of acute plaque rupture</strong></td>
</tr>
<tr>
<td><strong>• New electrocardiographic abnormalities (either ST-segment elevation or T-wave inversion)</strong></td>
</tr>
<tr>
<td><strong>• Absence of:</strong></td>
</tr>
<tr>
<td>- Recent significant head trauma</td>
</tr>
<tr>
<td>- Intracranial bleeding</td>
</tr>
<tr>
<td>- Pheochromocytoma</td>
</tr>
<tr>
<td>- Obstructive epicardial coronary artery disease</td>
</tr>
<tr>
<td>- Myocarditis</td>
</tr>
<tr>
<td>- Hypertrophic cardiomyopathy</td>
</tr>
</tbody>
</table>

Annals of Internal Medicine 2004;141:858-865
Revised Mayo Clinic Criteria for ABS

- Transient hypokinesis, akinesia, or dyskinesis of the left ventricular mid segments with or without involvement of the apex. The regional wall motion abnormalities extend beyond a single epicardial vascular distribution. Stressful trigger can often be identified, but is not always present.

- Absence of obstructive epicardial coronary artery disease or angiographic evidence of an acute plaque rupture.

- New electrocardiographic abnormalities: ST elevation with or without T wave inversion. Modest elevation in troponins.

- Absence of pheochromocytoma or myocarditis.
Cardiac Troponin T Release: ABS vs. AMI

**Figure 2**

- Reperfused anterior STEMI
- Apical ballooning syndrome

Onset of T wave inversion and QT prolongation

Days after onset of symptoms

Multiple of ULN (99th percentile)

American Heart Journal 2008;155:408-417
Diagnosis

*Echo:* Regional wall motion abnormalities extend beyond a single coronary distribution

*Coronary angiogram:* Normal or near-normal

*Left ventriculography*
Initial Management

Supportive therapy leads to spontaneous recovery.

Heart failure is the most common complication.

It is important to exclude dynamic left ventricular outflow tract obstruction with echocardiography in patients with severe heart failure or hypotension.

American Heart Journal 2008;155:408-417
Initial Management

Left ventricular outflow tract obstruction **absent**:

Diuretics are effective in most heart failure cases.

If tolerated, it is reasonable to initiate \( \beta \)-blockers.

Cardiogenic shock may require inotrope therapy or intra-aortic balloon counterpulsation (IABP).

*American Heart Journal 2008;155:408-417*
Initial Management

Left ventricular outflow tract obstruction present:
Systolic anterior motion of mitral leaflet and MR.
Cautious trial of intravenous fluids and β-blocker.
Alternatively, phenylephrine to increase afterload.

*American Heart Journal 2008;155:408-417*
Initial Management

Mechanical complications are relatively rare.

Reports of free wall rupture or severe MR.

Ventricular tachycardia and fibrillation are rare.

Atrial arrhythmias and non-sustained VT.

Left ventricular thrombus formation is infrequent.
Chronic Management

β-blocker therapy to reduce likelihood of recurrence.

Consider angiotensin-converting enzyme inhibitor.

Annual follow-up because natural history is unclear.

*American Heart Journal* 2008;155:408-417
Lack of necrosis
Favorable recovery

Variants

*Isolated mid- or basilar wall motion abnormalities sparing the apex*

*Right ventricular wall motion abnormalities*

*Shifting variants in same patient*

*No emotional and/or physical stressor*
Patient Discussion Points
Did I have a “heart attack”?  

No.

*Strictly speaking heart attack indicates heart muscle injury due to blocked artery. Stress CMP not caused by blocked artery*
Who is at risk?

For unknown reasons, post-menopausal women more susceptible.

Traditional coronary risk factors do not apply to Stress CMP.
Will this happen to me again after future stressful events?

*Probably not.*

*Fully 90% of patients do not have recurrence and endure a variety of stressful events without harm to heart.*
Is there something “wrong” with my ability to handle stress?

No.

*Stress CMP occurs as a result of a reflex response controlled by autonomic nervous system.*
Can this affect my family members?

No.

No evidence to suggest familial inheritance.
Will my heart be strong in the future?

Yes.

Long-term follow-up of patients suggests favorable recovery and prognosis.
Conclusions

• *Stress Cardiomyopathy mimics ACS presentation*
• *Typical findings of apical ballooning but many variants exist*
• *Most cases require supportive care and standard medications for HF for short duration*
• *Mostly outstanding prognosis*
References


Sharkey SW. et al. Takotsubo (Stress) Cardiomyopathy. Cardiology patient page. Circulation 2011; 124; e460-2