Structural Heart Disease Workshop

Presented by

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SwissRe

and

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AAIM Annual Meeting 2015
Broadmoor, Colorado Springs, Colorado
Case 1: Diastolic Dysfunction

73 year old male
- 6'0" (183 cm), 245 lbs (111 kg) [266 lbs (121 kg) in APS]
- BP 120/80
- Cholesterol 181 mg/dl (4.68 mmol/L) HDL cholesterol 70 mg/dl (1.81 mmol/l), Total Cholesterol/HDL ratio 2.57

Attending physician records
- June 1: Periodic assessment. Feels well except for intermittent edema for which he takes furosemide as needed.
- Medications: amlodipine/atorvastatin (Caduet), chlorthalidone, metoprolol, esomeprazole (Nexium), tadalafil (Cialis), ASA.

ECG February
Exercise test with nuclear study February
Echocardiogram June

<table>
<thead>
<tr>
<th>2D Dimensions:</th>
<th>Adult Values</th>
<th>Normal Range</th>
<th>BSA Adjusted</th>
<th>Normal Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVSd</td>
<td>1.5 cm</td>
<td>1.0 - 1.3 cm</td>
<td></td>
<td></td>
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<tr>
<td>LVMI</td>
<td>1.5 cm</td>
<td>0.9 - 1.3 cm</td>
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<tr>
<td>LVDD</td>
<td>5.5 cm</td>
<td>3.8 - 5.2 cm</td>
<td>2.2 cm²/m²</td>
<td>1.8 - 3.0 cm²/m²</td>
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<tr>
<td>LVIDd</td>
<td>3.5 cm</td>
<td>2.3 - 3.5 cm</td>
<td>1.4 cm²/m²</td>
<td>1.4 - 2.1 cm²/m²</td>
</tr>
<tr>
<td>FS</td>
<td>36</td>
<td>26 - 44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EF</td>
<td>73 %</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Ab Root Diam</td>
<td>3.2 cm</td>
<td>2.0 - 3.7 cm</td>
<td></td>
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<tr>
<td>LVIDt</td>
<td>2.6 cm</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Ascending aorta</td>
<td>3.7 cm</td>
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<table>
<thead>
<tr>
<th>Aortic Valve Regurgitation</th>
<th>Adult Values</th>
<th>Mild</th>
<th>Mod</th>
<th>Severe</th>
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<tbody>
<tr>
<td>Pressure Halftime</td>
<td>546 ms</td>
<td>&gt;500</td>
<td>600-250</td>
<td>&gt;250</td>
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<tr>
<td>AI % of LVOT</td>
<td>%</td>
<td>&lt;25</td>
<td>25-65</td>
<td>&gt;65</td>
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<tr>
<td>Vena contracts</td>
<td>cm</td>
<td>&lt;3</td>
<td>3-6</td>
<td>&lt;6</td>
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<tr>
<td>Regurgitant volume</td>
<td>ml</td>
<td>&lt;50</td>
<td>50-60</td>
<td>&gt;60</td>
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<tr>
<td>Regurgitant fraction</td>
<td>%</td>
<td>&lt;30</td>
<td>30-50</td>
<td>&gt;50</td>
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<tr>
<td>Regurgitant orifice area</td>
<td>cm²</td>
<td>&lt;4</td>
<td>4-10</td>
<td>&gt;10</td>
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<thead>
<tr>
<th>Aortic Valve Stenosis</th>
<th>Adult Values</th>
<th>Mild</th>
<th>Mod</th>
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<tr>
<td>Peak aortic velocity</td>
<td>2.0 m/s</td>
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<tr>
<td>Max gradient</td>
<td>16 m/m²</td>
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<tr>
<td>Mean gradient</td>
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<tr>
<td>Aortic Valve Area</td>
<td>3.4 cm²</td>
<td>&gt;1.5</td>
<td>1.5-10</td>
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<table>
<thead>
<tr>
<th>Mitral Valve Regurgitation</th>
<th>Adult Values</th>
<th>Mild</th>
<th>Mod</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure Halftime</td>
<td>546 ms</td>
<td>&gt;20</td>
<td>20-40</td>
<td>&gt;40</td>
</tr>
<tr>
<td>Max gradient</td>
<td>m/m²</td>
<td>&lt;5</td>
<td>5-10</td>
<td>&gt;10</td>
</tr>
<tr>
<td>Mitral Valve Area</td>
<td>cm²</td>
<td>&gt;1.5</td>
<td>1.5-10</td>
<td>&lt;1.0</td>
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<thead>
<tr>
<th>Tricuspid</th>
<th>Adult Values</th>
<th>Mild</th>
<th>Mod</th>
<th>Severe</th>
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<tr>
<td>Peak regurg velocity</td>
<td>2.6 m/s</td>
<td></td>
<td></td>
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<tr>
<td>RV systolic pressure</td>
<td>51 m/m²</td>
<td>&lt;30</td>
<td>30-50</td>
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<th>Pulmonic</th>
<th>Adult Values</th>
<th>Mild</th>
<th>Mod</th>
<th>Severe</th>
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</thead>
<tbody>
<tr>
<td>Peak Velocity</td>
<td>m/s</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max gradient</td>
<td>m/m²</td>
<td>&gt;50</td>
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<table>
<thead>
<tr>
<th>Diastolic Function</th>
<th>Adult Values</th>
<th>Mild</th>
<th>Mod</th>
<th>Severe</th>
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<table>
<thead>
<tr>
<th>LA Pressures</th>
<th>Normal</th>
<th>Variable</th>
<th>Elevated</th>
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<tr>
<td>B/A ratio</td>
<td>1.6</td>
<td>0.8-1.5</td>
<td>&gt;1.8</td>
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<tr>
<td>B/A ratio</td>
<td></td>
<td>&lt;1.8</td>
<td>0.8-1.5</td>
</tr>
<tr>
<td>LA volume</td>
<td>56 ml</td>
<td>&gt;100 ml</td>
<td>&lt;100 ml</td>
</tr>
<tr>
<td>LA volume index</td>
<td>23 ml/m²</td>
<td>&gt;24 ml/m²</td>
<td>&gt;24 ml/m²</td>
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</tbody>
</table>

**Findings**

- Left ventricular mass: 240 grams. LV mass index: 1.55 g/m². LVEDP: 18. Height: 5 feet 6 inches. Body weight: 190 pounds. Patient is in New York Heart Association functional class II. 

**Impression:**

1. Mild aortic regurgitation with aortic sclerosis.
2. Constrictive left ventricular thickening with preserved left ventricular systolic function.
3. Abnormal left ventricular diastolic properties suggestive of increased LVEDP.
Diastolic measurements from June echocardiogram

<table>
<thead>
<tr>
<th>Diastolic Function</th>
<th>I</th>
<th>II</th>
<th>III/IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>LA Pressure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E/A ratio</td>
<td>1.6</td>
<td>0.9-1.5</td>
<td>&lt;0.8</td>
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<tr>
<td>E/A valsalva</td>
<td>.8</td>
<td>No Change</td>
<td>Normalizes</td>
</tr>
<tr>
<td>E/E'</td>
<td>12</td>
<td>&lt;8</td>
<td>&lt;8</td>
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<tr>
<td>IVRT</td>
<td>63</td>
<td>&gt;100 ms</td>
<td>&lt;100 ms</td>
</tr>
<tr>
<td>LA volume</td>
<td>56 ml</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LA volume ind</td>
<td>23 ml/m²</td>
<td>22+/−8 ml/m²</td>
<td>&gt;28</td>
</tr>
</tbody>
</table>

Applied for insurance August….

**Discussion Questions**: Diastolic Dysfunction

1. Medications – what do you think of the medical regime? Anything missing?
2. Take note of the pattern of blood pressure response to exercise. What does that suggest to you?
3. A "non-homogenous distribution of radionuclide tracer" is reported. What are they saying here?
4. The echocardiogram report includes a classification of diastolic dysfunction severity. How are each of the diastolic function parameters determined? Which correlate best with increased LVEDP or HFNEF (heart failure with normal ejection fraction)?
5. What are the positive and negative factors of this case related to your mortality assessment?
Case 2: Hypertrophic Cardiomyopathy

58 year old man, nonsmoker
- 5’7” (170 cm) tall, 180 lbs (82 kg)
- BP 136/80
- History of hyperlipidemia and cardiomyopathy
- Total cholesterol 151 mg/dl (3.9 mmol/L), HDL 76 mg/dl (1.96 mmol/L), ratio 1.99
- Medications: ezetimibe/simvastatin combination, enteric-coated aspirin
- EKG: Deep T wave inversions in V2-V6
Attending physician records
- Abnormal EKGs date back at least to 2000
- Echocardiogram from 2014 showed the following:
  - Concentric left ventricular hypertrophy with septal and posterior wall thickness of 1.3 cm (normal up to 1.1 cm)
  - Upper limits of normal left ventricular chamber size (5.7 cm at end diastole)
  - Dilated left atrium of 4.7 cm (normal up to 4.0 cm)
  - Normal mitral and aortic valves with mild mitral regurgitation
  - Compared to 2010 echo, the left atrium is slightly larger (up from 4.4 cm)
- Cardiac MRI 2011: apical hypertrophic cardiomyopathy with maximum thickness of 1.9 cm. Mild left atrial enlargement. Moderate myocardial fibrosis involving the inferoapex and apical anterior wall in a non-coronary distribution.
- Two week event recorder March 2015, done as routine follow up. 2 episodes of nonsustained ventricular tachycardia, the longest consisting of 9 beats.

Discussion Questions: Hypertrophic Cardiomyopathy
1. What is known about the long-term mortality in hypertrophic cardiomyopathy?
2. Are there markers of higher or lower risk?
3. Is apical hypertrophic cardiomyopathy different from other varieties of hypertrophic cardiomyopathy?
4. What is the significance of the cardiac MRI findings?
Case 3: Dilated Cardiomyopathy

49 year old male
- 6' (183 cm) tall, 235 lbs (107 kg), BMI 31.9
- BP 138/90
- Total cholesterol 151 mg/dl (3.90 mmol/l), HDL 40 mg/dl (1.03 mmol/l), TC/HDL ratio 3.8

ECG 2012
Echocardiogram 2012

Indications
Cardiomyopathy

Final Impression
1. The left atrium is mildly enlarged.
2. Left ventricular function is mildly depressed. Ejection Fraction is 40%. There is Grade 1 diastolic dysfunction.
3. The right atrium is mildly enlarged.
4. Echogenicity is noted consistent with catheter or pacemaker lead.
5. There is trace to mild mitral regurgitation.
6. There is trace to mild tricuspid regurgitation. Estimated RVSP of 18 mmHg.
7. Compared to the previous study dated 05/14/2010 there is no significant change.

Procedure
Procedure: Description
A complete transesophageal echocardiogram utilizing 2D, M-mode, color flow and Doppler analysis was performed. The technical quality of the exam was fair.

Cardiac Chambers and Function
Left Atrium
The left atrium is mildly enlarged. There is no evidence of mass.

Left Ventricle
The left ventricle size is normal. The left ventricular wall thickness is normal. Left ventricular function is mildly depressed. Ejection Fraction is 40%. EF was measured using the Teichholz method. There is Grade 1 diastolic dysfunction. There is no thrombus or spontaneous contrast noted.

Right Atrium
The right atrium is mildly enlarged. There is no evidence of mass.

Right Ventricle
The right ventricle is normal in size. The right ventricular wall thickness is normal. Right ventricular function is normal. Echogenicity noted consistent with catheter or pacemaker lead.

Great Vessels
The visualized segment of the aorta is normal. The visualized segment of the pulmonary artery is normal. The inferior vena cava size is normal.

Cardiac Valves, Color Flow and Doppler
Aortic Valve
The aortic valve is an anatomically normal trileaflet valve. There is no aortic stenosis. There is no aortic regurgitation. There are no vegetations. No mass is present.

Mitral Valve
This is an anatomically normal mitral valve. There is trace to mild mitral regurgitation. There is no mitral valve stenosis.

Tricuspid Valve
This is an anatomically normal tricuspid valve. There is trace to mild tricuspid regurgitation. Estimated RVSP of 18 mmHg. There is no mass on the tricuspid valve.

Pulmonic Valve
There are no abnormalities of the pulmonic valve identified. There is no pulmonic stenosis. There is no pulmonic regurgitation.

Miscellaneous
Pleura/Percardium
There is no evidence of significant pericardial effusion. There is no Doppler evidence of tamponade.

Compared to the previous study dated 05/14/2010 there is no significant change.
Left ventricular mass: 315 gm
Left ventricular mass index: 138 gm/m² (nl up to 115 gm/m²)
Nuclear scan 2012

MYOCARDIAL PERFUSION STUDY

INDICATION: Exercise prescription. Patient with strong risk factors for coronary heart disease.

The patient was injected at rest with 11 mCi of technetium Sestamibi. He then underwent treadmill testing under my supervision. The resting blood pressure was 150/98. The resting electrocardiogram demonstrates sinus rhythm with poor precordial R-wave progression and occasional PVCs. He walked for eight minutes on a Bruce protocol, achieving 97% of his age-predicted maximum target heart rate. 1 min of flat ST segment depression was noted during the test, of borderline diagnostic significance. PVCs continued throughout exercise but there were no sustained arrhythmias. The blood pressure response was normal. Patient had no symptoms during the test. The test was terminated due to fatigue. At peak exercise, he received an additional 33 mCi of technetium Sestamibi. Stress and rest images are now compared.

The left ventricle appears to be at upper limits in size. There is a small, reversible perfusion defect in the high lateral wall of the left ventricle, consistent with ischemia in the circumflex or perhaps diagonal territory. No other reversible defects are seen. Analysis of gated SPECT images reveals moderate anterolateral hypokinesis. Remaining myocardial segments demonstrate mild global hypokinesis, and the calculated ejection fraction is 32%.

IMPRESSION:
1. Fair exercise capacity with borderline ECG changes.
2. Perfusion defects as noted above.
3. Strikingly abnormal left ventricular function, with segmental wall motion abnormalities as demonstrated above. Findings are possibly consistent with multivessel ischemia, and further study is probably warranted.
The patient was sedated with 2 mg of Versed. He attained level 2 sedation on a Ramsay scale. He was monitored continuously and stable throughout. Coronary angiography was performed via the right femoral artery without complication.

FINDINGS:
1. The left main, left anterior descending, circumflex, and right coronary arteries are without significant stenosis.
2. Left ventriculography reveals moderately diminished ventricular function with an estimated ejection fraction of 38%. Hypokinesis is global. There is no significant mitral regurgitation and no gradient across aortic valve pushback.

FINAL IMPRESSION:
Nonischemic cardiomyopathy.

My recommendation is a trial of medical therapy. The patient is currently on lisinopril, Lipitor, and Lopressor. These medications will be continued. The dose of Lopressor was increased to 50 mg p.o. b.i.d. We will follow up ventricular function with an echocardiogram and office visit in the next 1-2 months.
Prophylactic internal defibrillator (AICD) placed 2012
Discussion Questions: Dilated Cardiomyopathy

1. ECG – there appears to be some widening of the QRS in the lateral chest leads. What do you think?
2. Echo 2012 – The left ventricle in diastole is 6.9 cm but “indexed” within the normal range at 3.1 cm. What do you think? The left ventricle in systole is 5.5 cm. Where have you seen that measurement before?
3. Perfusion scan 2012 – Exercise capacity at 8 minutes! Overall, does this report change your impression of the case?
4. Cardiac catheterization 2012 – Do we have a final diagnosis and assessment?
5. An AICD (automatic implantable cardiac defibrillator) has been implanted for prophylaxis. What do the reports reveal and how would that revise your ultimate assessment?
Case 4: Athlete’s Heart Syndrome

44 year old man, nonsmoker, assistant basketball coach for major Division 1 program (former player)
- 6’ (183 cm), 180 lbs (81.8 kg)
- BP 118/76
- Palpitations 4 years ago. Had echocardiogram. No treatment and no recurrence
- Lab studies within normal limits

Attending physician records
- Only seen a few times for minor acute issues
- Palpitations 4 years ago. Started after a strenuous work out. Felt heart pounding and a little “shaky”. EKG showed LBBB, and atrial fibrillation with rapid ventricular response. Converted to sinus rhythm with vagal maneuver. Echocardiogram showed the following:

<table>
<thead>
<tr>
<th>Finding</th>
<th>Normal Range</th>
</tr>
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<tbody>
<tr>
<td>Left ventricular internal dimension (diastole)</td>
<td>6.5 cm, Up to 5.7 cm</td>
</tr>
<tr>
<td>Left atrium</td>
<td>5.0 cm, Up to 4.0 cm</td>
</tr>
<tr>
<td>Septal thickness</td>
<td>0.9 cm, Up to 1.1 cm</td>
</tr>
<tr>
<td>Posterior wall thickness</td>
<td>0.8 cm, Up to 1.1 cm</td>
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</tbody>
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Normal mitral and aortic valves.
Mild mitral regurgitation.
Mild apical hypokinesis with an ejection fraction of 45%
Normal tricuspid valve with mild-moderate tricuspid regurgitation. Estimated pulmonary artery systolic pressure is 35.
The right atrium and right ventricle appear mildly dilated

Conclusion: Mild dilatation of the left atrium and left ventricle with slightly diminished ejection fraction. Correlate clinically.

- Advised at the time of the episode to follow up with cardiologist, but has felt relatively well. Has 2 young children, feels like he never gets enough sleep. He travels for his job and is not able to work out regularly, but is very active especially during the season. He has not had any recurrent palpitations.
- Primary care physician feels likely athlete’s heart, so not really necessary to follow up unless patient wishes.
Discussion Questions:  Athlete’s Heart Syndrome

1. How is athlete’s heart syndrome defined?
2. Are you comfortable that this is likely athlete’s heart syndrome? Why or why not?
3. What is known about the long-term outcome of athlete’s heart syndrome?
4. Are there factors in this case of concern?
5. Would you like to have additional information? If so, what?
6. If proposed insured was 6'9" (206 cm) and 250 lbs (114 kg), would you view risk differently?
36 year old female
- 5'4" (163 cm), 142 lbs (64.5 kg)
- Family history: Father had an MI at age 40; also had multiple cerebral aneurysms.
  No family history of cardiomyopathy.

Attending physician records
One week post-partum normal delivery of twins noted extreme fatigue, swollen legs, and "could not lie flat without getting short of breath". A run of ventricular tachycardia was noted at the local urgent care center and again in the Emergency Department of the tertiary care hospital on transfer.

ECG 7/23
Echo 7/23

INDICATION: SOB, POSTPARTUM X T WECH
ECHO CARDIOGRAM REPORT
MEASUREMENTS: Left Ventri...mission. Wall Thickness: BVSD 6...range] PWTd 5 mm [range <12 mm] Aorta: Annulus 19 mm [normal up to 28 mm] Strusses 31 mm [normal up to 35 mm] Ascend Aorta 26 mm [normal up to 34 mm] LVOT mm LA Diameter: 40 mm (mll to 44 mm max, 40 mm women) LA Length: mml up to 55 mm
A complete 2-D Echocardiogram, M-Mode, Spectral and color flow doppler exam was performed. Image Quality: FAIR Chamber Sizes: DI...GLOBAL HYPKINESIS Estimated Ejection Fraction: 18-20% Right Ventricular Function: MILDLY HYPKINETIC
Valves Appearance and Doppler Assessment: Aortic: NORMAL TRILEAFLET, NO AS, TRACE AI Mitral: NORMAL. MODERATE MITRAL REGURGITATION Tricuspid: NORMAL. MILD TO MODERATE TR Pulmonic: NORMAL. MILD PL. NO PS PA Systolic Pressure (RV/RA + 10mm Hg): 45-50 mmHg
LV Diastolic Function: CANNOT ASSESS DIASTOLIC FUNCTION. HIGH TO MIDLLOW VELOCITY IS CONSISTEINT WITH HIGH LA PRESSURE
Pericardium: NO EFFUSION
Other Findings: PATIENT WAS TACHYCARDIC DURING THE EXAM.
CONCLUSION: SEVERELY REDUCED LV SYSTOLIC FUNCTION. MODERATE MITRAL REGURGITATION.

Persantine Thallium 7/24

EXAM: PERSANTINE THALLIUM MYOCARDIAL PERFUSION SPECT SCAN

DIAGNOSIS CODE: 425.4

CLINICAL INFORMATION: 36 year old with a history of post-partum cardiomyopathy.

PHARMACOLOGIC STRESS TEST: The patient had a total dose of 39 mg persantine infused IV over 4 minutes. The HR was 85 bpm at baseline and 98 bpm at peak persantine effect. The blood pressure response was normal going from 90/70 to 90/69. The patient's baseline ECG showed NS T wave abnormalities. There were no symptoms or ECG changes during or after Persantine to suggest ischemia or arrhythmia, however the pt reported nausea for which 75 mg of aminophylline were administered IV. Symptoms resolved afterward.

Following Persantine infusion the patient was injected with 4 mcg TL-201 chloride. SPECT cardiac imaging was then performed. Images were gated to evaluate wall thickening and wall motion. A left ventricular ejection fraction was calculated by computer analysis. Later in the day rest SPECT cardiac imaging was performed.

FINDINGS: The post persantine myocardial images show a possible apical defect and heterogeneous distribution of tracer in the LV, attributable to noisy cardiac images from extensive attenuation and shunting of cardiac tracer to the liver. Rest images show possible improvement in the apex but are otherwise grossly unchanged. ECG-gated resting myocardial images demonstrate global hypokinesis.

The calculated LVEF is 26%. The LV chamber size is moderately increased. The RV chamber and RV are normal.

IMPRESSION:

1) No definite evidence of myocardium at risk for coronary ischemia and no evidence of infarct.
2) Cardiomyopathy on basis of LVD and LVEF of 26%.
Holter monitor 7/26: PVCs but no episodes of ventricular tachycardia

Echo 8/26

**INDICATION:** CARDIOMYOPATHY

**ECHOCARDIOGRAM REPORT**

**MEASUREMENTS:**
- **Left Ventricle:** LVIDd 67 mm, LVIDs 55 mm [normal: up to 58 mm men, 53 mm women]
- **Wall Thickness:** IVSTd 9 mm (range) [normal: <12 mm], PWTd 6 mm (range) [normal: <12 mm]
- **Aorta:** Ascend Aorta 33 mm [normal up to 34 mm]
- **LA Diameter:** 26 mm [normal up to 44 mm men, 40 mm women], **LA Length:** 62 mm [normal up to 53 mm]

A complete 2-D Echocardiogram, M-Mode, Spectral and color flow doppler exam was performed.

**Image Quality:** GOOD

**Chamber Sizes:** DILATED LV, LEFT ATRIAL ENLARGEMENT.

**Global Left Ventricular Function & Wall Motion:** GLOBAL HYPOKINESIS

**Estimated Ejection Fraction:** 30-35%

**Valves Appearance and Doppler Assessment:**
- **Aortic:** TRILEAFLET, NO STENOSIS OR INSUFFICIENCY.
- **Mitral:** MODERATE REGURGITATION WITH SYSTOLIC EXPANSION OF THE LA
- **Tricuspid:** MILD REGURGITATION
- **PA Systolic Pressure (RV/RA + 10mm Hg):** 50

**LV Diastolic Function:** INDETERMINATE

**Pericardium:** NORMAL

Compared with TTE of 7/23/2006, THERE HAS BEEN SIGNIFICANT IMPROVEMENT IN LV SYSTOLIC FUNCTION.

**Conclusion:** CARDIOMYOPATHY WITH MODERATE MITRAL REGURGITATION AND MODERATE PULMONARY HYPERTENSION
Echo 11/29

Measurement tables
2D directed M-mode

2D measurements
Left ventricle
LVIdc, PLAX 58 mm 35-60
LVIdc, PLAX 41 mm 21-40
PWTe 8 mm 6-11
Ventricular septum Normal
IVSTD 8 mm 6-11
LVOT Normal
Diam 22 mm --
Aorta Normal
Root diam 28 mm --
Left atrium Normal
AP dim es, PLAX 24 mm 23-38

Findings
Cardiac structures and function
Left ventricle: The ventricle was mildly dilated. Systolic function was mild to
moderately reduced. Ejection fraction was estimated in the range of 40 % to 45 %. There
was mild to moderate global hypokinesis. Wall thickness was normal. Doppler: Left

Echo one year later 7/18

Measurements
Left ventricle (Reference range)
LVIdc 63 mm (35-60)
LVIdc 58 mm (21-40)
PWTd 4 mm (6-11)
Ventricular septum (Reference range)
IVSTD 4 mm (6-11)
LVOT (Reference range)
Diam 22 mm (--)
Aorta (Reference range)
Root diam 29 mm (--)
S-T Junct diam 21 mm (17-34)
Left atrium (Reference range)
AP dim es 27 mm (23-38)

Indication: Cardiomyopathy.
Image quality: Image quality was good.

Findings
Left ventricle: LWHF estimates by the use of the quantitative biplane method are
41-47%, and visually in the range of 35-45%. The ventricle was dilated.
Systolic function was mildly reduced. No wall motion abnormalities identified.
Doppler: The transmitral flow pattern was normal. Left ventricular diastolic
function was normal.
MD letter 3 years later. Current meds: lisinopril, metoprolol, and spironolactone

She is a patient followed in the cardiology for a history of non-ischemic cardiomyopathy. She continues to improve and her left ejection fraction was low normal.

She has not had any hospitalizations since her initial presentation. She is regularly followed in the outpatient clinic. She has been stable and well compensated. Her functional status also continues to improve.

Discussion Questions: Peri-partum cardiomyopathy

1. What are the risk factors for peri-partum cardiomyopathy?
2. What features of the clinical presentation are associated with an adverse prognosis? Are there any positive features that might improve your assessment?
3. An AICD (automatic internal cardiac defibrillator) was not implanted in this case. Would it change your assessment if an AICD was in place and well-monitored?
4. Comparing echo reports from 7/29 and one year later, the impression might be that there was further deterioration during that time. What do you think of the echo from one year later 7/18?
Case 6: Mitral Regurgitation

62 year old man, nonsmoker

- 5’9” (175 cm), 212 lbs (96 kg)
- BP 146/88, pulse 64
- History of HTN, high cholesterol, diabetes
- Current medications: valsartan/HCTZ combination, atorvastatin, glipizide
- On insurance lab studies
  - Total cholesterol 176 mg/dl (4.6 mmol/L), HDL 45 mg/dl (1.2 mmol/L), ratio 3.9
  - Hemoglobin A1c 7.1%
  - Urinalysis within normal limits
  - NTproBNP 491 pg/ml
- EKG: Normal sinus rhythm, rate 76. Prominent voltage, minor nonspecific ST-T changes diffusely

Attending physician records

- Routine care, regular visits
- Long history of a heart murmur, described as Grade 2-3/6 systolic murmur
- Abnormal EKG noted 4 years ago. Nuclear stress test done.
  - Resting heart rate 66, BP 138/84. Resting EKG - nonspecific ST-T changes
  - Exercised 7 minutes on a Bruce protocol to a peak heart rate of 150 and a BP of 204/96. Stopped due to shortness of breath and fatigue.
  - With exercise, accentuation of resting ST abnormalities, reaching a maximum of 2 mm of ST depression in the inferior and lateral precordial leads. There were also frequent PVCs throughout the later stages of exercise and early recovery. The EKG returned to baseline at 8 minutes of recovery.
  - No perfusion defects on the nuclear scan. Left ventricular size appeared normal and ejection fraction was low normal.
- Resting echocardiogram (also done 4 years ago):

<table>
<thead>
<tr>
<th>Finding</th>
<th>Normal Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left ventricular internal dimension (diastole)</td>
<td>5.7 cm</td>
</tr>
<tr>
<td>Left atrium</td>
<td>4.8 cm</td>
</tr>
<tr>
<td>Septal thickness</td>
<td>1.3 cm</td>
</tr>
<tr>
<td>Posterior wall thickness</td>
<td>1.2 cm</td>
</tr>
<tr>
<td>Aortic root</td>
<td>3.4 cm</td>
</tr>
</tbody>
</table>

Trileaflet, mildly sclerotic but freely mobile aortic valve. Mild mitral annular calcification with thickening of both mitral valve leaflets. No prolapse. Left ventricular ejection fraction 52%.

Doppler study:
- Mean gradient of 6 mm Hg across aortic valve
- Moderately severe (eccentric posterolateral jet) mitral regurgitation
- Right ventricular systolic pressure estimated at 36 mm Hg
- Evidence of mild diastolic dysfunction

Conclusion: Mild left ventricular hypertrophy. Aortic sclerosis. Moderately severe mitral regurgitation.
Discussion Questions: Mitral regurgitation

1. What factors in this case, both clinical and from the echo report, can be used to help assess the severity of the mitral regurgitation?
2. How do you view the ejection fraction of 52%? Is it normal and favorable?
3. What is the significance of the NTproBNP?
4. Does the severity of mitral regurgitation correlate with mortality risk?
5. Is there likely to be excess mortality associated with the findings in this case? What about morbidity?
6. What is the likelihood that this person will need surgical intervention? Repair or replacement? Would it matter from an insurance risk perspective?
7. What is the recommended clinical follow up for mitral regurgitation, and how is that relevant for insurance risk selection?
Case 7: Ventricular Noncompaction

26 year old male, professional athlete

- 6' 5" (196 cm), 200 lbs (90.9 kg), BMI 23.7
- BP 110/70
- Total cholesterol 208 mg/dl (5.38 mmol/l). HDL 112 mg/dl (2.9 mmol/l). mm TC/HDL ratio 1.8

ECG 2012
Echocardiogram 2012

**Measurements & Cardiac Doppler Hemodynamics**

<table>
<thead>
<tr>
<th>LV Diastolic</th>
<th>Aortic Valve</th>
<th>Mitral Valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>LVID 6.1 cm</td>
<td>Aortic root 3.7 cm</td>
<td>MV peak gr mmHg</td>
</tr>
<tr>
<td>LVPW 1.0 cm</td>
<td>AV peak gr 4.8 mmHg</td>
<td>MV mean gr mmHg</td>
</tr>
<tr>
<td>IVS 1.0 cm</td>
<td>AV mean gr 3 mmHg</td>
<td>MV PHT msecs</td>
</tr>
<tr>
<td>LV Systolic</td>
<td>LVOT diam cm</td>
<td>MV trace cm²</td>
</tr>
<tr>
<td>LVID 4.5 cm</td>
<td>AoV cm²</td>
<td>MVA cm²</td>
</tr>
<tr>
<td>LVPW cm</td>
<td>AoV traced cm²</td>
<td>Tricuspid Valve</td>
</tr>
<tr>
<td>IVS cm</td>
<td>Left atrium 3.8 cm</td>
<td>TR gr 21 mmHg</td>
</tr>
<tr>
<td>FS %</td>
<td>RA est. pressure mmHg</td>
<td></td>
</tr>
<tr>
<td>LV est. EF 55%</td>
<td>RSVP 25 mmHg</td>
<td></td>
</tr>
</tbody>
</table>

**Comments:**

This is a complete study of good quality.

**Aortic valve - proximal aorta:** The aortic root size is normal. The aortic valve leaflets are normal.

**Left atrium:** The left atrial chamber is normal in size measuring 3.8 cm.

**Mitral valve:** The mitral valve leaflets are normal.

**Left ventricular size and function (EF):** The left ventricular chamber size is normal. No wall motion abnormalities are seen. Overall global left ventricular systolic function is normal with an ejection fraction in the range of 55%. A prominent trabeculae is seen in the left ventricular apex.

**Tissue Doppler imaging - left ventricular diastolic function assessment:** Tissue Doppler imaging is suggestive of normal left ventricular diastolic function.

**Right atrial and right ventricular chambers and RV function:** The right atrium and right ventricle are normal in size and function.

**Conclusion:**

1. Overall global left ventricular systolic function is normal with an ejection fraction in the range of 55%.
2. Normal left ventricular diastolic function.
3. No specific evidence of hypertrophic cardiomyopathy.
Echocardiogram 2013

<table>
<thead>
<tr>
<th>2D/W Node Measurements</th>
<th>Doppler Measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>LVd</td>
<td>IV E Vel</td>
</tr>
<tr>
<td>LVIDd</td>
<td>1.1 cm (0.7 - 1.1)</td>
</tr>
<tr>
<td>LVIDd</td>
<td>8.3 cm (3.6 - 5.6)</td>
</tr>
<tr>
<td>LVIDc</td>
<td>1.2 cm (6.7 - 1.1)</td>
</tr>
<tr>
<td>LVIDc</td>
<td>4.9 cm (2.0 - 4.0)</td>
</tr>
<tr>
<td>LA Diam</td>
<td>3.7 cm (1.9 - 4.0)</td>
</tr>
<tr>
<td>Ao Diam</td>
<td>3.7 cm (2.0 - 3.7)</td>
</tr>
<tr>
<td>Ao aortic</td>
<td>3.1 cm</td>
</tr>
<tr>
<td>Ao Aortic Diam</td>
<td>2.6 cm</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NV DecT</td>
</tr>
<tr>
<td></td>
<td>240 ms</td>
</tr>
<tr>
<td></td>
<td>NV A Vel</td>
</tr>
<tr>
<td></td>
<td>0.2 m/s</td>
</tr>
<tr>
<td></td>
<td>NV E/A Ratio</td>
</tr>
<tr>
<td></td>
<td>1.6</td>
</tr>
<tr>
<td></td>
<td>E</td>
</tr>
<tr>
<td></td>
<td>0.12 m/s</td>
</tr>
<tr>
<td></td>
<td>D/E</td>
</tr>
<tr>
<td></td>
<td>3.6</td>
</tr>
<tr>
<td></td>
<td>AV Vmax</td>
</tr>
<tr>
<td></td>
<td>1.0 m/s</td>
</tr>
<tr>
<td></td>
<td>TR Vmax</td>
</tr>
<tr>
<td></td>
<td>2.2 m/s</td>
</tr>
<tr>
<td></td>
<td>TR maxPG</td>
</tr>
<tr>
<td></td>
<td>20 mmHg</td>
</tr>
</tbody>
</table>

**Findings**

**Study quality:** This was a technically good study.

**ECG rhythm:** Sinus rhythm.

**Left Ventricle:** The left ventricle is mildly dilated. Left ventricular wall thickness is normal. Overall left ventricular systolic function is low-normal with an EF between 50 - 55 %. There are no regional wall motion abnormalities noted. There are increased trabeculations noted within the left ventricle suggestive of noncompaction left ventricle.

**Left Atrium:** The left atrium is normal in size.

**Right Ventricle:** The right ventricle is normal in size and function.

**Right Atrium:** The right atrium is normal in size.

**Aortic Valve:** The aortic valve is trileaflet and appears structurally normal. There is no evidence of aortic stenosis. Trivial amount of aortic regurgitation.

**Mitral Valve:** The mitral valve is normal in structure and function. There is trace mitral regurgitation.

**Tricuspid Valve:** The tricuspid valve is normal in structure and function. Trace tricuspid regurgitation present. The right ventricular systolic pressure as measured by Doppler is 20 mmHg + right atrial pressure.

**Pulmonic Valve:** Pulmonic valve appears normal in structure and function. There is trace pulmonary regurgitation.

**Aorta:** The aortic root, ascending aorta and aortic arch are normal in size.

**Coronaries:** The left coronary artery arises normally. The right coronary artery arises normally.

**Pericardium:** The pericardium appears normal.

**Conclusions**

1. The left ventricle is mildly dilated.
2. Left ventricular wall thickness is normal.
3. Overall left ventricular systolic function is low-normal with an EF between 50 - 55 %.
4. There are no regional wall motion abnormalities noted.
5. There are increased trabeculations noted within the left ventricle suggestive of noncompaction left ventricle.
**Discussion Questions:** Ventricular non-compaction

1. Interesting ECG – how would you best describe the findings?
2. Echo 2012 – do you agree with the assessment of the findings? Ventricular size? Finding at the ventricular apex?
3. Echo 2012 – no clinical comment or evaluation. If this was all you had, what would you do?
4. Echo 2013 – do you agree with the assessment of the findings? Do you think there has been any significant change? What if the next LVED had been 5.9 cm?
5. If it was 2013, what would you do?
6. Team switch and league rules change – no further studies. It’s 2015 – what do you want to do?
Case 8: Takotsubo Cardiomyopathy

68 year old woman, nonsmoker
- 5'5" (165 cm) tall, 166 lbs (75 kg), BMI 28
- BP 134/76, pulse 62
- Treated for hypertension, chronic anxiety and depression.
- History of “broken heart syndrome” 2 years ago. Hospitalized for 6 days. Resolved.
- Current medications: losartan 50 mg daily
  atorvastatin 10 mg daily
  metoprolol 25 mg bid
  citalopram 20 mg daily
  alprazolam 0.25 mg as needed

Discussion Questions
1. What is “broken heart syndrome”?  
2. How is it different from acute coronary syndrome?

Attending physician records
- Long history of anxiety and recurrent depression. On a variety of medications over the years. Missed occasional days of work, but no long periods of disability, never hospitalized and no suicide attempts
- Two years ago, acute grief reaction in response to sudden death of her husband of 42 years
- The day after her husband’s death, she presented with chest pain and acute congestive heart failure. Diagnosed with takotsubo cardiomyopathy (broken heart syndrome)
  - EKG showed ST elevation in inferolateral leads
  - Troponins elevated; creatine kinase (CK) not elevated
  - Echocardiogram showed ballooning of the left ventricular apex during systole with an ejection fraction (EF) of 40%
  - Cardiac cath revealed minor nonobstructive coronary disease
  - Treated supportively, and was discharged after 6 days
- EKG and echo obtained 3 months later both back to baseline (normal). Left ventricular size was normal and EF was 55%
- Cardiac follow up 5 months prior to application was also favorable, with no symptoms reported. EKG remains normal.

Discussion Question
1. What is the long-term outlook for takotsubo cardiomyopathy?