Thyroid disease and the heart

David Stultz, MD
Cardiology Fellow PGY-IV
Patient AC 1

- AC is 45 yo WM with palpitations, sob, sweating, and chest pains x 2 weeks
- DOE over past month, worsening x 2 weeks
- Palpitations last a few minutes follow by diaphoresis, lightheadedness, and chest pain
- Chest pain is substernal chest pressure, radiates to left arm, 8/10 intensity; exertional in nature and relieved with rest or leaning forward
Patient AC 2

• Chest pain occurred 3 times on day of admission
  – 2 episodes while walking dogs
  – 1 episode when climbing steps
• No orthopnea or paroxysmal nocturnal dyspnea
• No pleuritic nature of chest pain
Patient AC

Past Cardiac History

• Admitted to Good Sam 2 years ago, diagnosed with atrial fibrillation and started on coumadin
• On coumadin x 3 months then DC’d by physician
• Stress test 2 years ago, negative per pt
Patient AC
Past Medical History

- Negative for hypertension, diabetes, hyperlipidemia
- Past Surgical – appendectomy in 1976
- Social
  - Maintenance worker
  - 50 pack/year smoking history, quit in 2001
  - Occasional alcohol
  - No illicits
- Family
  - Mother with DM, MI age 62
  - Father with CVA
  - Sister with DM
Patient AC

• Medications
  – Naprosyn 500mg po bid prn

• Physical Exam
  – T 97.1  P 94  BP 129/60  R 20  sat 98% on ra.
  – Gen NAD
  – HEENT: Perrla, eomi, MMM
  – Neck: Supple, no LAD, no JVD, no bruits
  – Heart: RRR, normal S1 + S2, no MRG, normal PMI
  – Lungs: CTA Bilaterally
  – Abdomen: BS+, soft, nontender, nondistended
  – Extremities: No C/C/E
  – Neurological: No focal deficits
Patient AC
Labs

LFT’s normal
BNP 541

Chest Xray – Mild Pulmonary Vascular congestion but no CHF
Patient AC

EKG 1
Patient AC
Initial Treatment

- Unstable Angina
  - ASA
  - Lovenox
  - Metoprolol 25 mg bid

- Further therapies
  - Lisinopril 5mg
  - Simvastatin 10 mg
  - Isordil 10 mg t.i.d
Patient AC

EKG 2
Patient AC
Echocardiogram
Patient AC
Cardiac Catheterization

• Catheterization
  • LV 111/10
  • LVEDP 10
  • Post LVEDP 12
  • AORTA 107/50 mm hg
    – Left Main: Mild plaque 10%
    – Left Anterior Descending: Osteal 40-50% stenosis
    – Left Circumflex: mild plaque
    – Right Coronary Artery: mild plaque
    – Left Ventriculogram: EF 65%
Patient AC
Subsequent Labs

• Cardiac Enzymes negative
  – CPK’s 37-38
• TSH 0.006
• Free T₄ 4.78 (normal 0.75-1.54)
Patient AC

Further history

• 30 pound weight loss recently
• Frequently diaphoretic at home
• Re-examination reveals mild hand tremor
Patient AB

- 46 yo WM with SOB x 1 month, increasing over past week
- Felt well until 1 month ago, symptoms progressively worse
- Noticed fatigue with yard work – had to rest in bed
- No chest pains or palpitations
Patient AB
Cardiac History

• Stress thalium 3 years ago
  – Reversible inferoapical ischemia

• Cardiac Catheterization 3 years ago
  – Normal coronaries
  – Normal LV function
Patient AB
Other Past Medical History

- Depression
- HLP
- ETOH abuse
- Surgical Hx:
  - Hx Knee surgery for trauma during sports
  - Hx Head surgery from MVA ?? Burr holes long time ago
Patient AB

- **Medications**
  - Elavil 75 mg qhs
  - Dilantin 300 mg qd

- **Family History**
  - Father died of emphysema
  - Otherwise unremarkable, no CAD
Patient AB
Physical Exam

- T:97.2 P:95 RR:16 BP:103/60 sat 92% RA
- Gen: NAD
- HEENT: Perrla, Eomi, MMM, no OP lesions
- Neck: Supple, no LAD, no bruits, no JVD
- Heart: RRR, normal S1+S2, no MRG, normal PMI
- Lungs: CTA Bilaterally
- Abdomen: BS+, soft, nontender, nondistended
- Extremities: 1+ B LE edema
- Neuro: CN 2-12 intact, DTR’s 2+ Bilaterally, Cerebellar function normal
Patient AB
Labs

ALT – 90
AST – 37
Alk Phos – 145
T. Bili – 0.4
Trigs 1064
HDL 28
LDL 100
Total Cholesterol 338

Chest Xray – Increased interstitial markings, no CHF
CPK – 280’s
MB – 5-6
Troponin T – all <0.01
Patient AB
EKG
Patient AB
Initial Treatment

• CHF Exacerbation
  – Lasix 40 mg po bid
  – Echo
  – Right and Left Heart Cath
Patient AB
Hemodynamics – PA/LV
Patient AB
Hemodynamics – RV/LV

92 BPM

RU
30/5 /14
( 17)
LV
98/4 /12
( 44)
Patient AB
Hemodynamics – RA/LV

Event Edit Load Timer Service Adm/Dis Playback Message
21 Jul 03 11:43:02 00:55:42
V 0.3
II 0.0
20 mm/mU
[ 40]
[ 40]
NBP 109/59 (88)
11:36
RR 19/m
SP02 92
14/10/11
(12)
LV
124/1 /16
(50)

ARTERIAL PED
50 mm/s
Patient AB
Left Cardiac Catheterization

- LM – patent
- LAD – patent
  - D1, D2, D3 – patent
- L Cx – small, patent
  - OM 1 – patent
- RCA – dominant, patent
- LV gram – LVEF 55%, no wall motion abnormalities or regurgitation
Patient AB
Echocardiogram
Patient AB
Echocardiogram
Patient AB

Echocardiogram – Mitral Doppler
Patient AB
Echocardiogram

- Pericardial thickening
- Mild pericardial effusion
- Systolic function preserved
- ? Diastolic dysfunction
Patient AB
PFT's

- There is an obstructive ventilatory defect which is Mild.
- A significant response to bronchodilators indicates a reversible component to the obstruction.
- There is a restrictive ventilatory defect which is Moderate.
- There is a gas exchange abnormality which is Moderate.
Patient AB

- TSH – 189
- Free $T_4$ – 0.16
- Further history revealed only cold intolerance.
- Further exam demonstrated a small L thyroid nodule but did not reveal any neurologic findings
- Thyroid uptake scan revealed decreased uptake in a heterogeneous pattern consistent with Hashimoto’s thyroiditis
Thyroid hormone

- $T_4$ prohormone converted to $T_3$ active
- Animal studies demonstrate
  - Direct positive inotropic effect
    - Increases sodium-calcium-ATPase which increases calcium influx
    - Increase in LV cavity without change in EDP
- Increases rate of depolarization
- Decreases refractory period
Effect on Myocardium

Myocardial calcium concentration

Myocardial tension

Hyperthyroidism

• Symptoms
  – Palpitations
  – Dyspnea

• Signs
  – Tachycardia
  – Systolic hypertension
  – Hyperactive precordium
  – Loud S1, accentuated P2, S3
  – Occasional systolic click, midsystolic murmur
  – Means-Lerman scratch – systolic scratch near LUSB
Hyperthyroidism

- ↑ Cardiac and stroke volume index
- ↑ Mean systolic ejection rate
- ↑ Coronary blood flow
- ↓ Systolic ejection period
- ↓ Systemic vascular resistance
- Widened pulse pressure
## Prevalence of Symptoms and Signs

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tachycardia</td>
<td>90</td>
</tr>
<tr>
<td>Palpitations</td>
<td>85</td>
</tr>
<tr>
<td>Exercise intolerance</td>
<td>65</td>
</tr>
<tr>
<td>Bounding pulses</td>
<td>75</td>
</tr>
<tr>
<td>Wide pulse pressure</td>
<td>75</td>
</tr>
<tr>
<td>Hyperactive precordium</td>
<td>75</td>
</tr>
<tr>
<td>Dyspnea on exertion</td>
<td>50</td>
</tr>
<tr>
<td>Fatigue</td>
<td>50</td>
</tr>
<tr>
<td>Systolic murmurs</td>
<td>50</td>
</tr>
<tr>
<td>Systolic hypertension</td>
<td>30</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>15</td>
</tr>
<tr>
<td>Angina pectoris</td>
<td>5</td>
</tr>
</tbody>
</table>

[http://www.medslides.com/member/Endocrinology&_Metabolism/hyperthyroid_heart.ppt](http://www.medslides.com/member/Endocrinology&_Metabolism/hyperthyroid_heart.ppt)
Hyperthyroidism and Atrial Fibrillation

• Previously thought that hyperthyroid patients have 5-15% incidence of atrial fibrillation
  – Studies involved older patients with known structural heart disease
• 1996 study demonstrates only 1% of new onset atrial fibrillation is caused by overt hyperthyroidism
• Treatment involves restoration of euthyroid state

Hyperthyroid Angina & CHF

• Previously thought only to occur in presence of coronary disease
  – CHF occurs experimentally in animals by administering T₄
  – CHF has developed in children with thyrotoxicosis and no coronary disease
  – Angina has been reported in a patient with normal coronaries, thought to be thyroid mediated coronary arterial vasospasm
  – Abnormal exercise LV function not reversed with β blockade, but is reversed by treating hyperthyroidism
  – Thyroid mediated cardiomyopathy may not be reversible

Dillman WH: Thyroid hormones and the heart: Basic mechanistic and clinical issues. Thyroid Today 19:1, 1996.
Treatment of Hyperthyroidism

• Resistance to cardiac glycosides
  – Increased volume of distribution
  – Reduced inotropic effect, decreased prolongation of AV refractory period

• β blockers

• Propylthiouracil (inhibits conversion $T_4 \rightarrow T_3$)

• Surgical or radioactive thyroid ablation
Hypothyroidism

- Myxedema
  - Pale, flabby, dilated heart
  - Myofibrillar swelling, loss of striations, interstitial fibrosis
  - Pericardial effusion (↑ capillary permeability)
- Sinus bradycardia, prolonged QT interval
- Low P wave amplitude
- AV/intraventricular conduction block
  - RBBB
Hypothyroidism

- Hypertension
  - Hypothyroidism found in 4% of hypertensive patients
  - Severe hypothyroidism results in normo- or hypotension
- Increase in SVR
- Diastolic relaxation is slowed

Myxedema vs CHF

• CHF rare in absence of cardiovascular disease
• Dyspnea, edema, effusions, cardiomegaly, T wave changes occur in both
• Left sided heart failure
  – PA pressure elevated with exercise
  – CO fails to rise
  – Valsalva response is normal
• Myxedema
  – PA pressure low with exercise; CO rises
  – Hemodynamic changes resolve with thyroid hormone
Atherosclerosis and Hypothyroidism

- Hypercholesterolemia and hypertriglyceridemia common
- Treatment of hypothyroidism corrects lipids
- MI and angina uncommon in hypothyroidism
  - Decreased metabolic demand
  - Initiate therapy slowly in patients with CAD
References

• http://www.medslides.com