Systolic Heart Failure: Evaluation of a New Diagnosis

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The initial evaluation is aimed at answering 3 key questions:

1. What is the cause of failure?

2. What interventions will reverse the process and support the rest of the body?

3. What is the prognosis?
Case of David

55 year old man

Came to the E.R. with severe swelling

Ejection fraction 15%
Data gathering
# History

## What are the symptoms?

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Symptom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dyspnea</td>
<td>Fatigue</td>
</tr>
<tr>
<td>Swelling</td>
<td>Lightheadedness</td>
</tr>
<tr>
<td>Chest pain</td>
<td>Diaphoresis</td>
</tr>
<tr>
<td>Palpitations</td>
<td>Weakness</td>
</tr>
<tr>
<td>Appetite</td>
<td>Sleep quality</td>
</tr>
<tr>
<td>Urine output</td>
<td>Weight changes</td>
</tr>
</tbody>
</table>

## How long ago did the symptoms start?

**Review of systems – screen for other organ system disease**
History

• Medications
  – Doxycycline
  – Herceptin
  – Cyclophosphamide

• Recreational drugs
  – Alcohol
  – Methamphetamine
  – cocaine
History

• Who else in the family has had heart problems?

• What other medical problems run in the family?

• What type of social support and social challenges are present?
David’s History

• Symptoms:
  – Swelling is all over, most severe in his abdomen
  – Short of breath at rest with orthopnea
  – Very poor appetite due to nausea and abdominal distention
  – Generalized weakness
  – Severe insomnia
  – No chest pain or palpitations
  Onset 3 month ago

• Medications:
  – Clonazepam
  – Venlafaxine

• Social:
  – Alcoholism after his divorce 2 years ago
  – Lives with his grown daughter
  – Stopped working a month ago due to symptoms

• Other diagnoses:
  – Anxiety and depression with suicide attempts

• Family:
  – His father had hypertension and a myocardial infarction at age 65
<table>
<thead>
<tr>
<th>Vitals</th>
<th>Constitutional</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Heart rate:</td>
<td>• Alertness</td>
</tr>
<tr>
<td>– too slow, too fast, irregular</td>
<td>• Diaphoresis</td>
</tr>
<tr>
<td>• Blood pressure:</td>
<td>• Pallor</td>
</tr>
<tr>
<td>– too high, too low</td>
<td>• Jaundice</td>
</tr>
<tr>
<td>• Respiratory rate:</td>
<td>• Rash</td>
</tr>
<tr>
<td>– tachypneic</td>
<td>• Obesity/cachexia</td>
</tr>
<tr>
<td>• Oximetry:</td>
<td></td>
</tr>
<tr>
<td>– hypoxemic</td>
<td></td>
</tr>
</tbody>
</table>
## Physical exam

<table>
<thead>
<tr>
<th>Neck</th>
<th>Pulmonary</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Carotid murmur</td>
<td>- Diminished</td>
</tr>
<tr>
<td>- Jugular vein pulse elevated</td>
<td>- Wheezing</td>
</tr>
<tr>
<td>- Kussmaul’s sign</td>
<td>- Rales</td>
</tr>
<tr>
<td>- Thyroid enlarged</td>
<td>- Pleuritic pain</td>
</tr>
</tbody>
</table>
Physical Exam

Cardiac
• Displaced apical pulse
• Murmur
• Gallop
• Rub
• Loud P2
• Right ventricle heave

Abdominal
• Organomegaly
• Liver pulsatile
• Ascites
• hepatojugular reflux
• Abdominal bruit
• Focal tenderness
### Physical Exam

#### Musculoskeletal
- Weakness
- Muscle atrophy
- Joint swelling
- Joint pain

#### Distal Extremities
- Capillary refill rate
- Edema
- Cold
- Cyanotic
- Pulses
David’s Physical Exam

- Heart rate 115 bpm
- Blood pressure 95/70 mmHg
- Respiratory rate 22/min
- Oximetry 88%

- Diaphoretic, jaundiced

- JVP 15cm, hepato-jugular reflux

- Apex pulse displaced laterally, no cardiac murmur or rub

- Breaths sounds diminished bilaterally

- Abdomen is distended, ascites, liver is pulsatile but not enlarged

- Severe edema in legs, slow capillary refill, cold hands and feet
Blood tests

- **Metabolic:**
  - Sodium
  - Potassium
  - Calcium
  - Bicarbonate
  - Urea nitrogen
  - Creatinine
  - Lactic acid

- **Complete blood count:**
  - White blood cells,
  - Hemoglobin,
  - Platelets,
  - Eosinophils

- **Biomarkers**
  - Troponin
  - BNP

- **Drugs of abuse**
  - Ethanol
  - Cocaine
  - Methamphetamine

- **Liver panel:**
  - Enzymes
  - Albumin
  - Bilirubin
  - Protime

- **Nutrition:**
  - Prealbumin
  - Vitamin D
  - Iron
  - Thiamine

- **Endocrine:**
  - TSH and T4
  - A1c
  - (cortisol)
  - (parathyroid hormone)

- **Autoimmune/Inflammation**
  - ESR
  - ANA panel
  - Rheumatoid factor
David’s Blood Tests

- BNP severely elevated
- Lactate mildly elevated
- Bilirubin moderately elevated
- Liver enzymes mildly elevated
- Iron very low
- Prealbumin very low
- Vitamin D low
Imaging

• Electrocardiogram:
  – Arrhythmia
  – LBBB
  – Hypertrophy
  – Low voltage
  – Atrial enlargement
  – Infarct

• Chest xray:
  – Cardiomegaly
  – Pericardial effusion
  – Pleural effusion
  – Pulmonary edema
Imaging

• Echocardiogram
  – Structure – muscle, chambers, valves, pericardium
  – Pressures
  – Cardiac output

• Perfusion study
  – Stress test
  – Coronary angiogram
  – Viability
David’s Imaging

- Chest xray:
  - large pleural effusion

- Coronary angiogram:
  - Mild plaque

- Right heart catheterization:
  - CVP mildly elevated
  - Wedge pressure mildly elevated
  - Pulmonary artery pressure normal
David’s Imaging

Echocardiogram:

- Myocardium is non-compacted
- Diffuse hypokinesi of the left ventricle
- Moderately dilated
- Mild mitral regurgitation
- Right ventricle normal size and function
• How do we use this information to answer the 3 key questions?

1. What is the cause of failure?

2. What interventions will reverse the process and support the rest of the body?

3. What is the prognosis?
Etiology

- How did this happen to me...?

What is the cause of the failure
Etiology

• Why does this matter?
  – May discover a reversible primary cardiac cause, with a good prognosis
  – May discover a systemic disease (that also impacts other organ systems), with the opportunity for intervention
  – May discover an irreversible cause, with a poor prognosis, requiring an early decision for advanced therapy or palliative care
Question.....

• What is the **second** leading cause of systolic heart failure in the U.S.?

• A. Familial

• B. Ischemia

• C. Hypertension

• D. Valve dysfunction

• E. Idiopathic
What is the second leading cause of systolic heart failure in the U.S.?

- A. Familial
- B. Ischemia
- C. Hypertension
- D. Valve dysfunction
- E. Idiopathic
Etiology

Primary cardiovascular:

- Ischemia
- Hypertension
- Valve dysfunction
- Tachycardia
- Arrhythmia
- Familial
- Stress
- Idiopathic
Etiology

Secondary systemic:

- Drugs – prescribed or abused
- Infiltrative – iron, amyloid
- Inflammatory – myocarditis, infection
- Autoimmune & Connective tissue – lupus, rheumatoid, sclerosis
- Endocrine – thyroid, parathyroid, diabetes
David’s Etiology

- Noncompacted myocardium
- Left bundle branch block
- Alcohol toxicity
- Tachycardia
Therapeutic targets

- Will medications be enough .... Do I need surgery?

What interventions will reverse the process and support the rest of the body?
Therapeutic targets

• Components of cardiac function

• Comorbid conditions
Cardiac Function

- 5 Components:
  1. Muscle
  2. Electrical
  3. Plumbing
  4. Valves
  5. Lungs
Muscle

- Is the weakness focal or diffuse?
- Is there mild or severe hypokinesis? Or Akinesis?
- Is the muscle hypertrophied or thinned?
- How severe is the diastolic function?
- Is the right ventricle also struggling?
Electrical

• Rate:
  – Too fast
  – Too slow

• Conduction:
  – Left bundle branch block
  – Pacemaker

• Rhythm:
  – Atrial fibrillation
  – PVC frequency
  – Ventricular tachycardia
Plumbing

- Obstructive atherosclerosis
- Vasospasm
- Dissection
Valves

- Stenosis
- Regurgitation
Lungs

- The first place blood backs up into when the left ventricle fails
- Pulmonary hypertension initially protects the lungs from high volumes, but also increases the work of the right heart
- Hypoxemia and hypercarbia requires the weak heart to work even harder
Therapeutic targets

• How are the other organs doing?
Which of these organs is most commonly dysfunctional in patients with systolic heart failure?

A. Spleen
B. Kidneys
C. Liver
D. Thyroid
E. Pancreas
Which of these organs is most likely to be dysfunctional in patients with systolic heart failure?

A. Spleen

B. Kidneys

C. Liver

D. Thyroid

E. Pancreas
Optimizing the other organ systems

- Kidneys
  - cardiorenal syndrome

- Lungs
  - obstructive and restrictive disease
  - central and obstructive sleep apnea
• Liver
  – Cirrhosis
  – congestive hepatopathy can lead to dysfunction interfering with medical therapy

• Endocrine
  – Thyroid
  – Diabetes
  – Adrenal
• Musculoskeletal
  – Muscle weakness and atrophy
  – Joint pain and dysfunction
  – Imbalance

• Nutrition
  – Protein
  – Vitamin D
  – Iron
  – Lipids
- Neurologic
  - Dementia
  - Neuropathy

- Psychiatric
  - Depression
  - Anxiety
  - Schizophrenia
David’s Case

Cardiac

- Myocardium is noncompacted, severely and diffusely weak
  - Bblocker, ACEI, aldosterone blocker

- LBBB
  - Optimize systolic efficiency with a biventricular pacemaker

- Tachycardia
  - Heart rate goal 60-70 bpm with a Bblocker

Other organ systems

- Pleural effusion
  - Thoracentesis

- Nutrition is poor
  - Supplement iron and vitamin D
  - Supplement protein

- Depression has been severe
  - Help with self care

- Alcoholism
  - Resources for abstaining
Am I ever going to get better?

What is the prognosis
Question…..

Which of these causes of systolic heart failure will resolve most quickly?

A. Alcohol toxicity

B. Hypertension

C. Peripartum

D. Stress-induced

E. Tachycardia-induced
Question.....

Which of these causes of systolic heart failure will resolve most quickly?

A. Alcoholic

B. Hypertensive

C. Peripartum

D. Stress-induced

E. Tachycardia-induced
All of the cardiac components and comorbid conditions impact prognosis to varying degrees
Prognosis

Underlying etiology

Idiopathic cardiomyopathy:

- 25% mortality at one year
- 50% mortality at 5 years

- 25% improve in < 1 year if the symptom onset was < 3 months

*Chance of myocardial recovery declines the more prolonged and severe the decompensation*
### Prognosis

Compared to idiopathic cardiomyopathy:

<table>
<thead>
<tr>
<th>Etiology</th>
<th>Hazard Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myocarditis</td>
<td>1.0</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1.0</td>
</tr>
<tr>
<td>Connective tissue diseases</td>
<td>1.0</td>
</tr>
<tr>
<td>Peripartum</td>
<td>1.0</td>
</tr>
<tr>
<td>Substance abuse</td>
<td>1.0</td>
</tr>
<tr>
<td>Ischemic</td>
<td>2.0</td>
</tr>
<tr>
<td>Doxycrubicin</td>
<td>2.6</td>
</tr>
<tr>
<td>HIV</td>
<td>4.0</td>
</tr>
<tr>
<td>Infiltrative</td>
<td>4.7</td>
</tr>
</tbody>
</table>
# Prognosis

## Cardiovascular parameters:
- Ejection fraction and cardiac output
- Heart rate and rhythm
- Left ventricle size and pressure
- Systemic blood pressure
- Central venous pressure
- Pulmonary artery pressure

## End-organ parameters:
- Sodium
- Urea nitrogen, creatinine
- AST, ALT, albumin, bilirubin
- Protime
- Hemoglobin
- Biomarkers
- Diuretic resistance
Prognosis

• Risk scores

A 2013 systematic review of 20 heart failure survival models showed only 2 capable of discriminating between good and poor prognosis

Heart Failure Survival Score
Seattle Heart Failure Model

But these were considered modest at best, likely because they were developed 20 years ago, so do not account for evolving therapies
David’s Case

**Favorable prognosis**

- Onset of symptoms was 3 months prior to presentation.
- A nonischemic cardiomyopathy without an infiltrative process.
- Alcohol toxicity may have contributed to his low EF to a degree and abstinence may regain some function.
- LBBB can be treated with a biventricular pacemaker.
- End organ function is reasonably good.

**Poor prognosis**

- EF is only 15% and the ventricle is moderately dilated.
- Noncompacted myocardium may not respond to medical therapy.
- Nutrition is poor, but this can be improved.
- Depression is severe, high risk for poor self-care and adherence to therapy and lifestyle requirements.
Summary

- Assessment of newly diagnosed heart failure encompasses all of the organ systems

- Evaluation of both the causes and consequences of heart failure is necessary

- Determining prognosis is difficult with many parameters that are dynamic

- We are gaining more control over these parameters as we discover more targets for therapy