Ambulatory assessment of volume status in patients with Heart Failure

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Disclosures:
“No financial relationships to disclose.”

Objectives
- Prognostic significance of congestion
- Sensitivity and specificity of clinical findings of heart failure
- Biomarkers for assessment of volume status
- Newer, device based methods of volume assessment
What do we know about these patients that get hospitalized for HF?

<table>
<thead>
<tr>
<th></th>
<th>ADHERE</th>
<th>OPTIMIZE HF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior HF (%)</td>
<td>75</td>
<td>87</td>
</tr>
<tr>
<td>New onset HF (%)</td>
<td>25</td>
<td>13</td>
</tr>
<tr>
<td>Cardiogenic shock (%)</td>
<td>2</td>
<td>&lt;1</td>
</tr>
<tr>
<td>LVEF &lt;40% (%)</td>
<td>59</td>
<td>52</td>
</tr>
</tbody>
</table>

The majority of patients admitted with ADHF are known to the medical system. The main reason for hospitalization is congestion.

Congestion

**Hemodynamic congestion** –
- Contributes to progression of HF by activating neurohormones, causing subendocardial ischaemia and remodeling of the LV
- Contributes to the cardio-renal syndrome

**Clinical congestion**
Causes symptoms

Clinical congestion is just the tip of the iceberg

*European Journal of Heart Failure (2010) 12, 423–433*
Prognostic significance of congestion

In patients with HF, elevated JVP is independently associated with adverse outcomes, including progression of heart failure.

The ability to maintain freedom from congestion identifies a population with good survival despite previous class IV symptoms.

Elevated PCWP, rather than severely reduced CI is of prognostic significance.
Clinical congestion at discharge is associated with an increased risk of 30-day and overall all cause mortality and heart failure hospitalization.

Question

The best way for assessment of congestion is
A. Clinical examination and weight
B. Right heart catheterization
C. Echocardiogram
D. BNP

Right heart catheterization is considered the gold standard for assessment of intracardiac filling pressures.
No improvement in survival or hospitalization
Increased in hospital complications

A significant proportion of patients are reclassified within a week of RHC and have increased filling pressures

JAMA. 2005;294(13):1625-1633

J Heart Lung Transplant 2015;34:438-447
Clinical assessment

The least sensitive physical finding for assessment of clinical congestion is

A. Edema
B. Rales
C. JVP
D. S3

Rales and pulmonary edema are found infrequently in patient with chronic heart failure due to exaggerated lymphatic drainage.
A combination of rales, edema, and elevated mean jugular venous pressure has a 100% specificity for PCWP ≥ 22 mmHg.

Clinical assessment

<table>
<thead>
<tr>
<th>Clinical finding</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
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<tbody>
<tr>
<td>Dyspnea on exertion</td>
<td>66</td>
<td>52</td>
</tr>
<tr>
<td>Orthopnea ≥ 2 pillows</td>
<td>86</td>
<td>25</td>
</tr>
<tr>
<td>Edema</td>
<td>46</td>
<td>73</td>
</tr>
<tr>
<td>Rales ≥ 1/3</td>
<td>15</td>
<td>89</td>
</tr>
<tr>
<td>Resting JVD</td>
<td>70</td>
<td>79</td>
</tr>
<tr>
<td>HJR</td>
<td>83</td>
<td>27</td>
</tr>
<tr>
<td>S3</td>
<td>73</td>
<td>42</td>
</tr>
<tr>
<td>Chest X ray</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulm edema</td>
<td>60</td>
<td>73</td>
</tr>
<tr>
<td>Pleural effusion</td>
<td>43</td>
<td>79</td>
</tr>
</tbody>
</table>

How to Estimate JVP

- A well-lit room
- Position the patient at an angle such that the meniscus of blood in the right jugular vein is brought into vision (usually an angle of 30 degrees to 45 degrees from the horizontal)

\[ \text{RAP (mm Hg)} = \frac{4}{3} \times \text{JVD (cm)} \]
Bendopnea

- The patient bends forward while sitting in a chair and touching one’s feet with one’s hands. The patient should not hold his or her breath. Then at 10-s intervals, the patient is asked if they are experiencing difficulty breathing.

- Bendopnea was considered present if dyspnea occurred within 30 s of bending.

Bendopnea was present in 28% of subjects and median time to symptom onset was 8 seconds.

Benefit of Intensive weight and symptom monitoring

Monitoring of weight and symptoms do not reduce readmission or death.
The biologically active form of natriuretic peptide is

A. BNP
B. NTproBNP

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**Question**

The biologically active form of natriuretic peptide is

A. BNP
B. NTproBNP

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**Natriuretic peptides**

- Natriuretic peptides (NPs) are released from the heart in response to pressure and volume overload.
- 3 major NPs: atrial natriuretic peptide (ANP), B-type natriuretic peptide (BNP), and C-type NP
- BNP has minimal storage in granules; rather, it is synthesized and secreted in bursts
- BNP and NTproBNP levels are reasonably correlated, and either can be used

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*J Am Coll Cardiol 2007;50:2357-68*
Prognostic significance of Natriuretic peptides

- For BNP, a concentration of ~125 pg/mL represents the inflection point for risk, while it is 1000 pg/mL for NT-proBNP.
- A biological variability of 25% for NT-proBNP and 40% for BNP is more to be expected.
- Largest prognostic value relative to changes in NT-proBNP concentration is observed 2 weeks after a therapy change.

Natriuretic peptide guided HF treatment

In high-risk patients with HFrEF, a strategy of NT-proBNP-guided therapy was not more effective than a usual care strategy in improving outcomes.
The Gheorghiade congestion score

Implantable devices of assessment of volume status

- Implantable rhythm devices
- Implantable hemodynamic monitors (IHM)
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Criterion</th>
<th>Clinical Relevance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid Index</td>
<td>≥60 ohm/days</td>
<td></td>
</tr>
<tr>
<td>AT/AF Duration</td>
<td>≥8 hours &amp; not persistent AT/AF</td>
<td></td>
</tr>
<tr>
<td>V rate during</td>
<td>AT/AF ≥24 hrs &amp; V ≥ 50 bpm</td>
<td></td>
</tr>
<tr>
<td>AT/AF Patient Activity</td>
<td>Avg. ≤1 hr per week</td>
<td></td>
</tr>
<tr>
<td>Night Heart Rate</td>
<td>≥85 bpm for 7 consecutive days</td>
<td></td>
</tr>
<tr>
<td>HRV</td>
<td>&gt;50 ms for 7 consecutive days</td>
<td></td>
</tr>
<tr>
<td>CRT % Pacing</td>
<td>&lt; 90% for 7 of 7 days</td>
<td></td>
</tr>
<tr>
<td>Shock(s)</td>
<td>1 or more shocks</td>
<td></td>
</tr>
<tr>
<td>OR Fluid Index ≥100 ohm/day</td>
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<td></td>
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</tbody>
</table>

**While data from rhythm devices can risk stratify patients, there is no data to use them in guiding treatment.**
Intra-cardiac filling pressure increase predates symptoms of HF by
A. Occurs at the same time
B. 24 hours
C. 7 days
D. 15-30 days

Intracardiac pressures can rise upto 2 weeks prior to HF decompensation

Question

Use of IHM reduce rates of hospital admission for heart failure in NYHA class III patients

CardioMEMS

Lancet 2011; 377: 658-66
Use of IHM
- Has sustained reduction in HF hospitalization in NYHA III patients
- Allows more up titration of HF therapies
- Has benefits in both HFrEF and HFpEF

Lancet 2016; 387: 453–61
Circ Heart Fail 2014; 7:935-944

CardioMEMS

Summary

- Congestion has significant prognostic implications and clinical congestion is only a tip of the iceberg
- Clinical assessment of congestion has significant limitations and may be inadequate to reduce HF hospitalizations.
- Assessment of natriuretic peptides has diagnostic and prognostic significance but cannot be used to guide therapy
- There are a large variety of implantable cardiac devices which can be used to assess intravascular volume status
- IHM guided therapy reduced HF hospitalization in NYHA III HF patients with both HFpEF and HFrEF
Thank You