Right Atrial Dysfunction from Speckle Tracking Strain Echocardiography
Associated with Mortality in Patients with Pulmonary Hypertension
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Background

- Right atrial (RA) size is an established marker for adverse outcomes in pulmonary arterial hypertension (PAH).
- Independent of RA size, RA function is impaired in PAH. However, the prognostic importance on mortality of RA function in PAH is not known.

Objective

- To evaluate the relationship of right atrial dysfunction and mortality in patients with PAH.

Methods

- Patients with an established PAH were enrolled from 2010 to 2014. All the patients underwent right sided focused echocardiography following the same protocol and complaint with the recent American Society of Echocardiography guidelines.
- RA deformation was comprehensively measured using speckle-tracking strain and strain rate echocardiography during each phase of the cardiac cycle as timed to ventricular events. (Figure 1)
- RA reservoir function (Peak longitudinal strain [PLS], peak systolic strain rate [PSSR]; with the time to peak to PLS and to PSSR), RA conduit function (Peak early diastolic SR [PEDSR]; with time to peak to PEDSR), and RA contractility (peak active contraction strain [PACS], peak contraction strain rate [PCSR]; with the time to peak to PACS and to PCSR). Additionally, traditional right sided echocardiographic measurements were included.
- The primary outcome of hospitalization or death was assessed on follow up.

Results

- Of the total 98 patients that were enrolled, 95 were completed.
- 85% were female and mean age was 59.3 ± 13.2 years.
- 94% of the patients had at least functional class II symptoms, with a mean 6-minute walk distance of 353.6 (±132.3) meters.
- The mean (SD) invasive pulmonary vascular resistance was 8.9 WU (±5.5), and 83% of patients were on PAH medications.
- 12.65% died over the median of 3 years during the study period. (Table 1)

Results (Continue)

<table>
<thead>
<tr>
<th>Strain/Strain Rate</th>
<th>Nonsurvivors (mean ±SD) (n= 12)</th>
<th>Survivors (mean ±SD) (n= 83)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA reservoir function</td>
<td></td>
<td></td>
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<tr>
<td>PLS% (1)</td>
<td>35.7±21.0</td>
<td>49.2±22.2</td>
<td>0.009</td>
</tr>
<tr>
<td>Time to PLS (2)</td>
<td>399.9±56.5</td>
<td>419.3±58.9</td>
<td>0.14</td>
</tr>
<tr>
<td>PSSR% (5)</td>
<td>1.791±24.4</td>
<td>1.847±30.9</td>
<td>0.87</td>
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<tr>
<td>Time to PSSR (6)</td>
<td>114.3±49.8</td>
<td>110.4±49.8</td>
<td>0.73</td>
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<tr>
<td>RA conduit function</td>
<td></td>
<td></td>
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<tr>
<td>PEEDSR% (7)</td>
<td>0.86±0.6</td>
<td>0.96±0.6</td>
<td>0.47</td>
</tr>
<tr>
<td>Time to PEEDSR (8)</td>
<td>453.2±130.8</td>
<td>447.9±107.1</td>
<td>0.84</td>
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<tr>
<td>RA active function</td>
<td></td>
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<tr>
<td>PACS% (3)</td>
<td>16.4±9.7</td>
<td>24.8±16.1</td>
<td>0.03</td>
</tr>
<tr>
<td>Time to PACS (4)</td>
<td>664.8±136.5</td>
<td>691.9±105.2</td>
<td>0.36</td>
</tr>
<tr>
<td>PCSR% (9)</td>
<td>1.6±1.0</td>
<td>2.1±1.2</td>
<td>0.06</td>
</tr>
<tr>
<td>Time to PCSR (10)</td>
<td>661.2±180.4</td>
<td>676.1±137.8</td>
<td>0.66</td>
</tr>
</tbody>
</table>

Table 1: Measurements of RA function in survivals versus mortality and PAH

Conclusions

- Impaired right atrial reservoir and active contraction function are associated with mortality in patients with pulmonary arterial hypertension.
- Speckle tracking strain analysis of RA function is a potential useful tool for risk stratification in these patients.

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Figure 1: Comprehensive RA strain, strain rate speckle tracking measurements; Vendor independent, specifically atrial oriented software (Tomtec: KP; YS: Leif; CTF: 2017) ;
1. Peak longitudinal strain [PLS]; 2. Time to PLS; 3. Peak active contraction strain [PACS]; 4. Time to PACS; 5. Peak systolic strain rate [PSSR]; 6. Time to PSSR; 7. Peak diastolic SR [PEDSR]; 8. Time to PEDSR; 9. Peak contraction strain rate [PCSR]; 10. Time to PCSR.