Right Ventricular Strain in Fetal Hypoplastic Left Heart Syndrome: Quantitating Function in the Dominant Chamber

Michelle Pelka, MD\textsuperscript{1}, Minji Kim\textsuperscript{1}, Greggory DeVore, MD\textsuperscript{1}, Mark Sklansky, MD\textsuperscript{1}, Gary Satou, MD\textsuperscript{1}, Yalda Afshar, MD, PhD\textsuperscript{1}

1.University of California, Los Angeles
Background

- Speckle tracking = measures myocardial speckles to assess myocardial deformation
- Myocardial loading conditions are altered when normal cardiac growth and flow patterns are disrupted in utero
- RV function is a major determinant of survival in patients with HLHS
- Fetal myocardial strain abnormalities may improve our understanding of myocardial responses in HLHS
Objective

• To determine RV myocardial deformation by speckle-tracking echocardiography in a cohort of prenatally-diagnosed HLHS.
Study Design

- Retrospective cohort study at a single tertiary referral center
- Thirty-one fetuses with HLHS were compared to 200 controls using the following variables:
  - RV global strain (GLS)
  - Longitudinal fractional shortening (LFS)
  - Transverse fractional shortening (TFS)
- Fetuses were excluded if imaging quality was inadequate

<table>
<thead>
<tr>
<th>Maternal Characteristics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years (SD)</td>
<td>31.2  (4.9)</td>
</tr>
<tr>
<td>BMI, kg/m² (SD)</td>
<td>27.9  (4.6)</td>
</tr>
<tr>
<td>Gestational Age, weeks (range)</td>
<td>29.7  (18.4 – 37.1)</td>
</tr>
</tbody>
</table>
Study Design

GLS, LFS, and TFS were calculated from end-diastolic and end-systolic lengths using 2DST and percent abnormal was determined.
Results

Area of the expected four-chamber view was decreased in 13% of fetuses with HLHS, associated with a decreased width (17%) and length (7%).
Results

The LFS was abnormal (<10\textsuperscript{th} %ile) in 26% of the fetuses with HLHS and GLS was abnormal (>90\textsuperscript{th} %ile) in 20% of the fetuses with HLHS when compared to controls.

**Figure 1:** Longitudinal displacement in the ventricle of a fetus with HLHS. The yellow square represents the septal wall. The blue line represents end-diastolic length, and the red line represents end-systolic length.

<table>
<thead>
<tr>
<th>RV Global Longitudinal Indices</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Longitudinal Strain</td>
<td>20*</td>
</tr>
<tr>
<td>Basal-Apical Length Fractional Change</td>
<td>26†</td>
</tr>
</tbody>
</table>

* >90\textsuperscript{th} centile
† <10\textsuperscript{th} centile
Results

The RV apical end-diastolic TLS was decreased in 35% of HLHS fetuses, with the mid-segments (0%) and the base-segments (10%) demonstrating a lower incidence than the apical-segments of the ventricle.

<table>
<thead>
<tr>
<th>RV Segmental Transverse Indices</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter Fractional Shortening &gt; 1SD</td>
<td></td>
</tr>
<tr>
<td>Apical (Seg 1-8)</td>
<td>36</td>
</tr>
<tr>
<td>Mid-Segments (Seg 9-16)</td>
<td>0</td>
</tr>
<tr>
<td>Base (Seg 17-24)</td>
<td>9.7</td>
</tr>
</tbody>
</table>
Results

Correlation between the LFS and GLS was 0.89 for the morphologic RV
Conclusion

• RV strain as measured by speckle-tracking echocardiography is abnormal in HLHS.
• The LFS in the systemic RV is significantly correlated with GLS.
• Prenatal assessment of RV function in HLHS may aid postnatal care of this complex congenital heart lesion.
Quantitating Right Ventricular Strain in Fetal Hypoplastic Left Heart Syndrome

Michelle Pelka, MD, Minji Kim, Gregory DeVore, MD, Mark Sklansky, MD, Gary Satou, MD, Yalda Afshar, MD, PhD

Background
- Speckle-tracking / strain echocardiography measures myocardial deformation.
- Myocardial deformation has demonstrated abnormal ventricular mechanics in congenital heart disease.
- Right ventricular (RV) function is a major determinant of survival in patients with hypoplastic left heart syndrome (HLHS).

Objective
We sought to determine RV myocardial deformation by speckle-tracking echocardiography in a cohort of prenatally diagnosed HLHS. Specifically, we measured global longitudinal strain (GLS) and longitudinal displacement fractional shortening (LFS) as a surrogate to postnatal sequelae.

Study Design
- Retrospective cohort study of fetuses with HLHS at single tertiary referral center.
- RV GLS and LFS were calculated from end-diastolic and end-systolic lengths using 2DSTE and percent abnormal was determined. Abnormal GLS defined as z-score >90th and abnormal LFS was defined as z-score <10th.
- RV segmental transverse strain was calculated from end-diastolic and end-systolic transverse diameter fractional shortening at the apical (segments 1-8), mid-segment (segments 9-16), and base (segment 17-24) of the RV.
- Fetuses were excluded if imaging quality was inadequate.

Results
- Thirty-one HLHS fetuses were compared to 200 controls.
  - Area of the expected four-chamber view was decreased in 13% of fetuses with HLHS, associated with a decreased width (17%) and length (7%).
  - Correlation between the LFS and GLS was 0.89 for the morphologic RV.
  - The LFS was abnormal (>90th %) in 26% of the fetuses with HLHS and GLS was abnormal (>90th %) in 20% of the fetuses with HLHS when compared to controls.
  - The RV apical end-diastolic widths were decreased in 35% of HLHS fetuses, with the mid-segments (0%) and the base-segments (10%) demonstrating a lower incidence than the apical-segments of the ventricle.

Questions?
Take a picture of this QR code to access the poster or email Dr. Michelle Pelka at mpeika@mednet.ucla.edu

Conclusion
- RV strain as measured by speckle-tracking echocardiography is abnormal in HLHS.
- The LFS in the systemic RV is significantly correlated with GLS.
- Prenatal assessment of RV function in HLHS may aid postnatal care of this complex congenital heart lesion.
Questions?
mpelka@mednet.ucla.edu