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

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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

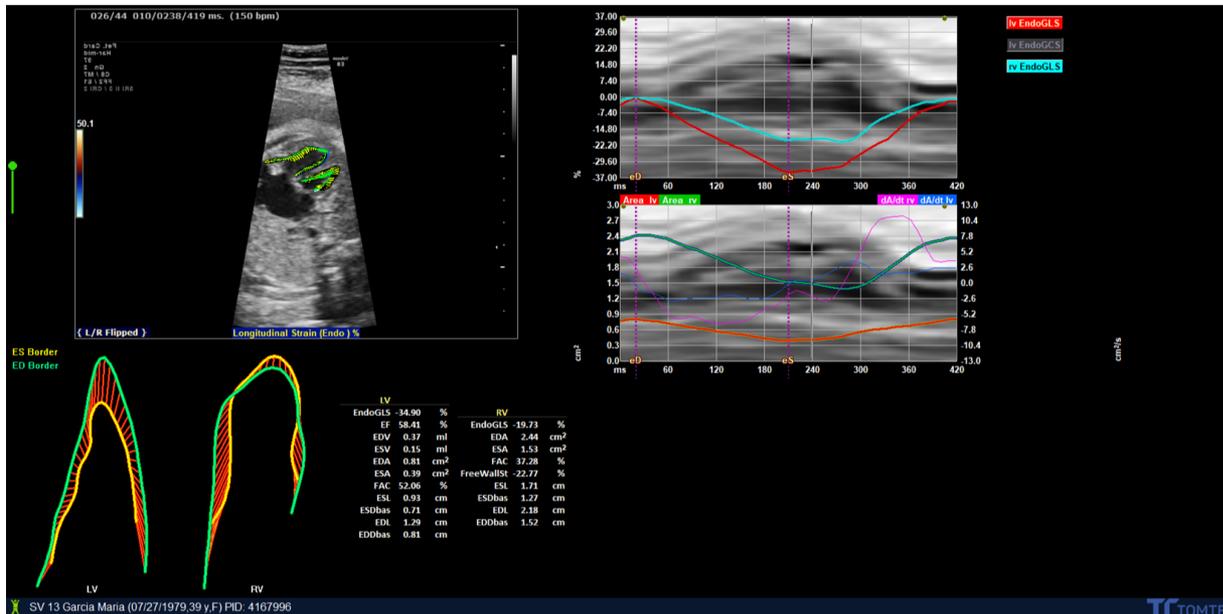
Maternal Characteristics

| | |
|--------------------------------|--------------------|
| Age, years (SD) | 31.2 (4.9) |
| BMI, kg/m ² (SD) | 27.9 (4.6) |
| Gestational Age, weeks (range) | 29.7 (18.4 – 37.1) |



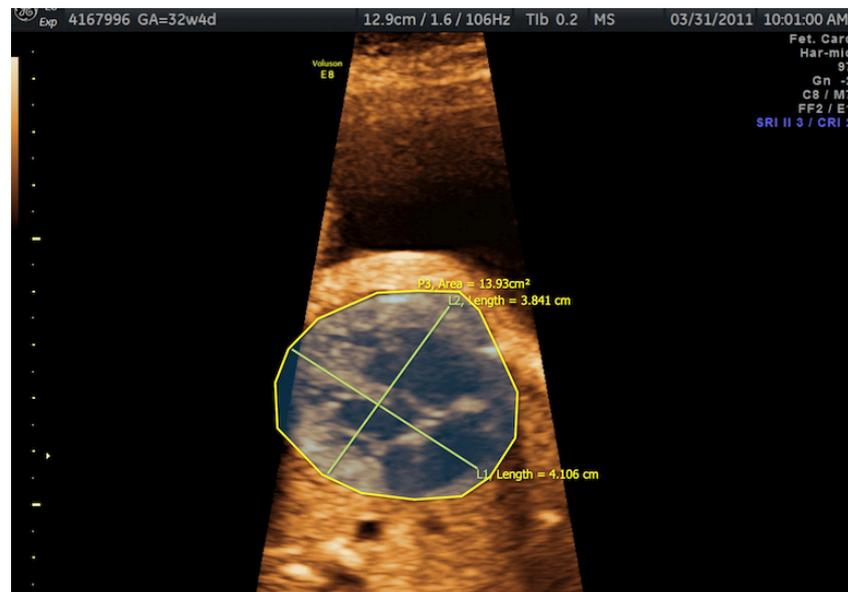
Study Design

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

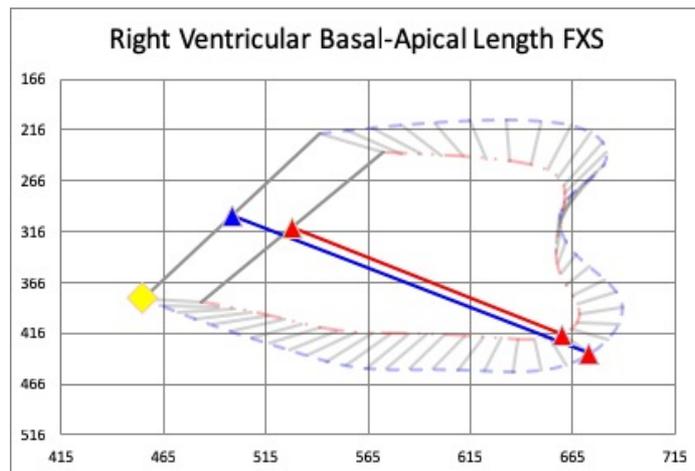


Figure 1: Longitudinal displacement in the ventricle of a fetus with HLHS. The yellow square represents the septal wall. The blue line represents end-diastolic length, and the red line represents end-systolic length

| RV Global Longitudinal Indices | (%) |
|---------------------------------------|------------|
| Global Longitudinal Strain | 20* |
| Basal-Apical Length Fractional Change | 26† |

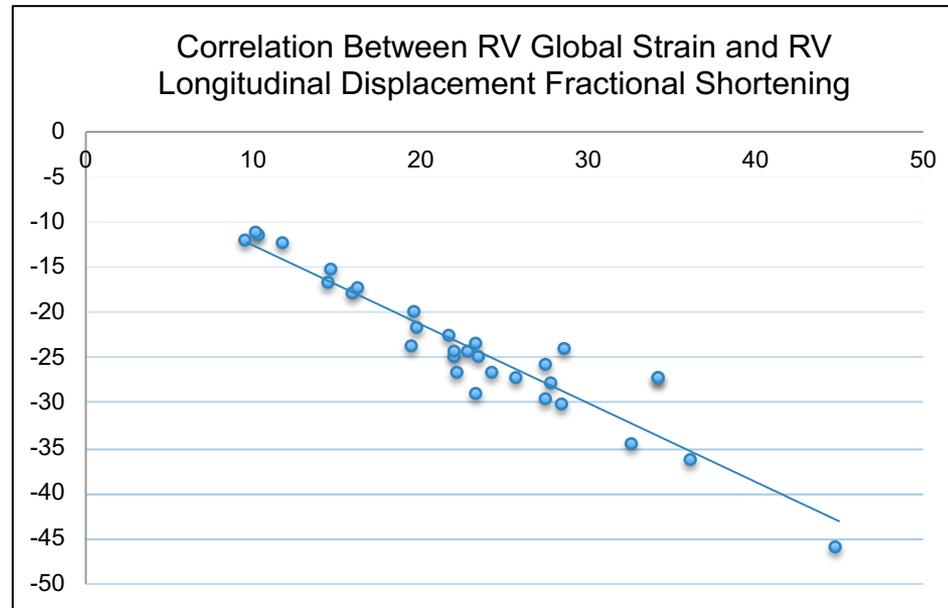
*>90th centile
†<10th centile

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.

| RV Segmental Transverse Indices | (%) |
|--|------------|
| Diameter Fractional Shortening > 1SD | |
| Apical (Seg 1-8) | 36 |
| Mid-Segments (Seg 9-16) | 0 |
| Base (Seg 17-24) | 9.7 |

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.

Background

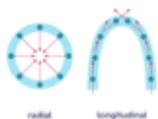
- Speckle-tracking / strain echocardiography measures myocardial deformation.
- Myocardial deformation has demonstrated abnormal ventricular mechanics in congenital heart disease.
- Right ventricular (RV) function is a major determinant of survival in patients with hypoplastic left heart syndrome (HLHS).

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 2DST and percent abnormal was determined. Abnormal GLS defined as z-score >90%ile and abnormal LFS was defined as z-score <10%ile.
- 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 (<10th %ile) in 26% of the fetuses with HLHS and GLS was abnormal (>90th %ile) 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.

Right ventricular myocardial strain is **abnormal** in fetuses with **hypoplastic left heart syndrome**, as determined by 2D speckle tracking



Questions?

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

| Maternal Characteristics | |
|--------------------------------|------------------|
| Age, years (SD) | 31.2 (4.8) |
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| Global Longitudinal Strain | 20* |
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| *90 th centile | |
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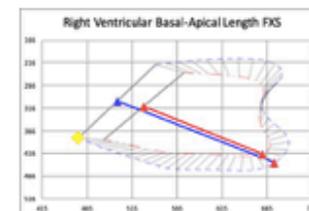


Figure 1: Longitudinal displacement in the ventricle of a fetus with HLHS. The yellow square represents the apical wall. The blue line represents end-diastolic length, and the red line represents end-systolic length.

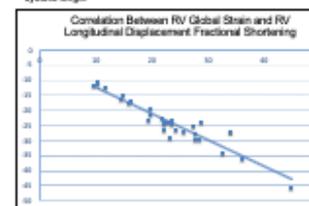


Figure 2: Correlation analysis between RV global strain and RV longitudinal displacement in fetuses with HLHS.

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.



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