Right Ventricular Tissue Doppler in Space Flight

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Space Normal Right Ventricle
Background

- First Right-Venticle Tissue Doppler from ISS
- Subset of data from SDTO “Bracelet-M”
- Russian Countermeasure
  - Medical prevention strategy for reducing fluid shifts in microgravity in long-duration crew
  - Acute change in effective circulating volume
Physiology of the Right Ventricle

- Transpulmonary gradient of 5 mmHg to drive blood flow across pulmonary circulation
- RV contraction peaks early in systole (brief) drops rapidly
- RV ejection into a low-impedance pulmonary circulation
- RV diastolic volume 20-30% > LV despite lower diastolic pressure
- Compliant
Imaging difficulties

- Difficult to assess mass & volumes due to geometry
Methods

- Remote Guidance
  - Communication 1.8- to 2-second delay between operator on board the ISS and expert instruction mission control.
- Operator
  - Astronaut on colleague astronaut crewmembers
  - Operators utilizing a self-scanning technique
- Nine sessions with and without Braslet
Tissue Doppler spectrum registers movement of a given sample of cardiac tissue throughout the cardiac cycle.
RV Tissue Doppler

Systolic Velocity

Early Diastolic

Late Diastolic
Rt Tei Index

- IVCT + IVRT / ET
- Myocardial Performance

Summary of Results

Space Normal % Change Right Ventricle Parameters after Preload Reduction

<table>
<thead>
<tr>
<th></th>
<th>S'</th>
<th>E'</th>
<th>A'</th>
<th>IVCT</th>
<th>ET</th>
<th>IVRT</th>
<th>Rt Tei</th>
<th>HR</th>
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<tbody>
<tr>
<td>% CHANGE</td>
<td>-30</td>
<td>-25</td>
<td>-20</td>
<td>-15</td>
<td>-10</td>
<td>-5</td>
<td>0</td>
<td>5</td>
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The chart shows the percentage change in various right ventricle parameters after preload reduction.
Summary

- Unique data: acute preload change on RV
- Space Normal Tei index larger in microgravity than normal Tei index (< 0.3)
- Tissue Doppler can be performed by crew with high fidelity
- Need larger sample for better fidelity on Space Normal RV function
- More image data for RV Mass and Volume