Right Ventricular Tissue Doppler in Space Flight

Kathleen M. Garcia, B.S.
Douglas R. Hamilton, M.D., PhD
Michael R. Barratt, M.D.
Ashot E. Sargsyan, M.D.
Douglas Ebert, PhD

David S. Martin, B.S.
Valery V. Bogomolov, M.D., PhD
Scott A. Dulchavsky, M.D., PhD
J. Michael Duncan, M.D.
Space Normal Right Ventricle
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

- 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
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