Comparing Intra-Operative Left Ventricular Contractility Measurements: Echocardiogram vs. Novel Software

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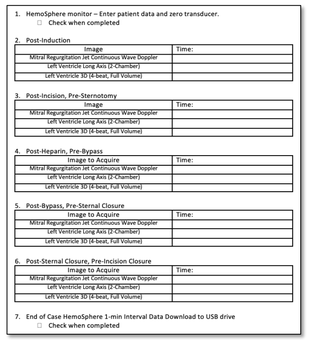
BACKGROUND

- The contractility of the left ventricle (LV) is an important determinant of cardiac function
- Measured as dP/dt_{max}, the maximum rate of left ventricular pressure change during isovolumetric contraction
- Direct measurement involves invasive catheter placement, but can measure indirectly with echocardiogram [1]
- More recently, arterial pressure waveform analysis proposed as a new method of determining dP/dt_{max} [2-5]
- In the OR, the Hypotension Prediction Index (HPI) software is a new technology that predicts impending intraoperative hypotensive episodes
- The HPI provides a calculated dP/dt_{max}, determined from the radial arterial pressure waveform
- Recent study has demonstrated significant correlation between the HPI radial arterial dP/dt_{max} values to those calculated using echo in patients with acute heart failure in the cardiac ICU setting [5]

OBJECTIVES

1. Determine how well correlated dP/dt_{max} as calculated by the HPI software is to dP/dt_{max} as calculated by TEE
2. Secondarily, evaluate correlations between three methods of measuring cardiac ejection fractions (Fractional Area Change, Simpson's Method of Disks, and 3D reconstruction) and their respective correlations to dP/dt_{max}

METHODS



1. HemoSphere monitor – Enter patient data and zero transducer.
   ☐ Check when completed

2. Post-Induction

Image	Time:
Mitral Regurgitation Jet Continuous Wave Doppler	
Left Ventricle Long Axis (Z-Chamber)	
Left Ventricle 3D (4-beat, Full Volume)	

3. Post-Incision, Pre-Sternotomy

Image	Time:
Mitral Regurgitation Jet Continuous Wave Doppler	
Left Ventricle Long Axis (Z-Chamber)	
Left Ventricle 3D (4-beat, Full Volume)	

4. Post-Heparin, Pre-Bypass

Image to Acquire	Time:
Mitral Regurgitation Jet Continuous Wave Doppler	
Left Ventricle Long Axis (Z-Chamber)	
Left Ventricle 3D (4-beat, Full Volume)	

5. Post-Bypass, Pre-Sternal Closure

Image to Acquire	Time:
Mitral Regurgitation Jet Continuous Wave Doppler	
Left Ventricle Long Axis (Z-Chamber)	
Left Ventricle 3D (4-beat, Full Volume)	

6. Post-Sternal Closure, Pre-Incision Closure

Image to Acquire	Time:
Mitral Regurgitation Jet Continuous Wave Doppler	
Left Ventricle Long Axis (Z-Chamber)	
Left Ventricle 3D (4-beat, Full Volume)	

7. End of Case HemoSphere 1-min Interval Data Download to USB drive
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Figure 1. Data Collection Sheet

Figure 2. HemoSphere

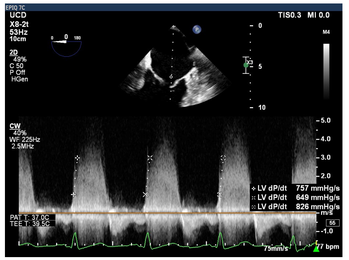

Figure 3. Continuous Wave Doppler on Mitral Regurgitant Jet with dP/dt

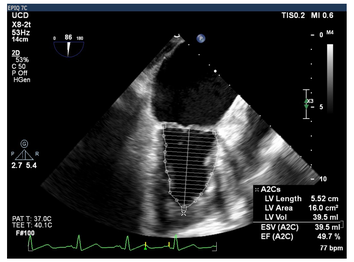

Figure 4. Left Ventricular Long Axis (Systole)

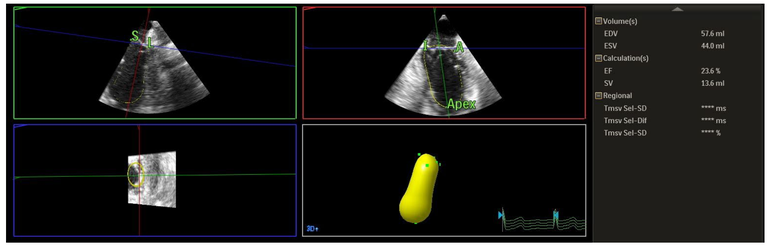

Figure 5. Left Ventricle 3D Reconstruction

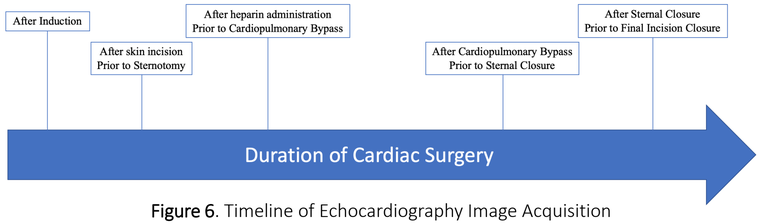

Figure 6. Timeline of Echocardiography Image Acquisition

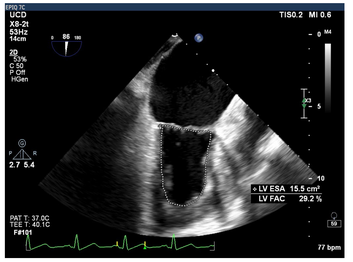

Figure 7. Fractional Area Change EF Calculation (Systole)

RESULTS

- Due to unforeseen delays, patients have only begun to be recruited for this study
- Pilot trial runs have been completed to assure quality and feasibility of study with good results

CONCLUSIONS

- Currently too early in data collection process for definitive conclusions
- Hopeful that analysis of data collected from this study can be used to evaluate accuracy and precision of a newer method of dP/dt_{max} measurement
- Further corroboration of the reliability of this newer method and quantifying the correlations in different clinical settings will hopefully allow for more accurate and efficient measurement of dP/dt_{max} in a larger number of settings in the future

REFERENCES

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4. Garcia, Manuel Ignacio Monge, et al. "Performance Comparison of Ventricular and Arterial DP/Dtmax for Assessing Left Ventricular Systolic Function during Different Experimental Loading and Contractile Conditions." Critical Care, vol. 22, no. 1, 2018, doi:10.1186/s13054-018-2260-1.
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Fig 3 from https://www.edwards.com/gb/devices/hemodynamic-monitoring/hemosphere