Use of a Blood Substitute to Determine Instantaneous Murine Right Ventricular Thickening With Optical Coherence Tomography

Marc D. Feldman, Joseph W. Villard, Jeehyun Kim, Thomas E. Milner, Gregory L. Freeman, University of Texas Health Science Center, San Antonio, Texas, University of Texas Biomedical Engineering Program, Austin, Texas.

Background: A satisfactory imaging technique to determine regional wall thickening of the murine myocardium is not available. Although cardiovascular imaging with light offers a novel solution, application is problematic because scattering by RBC's causes optical attenuation.

Methods and Results: Optical Coherence Tomography (OCT) is a technique for high resolution imaging of biological tissues. To reduce scattering, murine blood was replaced with a hemoglobin-based blood substitute. The scattering and absorption properties of in vitro preparations of whole blood and dilutions of blood with a blood substitute were determined with a spectrophotometer. A reduction in light scattering occurred at a hematocrit less than 5%.

A fiber-optic OCT imaging system was used to image the murine RV before (Figure above) and after (Figure below) isovolumic replacement with blood substitute (n=6). Light attenuation prevented full thickness imaging before replacement, while visualization of the full ventricular thickness was possible after replacement. Baseline and imaging hematocrits were 52.4 ± 3.8% and 3.7 ± 1.2%. End systolic and diastolic thickness values were 0.458 ± 0.051 mm and 0.352 ± 0.047 mm. Percent thickening fraction was 30.8 ± 7.5%.

Conclusion: Optical imaging of the intact beating murine RV was substantially improved by isovolumic blood replacement with a hemoglobin-based blood substitute. A blood substitute may also be applied to other optical techniques under investigation in cardiology.

Three-Dimensional Reconstruction of Coronary Arteriole Plexus Image by Contrast Echocardiography Using High Frequency Transducer

Fuminobu Ishikura, Syunichi Kashiwagi, Sachiko Yagura, Kenntaro Ohtani, Jyud Okazaki, Hideo Hiyama, Toshihiko Asanuma, Akiko Iwata, Tatsuya Kawagishi, Yoshitsuka Mine, Shintaro Beppu, Osaka University, Suita, Japan, Toshiba Corp., Tokyo, Japan.

Background: Real time myocardial contrast echocardiography (MCE) may visualize fine anatomy of coronary microcirculation. But resolution is limited because of low frequency of the transducer having second harmonic mode.

Purpose: The aim of this study was to examine the efficacy of newly developed high frequency linear probe for fine quality MCE.

Methods: A new high frequency linear transducer for harmonic imaging (4.2/8.0 MHz) was set to Toshiba SSA-770A (Aplio). Real-time myocardial perfusion image with low mechanical index (0.1) and intermittent flash image with relatively high MI (0.4) was recorded on the dual display during infusion of Definity in 5 open chest dogs. As arteriole plexus was demonstrated by flash imaging, simple 3-D image was easily and quickly obtained as shown in a figure.

Conclusion: A new high frequency transducer could demonstrate fine and clear opacification image which could not be obtained by conventional probes. Although 3-D reconstruction image was simple and easy, it might provide a new information about coronary arterioles.