AbstractID: 4161 Title: Imaging Ultrasound Contrast Agents

Purpose:
Existing Doppler ultrasound techniques are capable of detecting blood flow in large vessels with velocities high enough (>3 cm/sec) to enable removal of tissue signals. Microbubble ultrasound contrast agents can be administered intravenously to increase the backscatter from blood. The nonlinear behavior of ultrasound contrast agents enable discrimination from tissue both nearly stationary microbubbles in the microcirculation and higher velocity microbubbles in the larger vasculature. The visualization of blood flow in both the macro- and micro-circulation has been used to assess organ function and characterize tumors.

Method and Materials:
Imaging techniques for ultrasound contrast agents have been developed utilizing both the nonlinear and transient nature of contrast agents. These techniques are based on detecting microbubble nonlinear responses to the acoustic field of diagnostic ultrasound. Different multi-pulse transmit sequences will be described that have been used detect the nonlinear activity of the microbubbles (harmonic imaging, pulse inversion, amplitude modulation, and coded excitation). Only low amplitude acoustic fields may be used for interrogation to avoid bubble destruction and enable continuous contrast agent imaging. The difficulties of detecting nonlinear activity with low excitations are addressed. Doppler imaging techniques are used in cases where transient properties of contrast agents are to be imaged. With these techniques high acoustic amplitude is used to intentionally destroy the contrast microbubbles and form an image. Once the bubbles in a region are destroyed, the user must wait for the area to be replenished before forming another image or move to a new imaging plane.

Results:
While destruction techniques have an excellent signal to noise ratio (SNR), clinical use is difficult due to the destruction of contrast agent. Nonlinear imaging techniques are clinically easier to use, but suffer from SNR and are often penetration limited. A number of different ultrasound contrast agents have been approved for clinical use in Europe and Asia and are in the Federal Drug Administration approval process in the US. Most these contrast agents can be imaged in real-time using the nonlinear imaging techniques.

Conclusion:
Ultrasound contrast agents can be used to image blood flow in both the micro- and macro- circulations. Clinical examples of imaging ultrasound contrast agent with both low and high amplitude techniques will be presented for both radiology and cardiology applications.

Conflict of Interest (only if applicable):