AIUM/QIBA
Ultrasound Volume Blood Flow Biomarker

MINUTES 2016-09-12

Attendance:

K. Akaki, M. Bruce, D. Cosgrove, V. Devaraju, D. Dubberstein, T. Erpelding, B. Fowlkes, J. Zagzebski, A. Hall, T. Hall, O. Kripfgans, R. Leichner, M. Lockhard, T. Lynch, Andy Milkowski, K. Minton, J. Rubin, S. Chen, R. Tadross, M. Trew

I. Meeting Minutes review

This review also included discussion of the QIBA Data Set Description, included as Appendix I in the minutes as well as discussion of the initial Prototype Phantom testing results, which were included as Appendix II in the previous minutes.

Straight tube: 6% error for 70 to 700 mL/min constant flow, 12% error 30 to 350 mL/min for pulsatile flow; **curved tubing in 3D**: constant flow, up to 530 mL/min, max 23%; **stenosis**: constant flow, 50 to 450 mL/min, in stenosis 26% error, post stenosis 10% error.

Setting is 5 to 6 cm depth, 5 mm diameter tubing, 3 MHz color flow center frequency. Michigan requested discussion on the possibility to raise the color flow center frequency to 5 or 6 MHz. This is not to spatially resolve turbulence, but to achieve a certain number of image voxels across the lumen. In the past it has been the case that at least 4 voxels of 100% blood had to exist within the lumen in every condition.

II. Phantom production schedule and modifications

1. Prototype phantom was tested and largely corresponds to what the in vivo setting would be. Gammex will complete the specifications for the latest agreed upon changes and start phantom production soon.
2. The committee debated if the current tubing size is adequate or if it should be increased from 5 mm to a larger diameter. The committee decided to *keep* main tube size and for increased utility seek to include an additional section of tubing with a larger diameter (4-5 mm diameter) to simulate arterial venous fistulas (AVF). This section should also contain a stenosis of x% reduction in area, x to be defined. The entire section should be less than 0.69 cm below the surface (anterior wall of lumen to skin surface). Gammex predicts that adding more tubing will pose more load on the system (pump load and spatial crowding) and is a challenge. Producing a separate phantom would be easier. A compromise is to bring the looping tube section to within 0.69 cm of the surface.
3. A volumetric flow rate approaching 1 L/min would be advantageous for use in simulating AVF. It was therefore discussed if an increase in flow pump capacity is possible. No conclusion was drawn and the discussion routed to offline.

III. Data acquisition times

Total of 7 hour data acquisition for a mixture of parametric study (flow speeds) as well as measurements on different tubing sections, 60 data points, 20-30 acquisitions per data point. ½ day for setup as well as ½ day for tear down. The experiment can sit overnight to break acquisition between days.

Need to create a draft data collection and schedule document.

Appendix I
Round Robin Guidelines

QIBA Volume Flow Protocol

Objective

The objective of this protocol is to provide minimal but uniform instructions to QIBA committee partners engaging in the proposed Round-Robin phantom study. The objective of the QIBA study is to further standardization of quantitative volumetric flow and find sources of error and bias in quantitative volumetric flow estimation.

Protocol

The following setup instructions are meant to guide the user minimally, yet prevent obvious sources or bias or error.

1. Setup flow phantom and ultrasound machine for color flow and locate the flow tube.
2. Specifically set the PRF to the lowest setting where no alias is seen, then add 3 more clicks.
3. Specifically set the receive gain to fill the entire vessel. Error on to high receive gain, *i.e.* blooming.
4. Specifically set the wall filter to its minimum.
5. Calibrate the forthcoming measurements, i.e. validate the phantom
    a. For speed of sound calibration purposes, record the deepest vessel location (TBD) and perform cross-sectional, *i.e.* diameter measurement. This is to determine the correct speed of sound of the phantom. Also confirm that the used imaging mode on the scanner is based of 1540 m/s speed of sound to assure proper beam forming.
    b. For flow calibration purposes record straight tubing section first for low, medium and high flow, *i.e.* 1, 6, and 12 mL/s (60, 360, and 720 mL/min). Use this range calibration to validate the condition of the flow pump of the phantom.
6. Choose 3D c-plane and align the focus to that c-plane.
7. Record at least 10 full volumes for each pump setting (1 to 12 mL/s in steps of 1 mL/s and in accordance with the QIBA proposal, i.e. limited to flow rates of less than ±10% calibration error).
8. In a randomized order, record data for all pump settings.

Store data on QIBA data warehouse site for full access by other QIBA volume flow participants.

Return ultrasound machine and flow phantom to UM investigators.