AIUM/QIBA
Ultrasound Volume Blood Flow Biomarker

Summary – 06-May-2024

Attendees: Brian Fowlkes, Oliver Kripfgans, Tim Hall, Haylea Weiss (AIUM), Jonathan Rubin, Jing Gao, Stephen Pinter, Jim Zagzebski, Megan Russ, Ted Lynch

Quick recap

The team discussed various ongoing projects, the need for revising outdated IEC standards, and the design and performance for testing profile. They also addressed data analysis and measurement issues, as well as the impact of parameters on measurements. Lastly, they focused on improving the accuracy of measurements and specifications for flow phantoms.

Next steps

• Brian F. will investigate and address the discrepancy in the tube diameter specification in the profile. This will need to be changed in the profile.
• The team will consider contributing to resolving the issues with the IEC flow standards and consider revisiting the test object (phantom) to examine specifications and improved performance.
• The team will reconvene on July 1st to discuss progress and next steps.

Summary

Team Roll Call and Attendance Discussion

The team gathered for a discussion led by Brian Fowlkes. See list of attendees above. The previous call summary was made available in a dropbox. Brian noted that confidential information should not be shared outside of the group.

Project Updates and Data Analysis Discussion

Brian discussed the progress of various projects and issues. He also mentioned plans to collect more data for the resistive index assessment in the QIBA phantom, and to write an appendix on the analysis of pulsatile flow data. The UM team is considering the development of a standalone application for data analysis, but this is still in the early

stages. Brian also mentioned the need for multiple sites to demonstrate the technical feasibility of a profile, and the challenges of collecting and processing data. Finally, Brian brought up outstanding items regarding the backscatter for blood mimicking fluid and the need for a protocol for making measurements.

Ongoing Projects and Revisioning Standards
Brian discussed various ongoing projects including the determination of the backscatter coefficient and additional analysis for reference 24. There was also mention of a potential source of information for pulsatile flow parameters from a carotid study. Furthermore, Brian addressed the need to revisit existing standards related to flow measurements at the IEC, particularly the standards for pulse wave and color flow imaging. These standards, last updated around 2000, were deemed outdated and in need of revision, considering their relevance to the volume flow profile and the AAPM Task Group 353. Lastly, Brian highlighted an ongoing issue regarding the backscatter coefficient related to tissue mimicking fluid in the current profile.

Device Design and Velocity Measurement Discrepancies
Brian presented the frequency range and design specifications for the first edition of IEC standards a flow phantom and pulse wave technology evaluation. The phantom, designed for analyzing blood vessel size and depth effects within a frequency range of 2-10 MHz and has a velocity measurement uncertainty of no more than 5% with a 95% confidence level. However, data from the TG 353 activities shows discrepancies between expected velocities and actual measurements across different platforms and transducers, with a systematic underestimation for a 5mm vessel and an overestimation for a 5.5mm vessel. There is also need to investigate the impact of the 10% variance in tube diameter on velocity measurements.

Tube Diameter, Peak Velocity, and Calibration
The team discussed the impact of tube diameter on peak velocity at different flow rates, focusing on potential discrepancies caused by hydrodynamic effects and calibration issues. It was suggested that a calibration method using volume collection for more accurate measurements to address inconsistencies between peak and mean velocities. Megan presented data on the dependence of peak velocity on receive gain for three different transducer types, noting the occurrence of saturation and the curvilinear transducer's lower saturation point. Jim questioned Megan's expectation of the data dropping off to 20 cm per second. The team agreed on the need to check the acceptance testing on flow phantoms despite the challenges due to the system dependent setup and measurements.

Addressing Measurements and Data Analysis Issues
Megan and Jim discussed concerns regarding the measurements and data analysis, particularly focusing on the L 12-5 transducer. They identified issues with the degree of saturation affecting the data, a systematic underestimation and overestimation, and the non-uniformity of the spectrum. They also compared the performance of the curvilinear transducer with linear ones, noting the former's superior performance, although the reasons were not clear. Lastly, they discussed challenges with high frequency transducer, the problematic aspects of reaching the true peak expected in the phantom, and the

potential impact of particle size on their findings. Ted Mentioned the potential that the flow might not go to zero at the walls due to finite particle size. A decision was made to examine the real velocity profile by taking a small sample volume and moving it systematically across the vessel. Additionally, Brian expressed the intention to present a comparison table between the phantoms at the end of the discussion.

Tissue Mimicking Materials and Phantoms
Brian discussed the parameters for tissue mimicking materials (BMF and background) in phantoms and highlighted the need to understand what the industry and end-users require for making measurements. He mentioned the need to review the literature for gaps and to consider updates. He also presented a tabular comparison between the volume flow of biomarker parameters and the parameters in the current IEC documents. The discussion focused on sound velocity, density, acoustic impedance, and backscatter coefficient, with specific comments regarding the backscatter coefficient measurement. Brian suggested that volunteers from the call might be interested in this activity to help resurrect the IEC color flow standard.

Flow Phantom Measurement and Specification Uncertainties
The group discussed the potential errors and uncertainties in measurements and specifications of a flow phantom, specifically regarding viscosity and diameter. They agreed that higher viscosity could aid in achieving parabolic flow more quickly, while the specified diameter tolerance was found to be too tight, leading to an action item for profile modification. The accuracy of volume flow rate and vessel size were also identified as influencing overall measurement accuracy. Lastly, it was decided to skip the June meeting, with the next one set for July 1st, and an email with updates was promised to be sent soon.

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