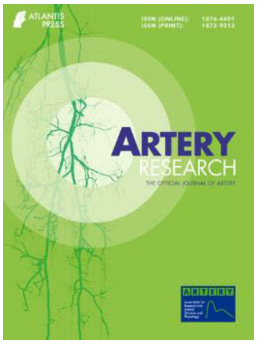

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P2.21: COMPLEXITY OF 3D CAROTID BIFURCATION BLOOD FLOW PATTERNS IS NOT ADEQUATELY CAPTURED BY CURRENTLY USED ULTRASOUND MODALITIES

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P2.19

VALIDATION OF A NEW SYSTEM FOR THE ASSESSMENT OF FLOW MEDIATED DILATION: COMPARISON WITH A REFERENCE METHOD

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Endothelial function is linked to cardiovascular risk factors, provides prognostic information when studied non-invasively by measurement of flow-mediated dilation (FMD). Despite the large effort to standardize the methodology, the FMD examination is still characterized by problems of reproducibility and reliability that can be overcome with the use of automatic systems. In our lab, we developed a system for the assessment of brachial FMD from ultrasound images which is able to automatically evaluate the brachial artery diameter in real-time. In order to validate our system, we carried out a comparison with another automatic method, available at the Vascular Physiology Unit of the Institute of Child Health (London), that it is considered as a reference method in FMD assessment. Two protocols have been followed in order to evaluate the agreement between the systems.
Protocol 1: 47 VCR recorded FMD sequences have been analyzed. Mean baseline (Basal), maximal (Max) brachial artery diameter and FMD, as maximal percentage diameter increase (%FMD) have been evaluated for each sequence.
Protocol 2: brachial artery diameter (Diam) has been evaluated in 618 frames from 12 sequences. Diam value and %FMD have been considered for each frame. Bland-Altman analysis has been used. As shown in the table, the bias is negligible and the SD of the differences is satisfactory. In conclusion, the compared systems show a optimal grade of agreement and they can be used interchangeably. Thus, the use of a system characterized by real-time functionalities would represent a referral method for assessing endothelial function in clinical trial.

	PROTOCOL 1			PROTOCOL 2	
	Basal	Max	%FMD	Diam	%FMD
Mean of Diff.	-0.014 mm	-0.024 mm	-0.31 %	-0.093 mm	-0.26 %
SD of Diff.	0.028 mm	0.037 mm	0.58 %	0.028 mm	0.61 %

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P2.20

ASSESSMENT OF THE CAROTID DIAMETER AND INTIMA-MEDIA THICKNESS FROM ULTRASOUND DATA: COMPARISON BETWEEN TWO METHODS

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The aim of this study was to compare a new device for the automatic evaluation of carotid diameter (D) and intima-media thickness (IMT) from ultrasound B-mode image sequences, with a RF echotracking system (RFES). A total of 90 scans of the right/left common carotid artery from 21 patients with various cardiovascular risk factors and 12 healthy volunteers were analysed. The measurements were performed in real-time by using the two systems sequentially. Different Regions of Interest (ROI) were adopted, as our device best works on 1cm width ROI and the other on 4cm width ROI; a subgroup of scans (31) were analyzed using the same ROI width for the two systems. Moreover, on the healthy volunteers the analysis was repeated twice with each device in order to evaluate the intraobserver variability.
The agreement between the two systems was evaluated by Bland-Altman analysis; the bias and the standard deviation were 0.100mm and 0.190mm for D and 0.003mm and 0.057mm for IMT respectively. Moreover, in the subgroup where the same ROI width was adopted the bias and the standard deviation were: 0.060mm and 0.110mm for D and -0.006mm and 0.039mm for IMT. The coefficients of variation of the intraobserver measurements were: 2%±2% (D) and 5%±5% (IMT) for the RFES and 2%±1% (D) and 6%±6% (IMT) for our device.
In conclusion, although it is common opinion that B-mode based devices have lower precision than the RF based ones, our system shows reproducibility comparable to that of the RFES and good agreement with it.

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P2.21

COMPLEXITY OF 3D CAROTID BIFURCATION BLOOD FLOW PATTERNS IS NOT ADEQUATELY CAPTURED BY CURRENTLY USED ULTRASOUND MODALITIES

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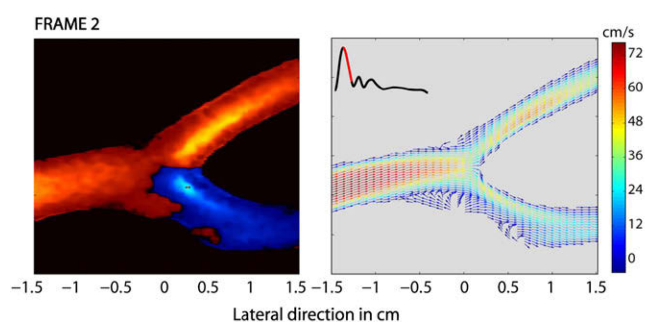
Background: Ultrasound is still the preferred method for non-invasive investigation and blood flow visualization in the carotid artery, using pulsed Doppler and color flow imaging. These techniques are widespread, and data are often displayed in a (color-coded) format allowing easy interpretation. Nevertheless, in currently applied techniques, not all aspects of blood flow are captured, especially in regions with complex anatomical shapes such as the carotid bifurcation, and when flow is further complicated by presence of plaque.
Methods and Results: We developed a 3D anatomically correct computer model of a carotid bifurcation with plaque, and calculated the complex flow field using numerical techniques (CFD; Computational Fluid Dynamics). Next, we coupled these data to an ultrasonic model (Field II) allowing simulation of ultrasound data based on the computed flow field. The pulsed Doppler simulations showed good agreement between the ultrasound velocities and the computed flow field. Simulated color flow images demonstrated that flow patterns are generally well obtained but that vortex formation in the bifurcation, internal carotid artery and downstream of the plaque are not easily discernable. These results were also confirmed in an experimental validation study.



Discussion: Currently used ultrasound imaging modalities have important limitations to assess complex flow in the carotid artery. This complicates the use of these images to extract quantitative data related to flow such as wall shear stress. This virtual ultrasound environment is a powerful tool to assess limitations of currently used ultrasound imaging modalities and to develop new algorithms of upcoming techniques such as 3D ultrasound.

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P2.22

COMPARING COMPUTATIONS OF VASCULAR WALL PARAMETERS IN THE ABDOMINAL AORTA (AO) BASED ON PRESSURE CURVE FORMS FROM THE AO AND BRACHIAL ARTERY

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With aid of the pulse pressure and radius wave form of the AO as input to a mechanical model, a set of aortic wall parameters can be identified describing different properties of the aortic wall, e.g. elastin, collagen content and distribution. This makes it possible to perform a deeper analysis of the components in the wall and the acting forces (VaMoS) [1]. To facilitate the use of VaMoS it would be preferable to use a more accessible arterial pressure wave form as indata. The aim was to test if pressure curves taken