

Measurement of the Aortic Pulse Wave Velocity in MRI: Comparison of Transit Time Estimators

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Introduction. The aortic pulse wave velocity (PWV) is calculated as the ratio between the distance separating two aortic locations and the transit time (Δt) needed for the flow wave to cover this distance. While the distance can be accurately estimated from MR Cine images, the determination of Δt from Phase Contrast (PC) acquisitions remains more difficult. The aim of this study was to describe a new method (MSeg) for Δt estimation and to compare it with three previously described methods (MUpslope, MFoot, MPoint), in terms of correlation with aging and reproducibility.

Methods. We studied forty volunteers (42 ± 15 year) who had cine and PC acquisitions at the level of the aortic arch. The 3D length of the aortic arch was calculated from axial and coronal acquisitions. Δt was defined as the time shift between the flow curves of the ascending (CA) and descending (CD) aorta and calculated with: 1) MSeg by minimizing the area delimited by two sigmoid curves fitted to the systolic up-slope of CA and CD, 2) MUpslope by minimizing the area between the systolic up-slope of CA and the CD curve, 3) MFoot using CA and CD feet, 4) MPoint using the half maximum of CA and CD.

Results. PWV linearly increased with aging: results of Pearson coefficient (r) and PWV values are summarized in the following table. Transit time estimation by two operators introduced a variability of 6.04% (MSeg), 7.13% (MUpslope), 6.62% (MFoot), and 6.67% (MPoint).

Results of Pearson coefficient of the linear regression and Mean \pm SD of PWV		Mean \pm SD PWV (m/s)		
Methods of Δt estimation	r of the linear regression	All subjects (n=40)	Subjects <40 years (n=21)	Subjects \geq 40 years (n=19)
MSeg	0.85	4.53 \pm 1.29	3.82 \pm 0.6	5.33 \pm 1.41
MUpslope	0.85	4.6 \pm 1.4	3.86 \pm 0.69	5.42 \pm 1.55
MFoot	0.65	4.72 \pm 1.53	4 \pm 1.27	5.53 \pm 1.41
MPoint	0.76	4.97 \pm 1.52	4.32 \pm 0.99	5.69 \pm 1.7

Conclusion. All Δt estimators provided the expected trend of PWV according to aging. However, MSeg resulted in a better correlation with aging, higher reproducibility, and less overlap between the <40 and \geq 40 years groups.