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Indexed Plaque Volume: A Novel Volumetric Tool for assessment of the Severity of Carotid Disease

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INTRODUCTION:

Carotid Plaque Volume (PV) tends to become a marker for the atherosclerotic burden. The initiative for this study came from the frequent observation of the same plaque volumes resulting in different degrees of carotid artery stenoses.

OBJECTIVES:

By using a novel plaque volume index (PVI) we hypothesize that 3D ultrasound can also be used for assessment of the hemodynamic impairment caused by the plaque, currently performed using 2D duplex sonography. The aim of this prospective observational study was to evaluate PVI for assessment of the disease severity in comparison to conventional Duplex sonography.

METHODS:

Consecutive patients with a history of stroke or TIA and clinically indicated carotid ultrasounds were recruited. The plaque volume and the artery segment volume (AV) occupied by the plaque were measured by 3D ultrasound (Philips iU 22, volumetric-transducer vL 13-5) using a method previously published by our group[1] (Figure 1 A and B). The PVI was calculated using the following equation PVI=PV/AV. The degree of carotid stenosis was determined using conventional Duplex sonography according to the Consensus Statement[2] (iU 22, L 9-3 transducer) and classified into four groups: 1-15%, 15-49%, 50-69% and 70-99% stenoses.

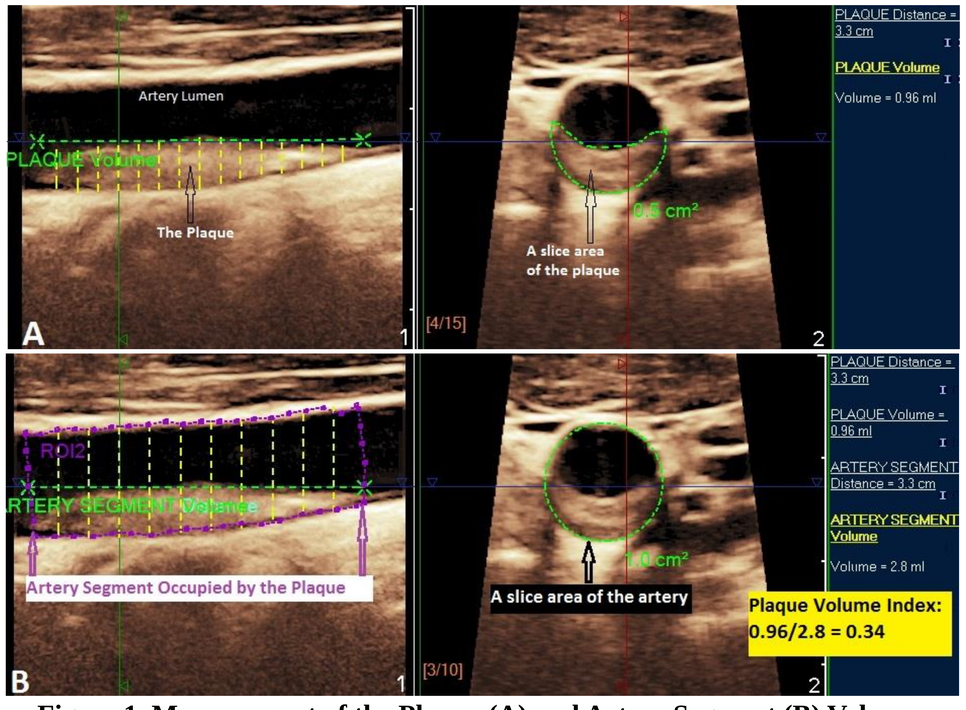

Figure 1. Measurement of the Plaque (A) and Artery Segment (B) Volumes and calculation of the Plaque volume Index

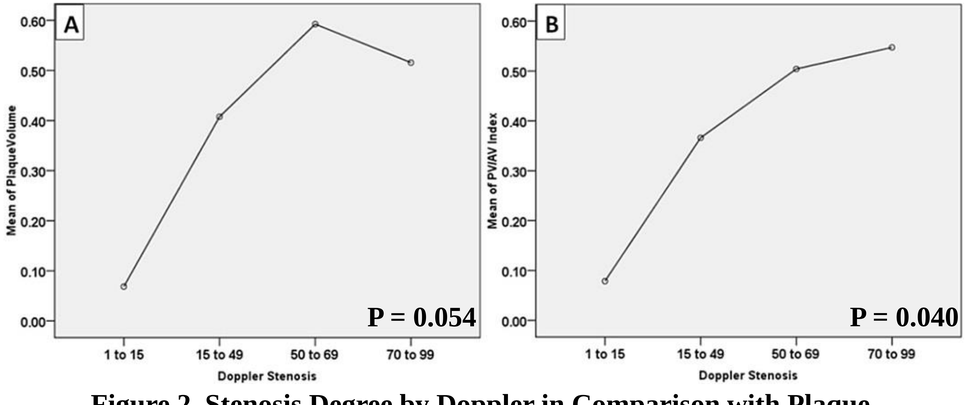

Figure 2. Stenosis Degree by Doppler in Comparison with Plaque Volume (A) and Plaque Volume Index (B)

RESULTS:

Of 214 arteries screened from 107 patients (mean age 67.9±9.7, 64.5% men), PVs could be measured in 190 and 186 PVIs were calculated. One-Way-ANOVA showed significant correlation between stenosis degree classification and PVI but not for PV (Table 1). The means of PV and PVI were plotted according to the stenosis groups presented in the Figure 2 (A and B).

Table 1
One-Way ANOVA

		N	Mean	Std. D	95% Confidence Interval for Mean		Between Component Variance
					Lower Bound	Upper Bound	
Plaque Volume	1 to 15	56	0.069	0.135	0.033	0.105	p=0.054
	15 to 49	103	0.408	0.257	0.357	0.458	
	50 to 69	24	0.592	0.334	0.451	0.734	
	70 to 99	7	0.516	0.528	0.028	1.004	
	Total	190	0.335	0.311	0.290	0.380	
PV/AV Index	1 to 15	55	.0786	0.129	0.044	0.114	p=0.040
	15 to 49	100	0.366	0.114	0.344	0.389	
	50 to 69	24	0.504	0.122	0.453	0.556	
	70 to 99	7	0.547	0.125	0.432	0.663	
	Total	186	0.306	0.197	0.277	0.334	

CONCLUSIONS:

The novel volumetric measure, Plaque Volume Index, provides information on the hemodynamic consequences of atherosclerotic carotid disease and should be reported in addition to plaque volume, which represents the atherosclerotic burden.

REFERENCES:

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2. Grant EG, Benson CB, Moneta GL, Alexandrov AV et al. **Carotid artery stenosis: gray-scale and Doppler US diagnosis-Society of Radiologists in Ultrasound Consensus Conference.** Radiology 2003; 229(2): 340-346.

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