

Hayrapet Kalashyan MD, Ashfaq Shuaib MD, FRCPC*, Khurshid Khan MD, FRCPC*, M. Saqquar MD, FRCPC*, Helen Romanchuk RN, RVT*, Harald Becher MD, PhD, FRCP

Volume Reduction vs. Velocities: Carotid Stenosis Measurement by New Three-Dimensional (3D) Ultrasound Technique

Mazankowski Alberta Heart Institute, *Department of Neurology, Stroke Program, University of Alberta Hospital, Edmonton, Canada

INTRODUCTION:

Assessment of Carotid stenosis using conventional Doppler ultrasound is operator dependent and time consuming. Recently a new 3D imaging method, using volumetric transducer became available. This method provides absolute values of plaque volume and carotid stenosis. This technique allows acquisition of three-dimensional volumetric datasets in only 2 to 4 seconds with the transducer maintained in a single fixed position. To our knowledge, the reproducibility of this technique has not been assessed in clinical studies so far.

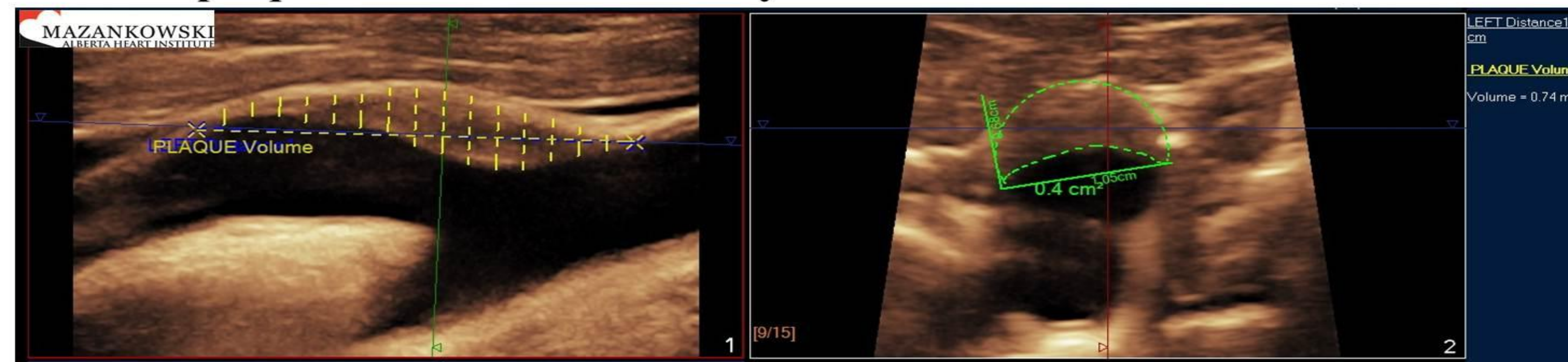
OBJECTIVES:

1. To assess the reproducibility of single sweep three dimensional ultrasound in internal carotid artery (ICA) stenosis and plaque volume measurements, and
2. To compare 3D Ultrasound with established spectral Doppler.

METHODS:

47 consecutive patients with history of Stroke or TIA, clinically indicated for carotid ultrasound. 3D ultrasound was performed using a Philips iU 22 ultrasound system equipped with the new single sweep volumetric transducer vL 13-5. The analysis was performed offline with Q-Lab (8.1) advanced quantification software provided by the manufacturer (Figure 1).

Figure 1. The area occupied by plaque is measured in 15 consecutive slices and the total plaque volume is calculated by the method of discs.



Plaque Volume measurement from the 3-Dimensional dataset. Image on the left is longitudinal view of the Internal Carotid Artery with the corresponding transversal view on the right side. The dashed blue line indicates the distance of occupied lumen. The green line in the longitudinal (left sided) image indicates the position where the transverse slice was taken. The yellow dashed lines indicate the consecutive slices used for calculation of the plaque volume.

Table 1 2D Stenosis and 3D Stenosis Cross tabulation

		3D Stenosis			Total
		1-49%	50-69%	>70%	
2D Stenosis	>70%	1	2	1	4
	50-69%	2	5	1	8
	1-49%	31	3	0	34
Total		34	10	2	46

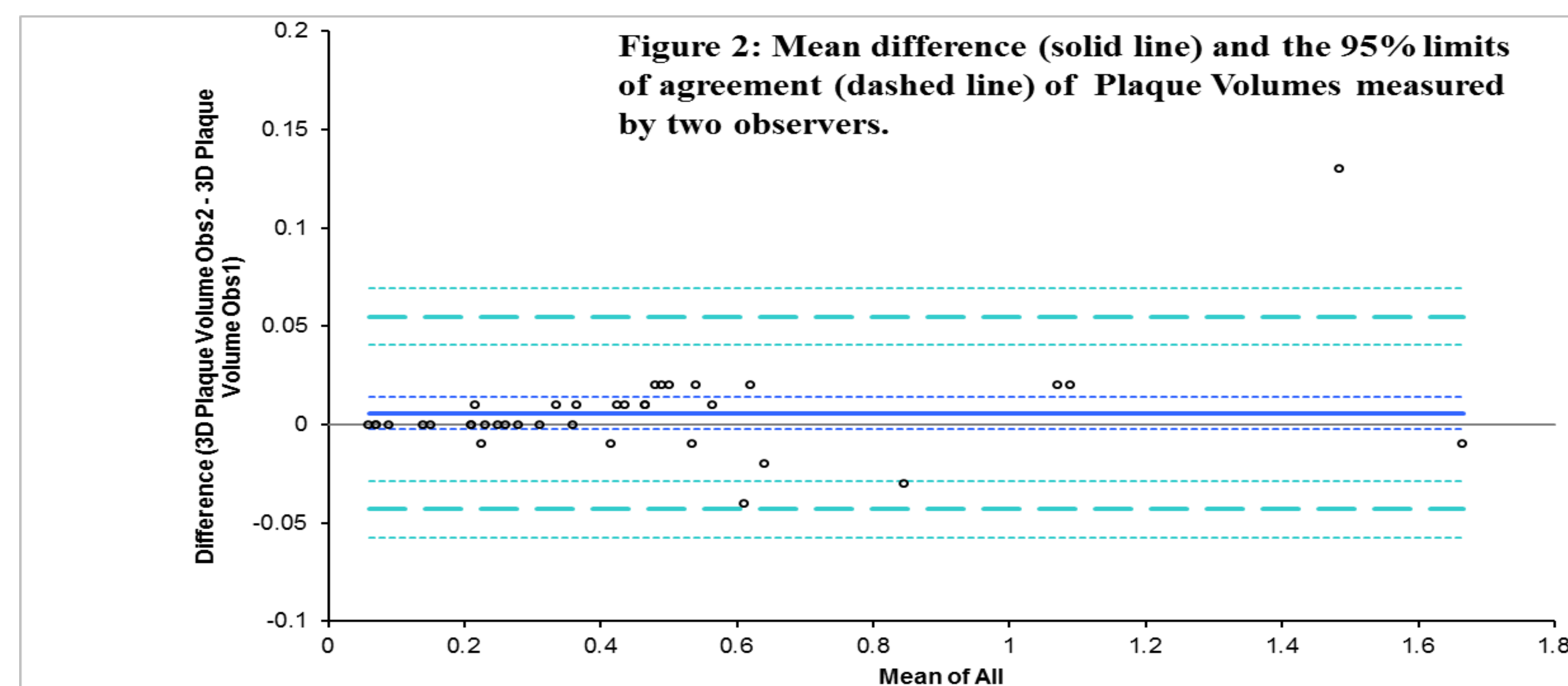


Figure 2: Mean difference (solid line) and the 95% limits of agreement (dashed line) of Plaque Volumes measured by two observers.

Two independent observers measured volumes of plaques and arteries. The ICA stenosis degree by volume reduction method was calculated using the following equation: $Stenosis = PV/AV * 100$, where PV is Plaque Volume, AV is the plaque occupied artery volume. The total time taken to calculate both plaque and segmental arterial volumes was less than ten minutes. The severity of the stenosis was classified into three groups: 1-49%, 50-69%, >70% stenosis

RESULTS:

Comparison between conventional Doppler and 3D ultrasound methods of stenosis measurement is presented in the table 1:

Kappa value=0.525

Agreement between two observers in plaque volume measurement was assessed in 37 cases by Bland Altman test showing very narrow limits of agreement (Figure 2).

CONCLUSIONS:

- Good reproducibility of plaque volume measurement was found using the new automated 3D method.
- The good agreement between conventional and new 3D volume reduction method of carotid artery stenosis warrant further larger studies.