

Potential bias on measurement of atherosclerotic stenosis: The implication from calibrations at various positions along arteries

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Purpose: To estimate nature variation of diameters of carotid artery and coronary artery in healthy volunteers and evaluate its potential affection to measurement of atherosclerotic stenosis.

Materials and methods: Approved by IRB, images of 30 health volunteers were retrospectively reviewed. Ten subjects (Group A, age 35-47 y/o, male 7) had carotid contrast enhanced magnetic resonance angiography (CE-MRA, with a 3-T scanner, GE signa excite HD) and the other twenty (Group B, age 46-59 y/o, male 11) had coronary artery computed tomography angiography (CTA, with a 64 slice CT, Toshiba Aquilion). Twenty internal carotid arteries (ICA, both sides on ten subjects) and 20 Left main artery- Left anterior descending branches (LMA-LAD) are eligible for analysis. Diameter of different parts of vessel was measured on Maximal intensity projection (MIP, a projection with least overlying of ICA) and curved multiplanar reconstructed (CMR). The measurement was done at 6 points on arteries, 0cm(a), 1cm(b), 2cm(c), 3cm(d), 4 cm(e) and 5cm(f) from origin of ICA and LMA with an Advance Work Station (GE Healthcare, software version 4.2). We set diameter of point "a" as baseline (100%), diameters at other points are presented as percentage of diameter at point "a". Percentage values of points (b, c, d, e, f) in two groups are compared with independent t test with SPSS 10.0. P<0.01 is considered as a statistical difference.

Results: The diameters of distal parts decrease gradually and greatly from the origin. On ICA, the average diameters at points b, c, d, e, f were 85%, 76%, 73%, 68%, and 65%. On LMA-LAD, the average diameters at points b, c, d, e, f were 103%, 98%, 96%, 90%, and 84%. In each distance from the origin, calibration (percentage) in ICA (Group A) is statistically lower than its counterparts in LMA-LAD (Group B) (P<0.01). Typical images of diameter variation (with measurement) in ICA and LMA-LAD are shown on figure 1, 2. Trends of variation of average diameter along the arteries are shown in figure 3.

Discussion: The criteria of North American Symptomatic Carotid Endarterectomy Trial (NASCET), (1) a well accepted vessel stenosis evaluation method for determining whether a patient needs carotid operation, is defined by comparing diameters on the narrowest part of vessel to its reference distal part. In this pilot study, we measured the trend of variation in some arteries in which atherosclerosis would probably cause serious clinical events. We found that, in health volunteer without atherosclerosis, the diameter in 5cm from the carotid bifurcation decreases to only 65% of the diameter of its origin averagely. Therefore, a pathological reduction on original lumen calibration in proximal ICA probably may not smaller than the first "normal" segment of distal part of ICA. That means, when using NASCET method, it is not a surprise that a severe atherosclerotic lesion may be veiled by zero or negative "stenosis", especially in ICA. Furthermore, subjective selection of reference segment will affect reliability of measurement.

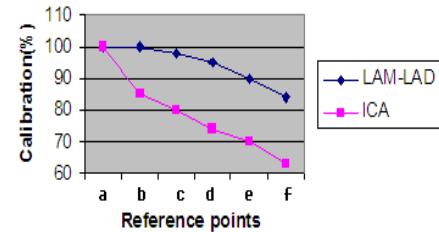
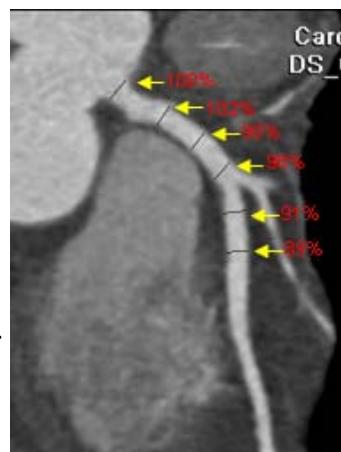
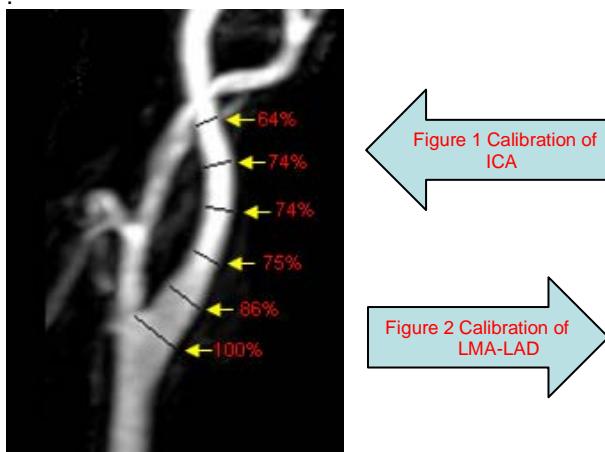


Figure 3 Trends of calibration. Arteries become thinner from its origin. Calibration (percentage) of distal ICA is lower than LMA-LAD (P<0.01)

Conclusion: In healthy subjects, the diameters in distal parts of ICA and LMA-LAD decrease gradually and greatly from the origin. This trend seems more obvious in ICA than in LMA-LAD. In clinical practice or clinical trial, parts of vessel selected for calculation should be seriously taken account into measurement of atherosclerosis stenosis.

Reference:

- 1 Barnett HJ, Taylor DW, Eliasziw M, et al, Benefit of carotid endarterectomy in patients with symptomatic moderate or severe stenosis. North American Symptomatic Carotid Endarterectomy Trial Collaborators. *N Engl J Med.* 1998 Nov 12;339(20):1415-25.