

¹School of Medicine, University College Dublin, Dublin, Ireland. ²Vascular Surgery, St Vincent's University Hospital, Dublin, Ireland. ³Department of Medicine for the Elderly, St Vincent's University Hospital, Stroke Service, Dublin, Ireland. ⁴Stroke and Hypertension Unit, Connolly Hospital, Dublin, Ireland. ⁵Acute Stroke Service, St. James Hospital Dublin and Trinity College Dublin, Dublin, Ireland. ⁶HRB Stroke Clinical Trials Network Ireland, University College Dublin, Dublin, Ireland. ⁷Radiology Department, Mater Misericordiae University Hospital, Dublin, Ireland. ⁸Neurovascular Unit for Translational and Therapeutics Research, Mater Misericordiae University Hospital, Dublin, Ireland. ⁹Department of Vascular Surgery, Mater Misericordiae University Hospital, Dublin, Ireland. ¹⁰Geriatric Medicine, Beaumont Hospital and Royal College Surgeons Ireland, Dublin, Ireland.

Introduction:

Atherosclerosis and relative complications represent the leading cause of mortality in western developed countries (WHO, 2011). Recent results demonstrated that the average stroke rate in asymptomatic carotid stenosis, greater than 50%, can be in the order of 1%, showing that luminal stenosis alone is a weak patient-risk stratification technique (Hadan et al., 2014).

In addition to traditional imaging techniques, which rely on arterial lumen stenosis as an indirect measure of mural plaque, High-Resolution MRI (HR-MRI) allows direct imaging of mural plaque burden and composition; however, few data exist on the relationship of these parameters to clinical factors in patients with symptomatic carotid stenosis. In this study we investigated the relationship between HR-MRI plaque features, clinical characteristics, and plaque morphology on from CT angiography.

Inclusion criteria were: (1) Speech/motor TIA or non-severe stroke (Rankin ≤ 3), (2) Ipsilateral carotid stenosis $\geq 50\%$, (3) Age ≥ 50 , (4) Carotid HR-MRI and CTA performed. Exclusion criteria were: pregnancy, malignancy, dementia, renal impairment, cervical irradiation/endarterectomy/stent.

Semi-automatic quantitative measurements of plaque components and morphological features were obtained with Plaque View (VPDiagnostic, Seattle, WA) (see Fig. 1) and TeraRecon iNtuition (TeraRecon, Foster City, CA) (see Fig. 2).

Relationships between plaque morphological biomarkers, baseline characteristic and clinical outcomes were investigated.

Results:

A t-test confirmed that HR-MRI maximum plaque wall area was greater in patients with index stroke compared with TIA ($p = 0.007$). Furthermore, t-test showed that plaque maximum wall thickness was greater in diabetes ($p = 0.016$) and statin-untreated patients ($p = 0.003$). Volume of lipid-rich necrotic core was less ($p = 0.018$) and fibrous cap (FC) thickness ($p = 0.05$) greater in aspirin-treated patients. When HR-MRI was compared with CTA, strong correlations were observed for lumen area (Spearman's rho = 0.976, $p < 0.001$), maximum wall thickness (rho = 0.878, $p < 0.001$), and maximum wall area (Pearson $r = 0.981$, $p < 0.001$).

Table 1. HR-MRI plaque morphology.

	HR-MRI mean values		<i>p</i> value
Vessel wall max area stroke / TIA	91.89 mm ²	66.13 mm ²	0.007
Wall thickness max diabetes / no diabetes	5.58 mm	4.17 mm	0.016
Wall thickness max statin / no statin	4.38 mm	6.14 mm	0.003
MR lipid rich necrotic core volume aspirin / no aspirin	90.58 mm ³	116.16 mm ³	0.018
MR FC % volume aspirin / no aspirin	5.1%	2.87%	0.050

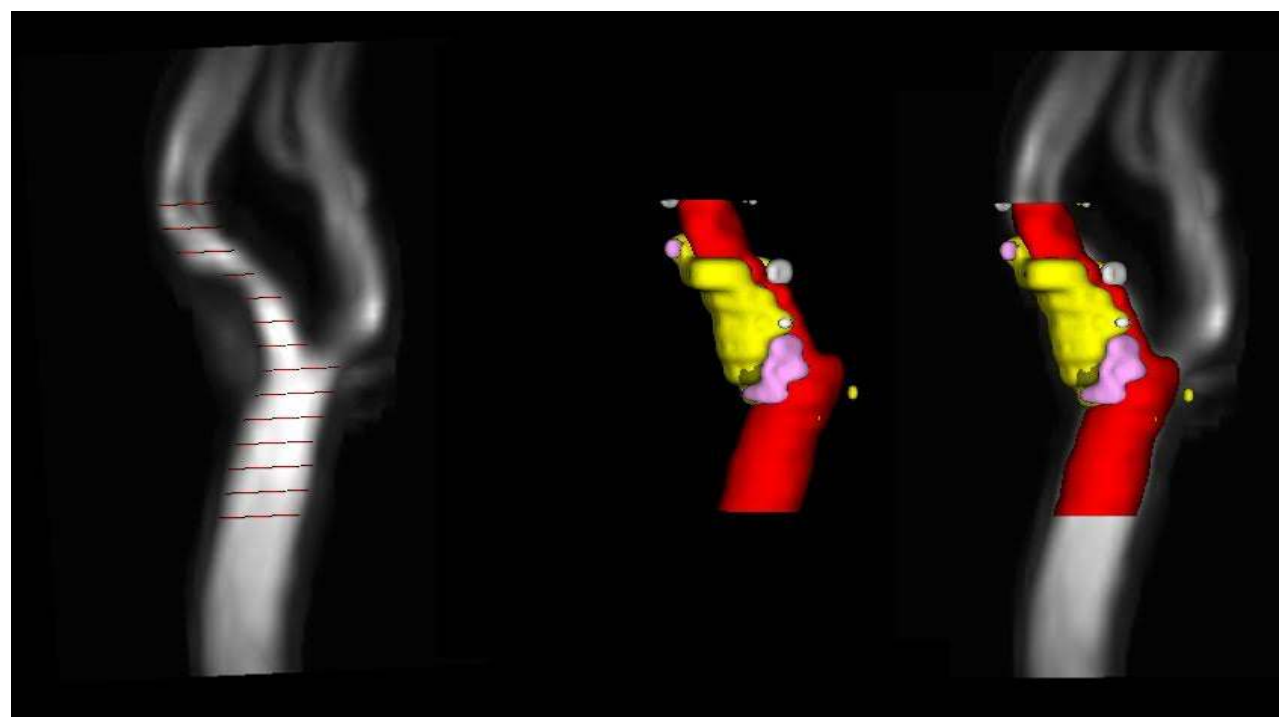


Figure 1. 3D image of ICA plaque components.

Methods:

Carotid CTA of twenty-seven patients, a sub-group of the prospective BIOVASC plaque imaging study, with confirmed internal carotid artery (ICA) stenosis and meeting the inclusion criteria of the prospective BIOVASC plaque imaging study were included in the analysis (78% men; mean age 66 years, 36% stroke; 64%TIA; 39% currently smoking).

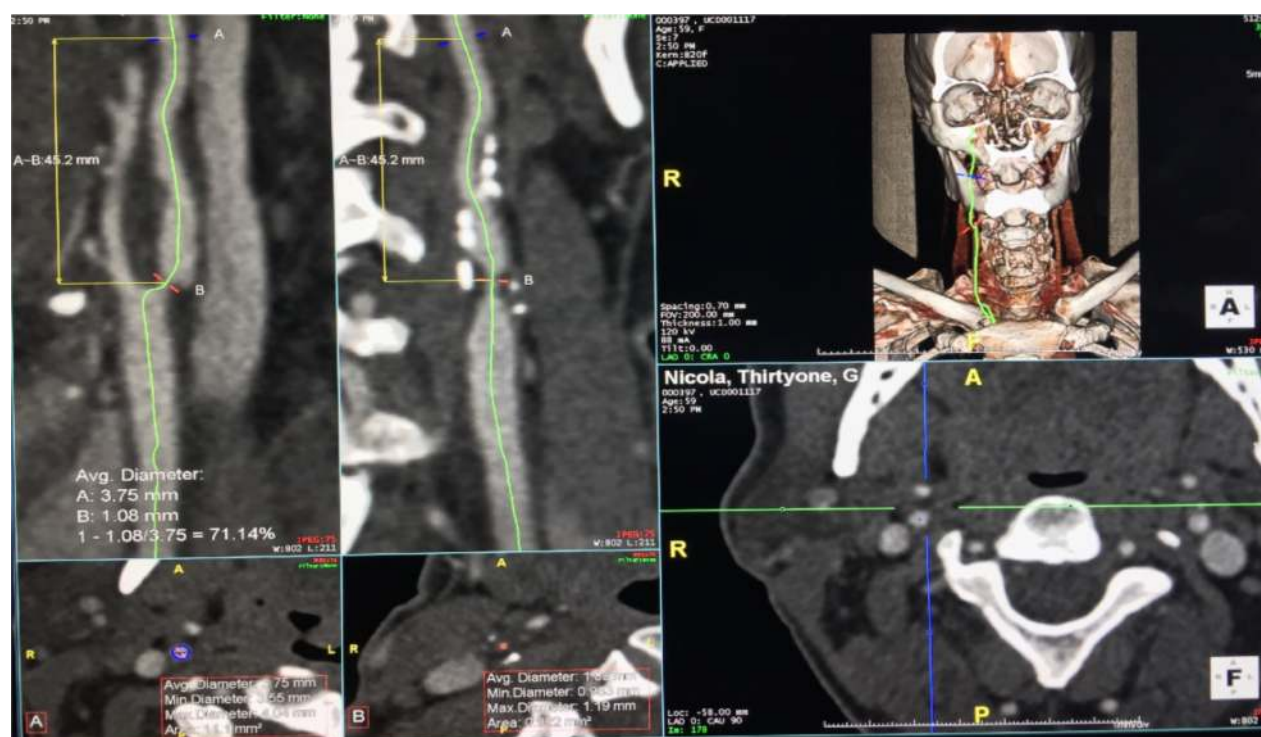


Figure 2. CTA plaque morphology measurements.

Conclusion: If replicated, our findings may inform the application of plaque HR-MRI and CTA as surrogate markers in future clinical practice and randomised trials for stroke prevention.

References:

1. Global status report on non-communicable diseases 2010. Geneva: World Health Organization; 2011.
2. Hadan N et al. Asymptomatic carotid artery stenosis treated with medical therapy alone: temporal trends and implications for risk assessment and the design of future studies. *Cerebrovascular Diseases*. 2014; 38:163–73.