

Carotid Plaque Volume (CPV) as an indicator of high risk plaque.

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Introduction

The degree of stenosis has been the method of defining the necessity of surgery in symptomatic carotid stenosis since the NASCET and ECST randomized trials of the 1990's (1). But a greater degree of stenosis does not correlate to a greater risk of stroke. Atherosclerotic plaque burden in the coronary and carotid arteries is reported to be a more important risk factor for future event than severity of stenosis (2–6). Measuring carotid plaque volume (CPV), as a measure of atherosclerotic burden, may be of more importance in predicting likelihood of further event than degree of stenosis alone. The case presented highlights the added benefit of assessing CPV prior to surgery to appreciate the risk of Stroke.

Case description

A 75-year-old male presented with a history of left arm weakness and left facial droop which lasted 20 minutes and had fully resolved. His past medical history included Atrial Fibrillation currently treated with Apixiban and adequately rate controlled. A computed tomography (CT) scan of the brain showed no evidence of an acute infarct so the diagnosis of a single Transient Ischaemic Attack (TIA) was made. Carotid Doppler examination showed a right internal carotid artery stenosis of >70% based on grey scale measurement and peak systolic velocity.

The plaque was noted to be composed of echo-lucent material on standard duplex (Figure 1). 3-D tomographic ultrasound (tUS) followed by contrast enhanced tomographic ultrasound (CEtUS) assessment was performed as part of recruitment to an ongoing research study. On tUS the full extent of the large, echo-lucent plaque could be appreciated (Figure 2). Measurement of the CPV was performed based on these assessments.

The patient underwent a right carotid endarterectomy (CEA) within 24 hours of admission. Intraoperative findings confirmed a plaque composed of liquefied lipid with intra-plaque haemorrhage (Figure 3). The surgeon commented in the operative notes that this was a plaque with extremely adverse features at high risk of causing a future event had surgery not been performed promptly.

The CPV measured from the endarterectomy specimen was exceptionally high at 1.754cm³. Carotid plaque volume as calculated by tUS was accurate to within 0.1cm³ of the endarterectomy specimen.

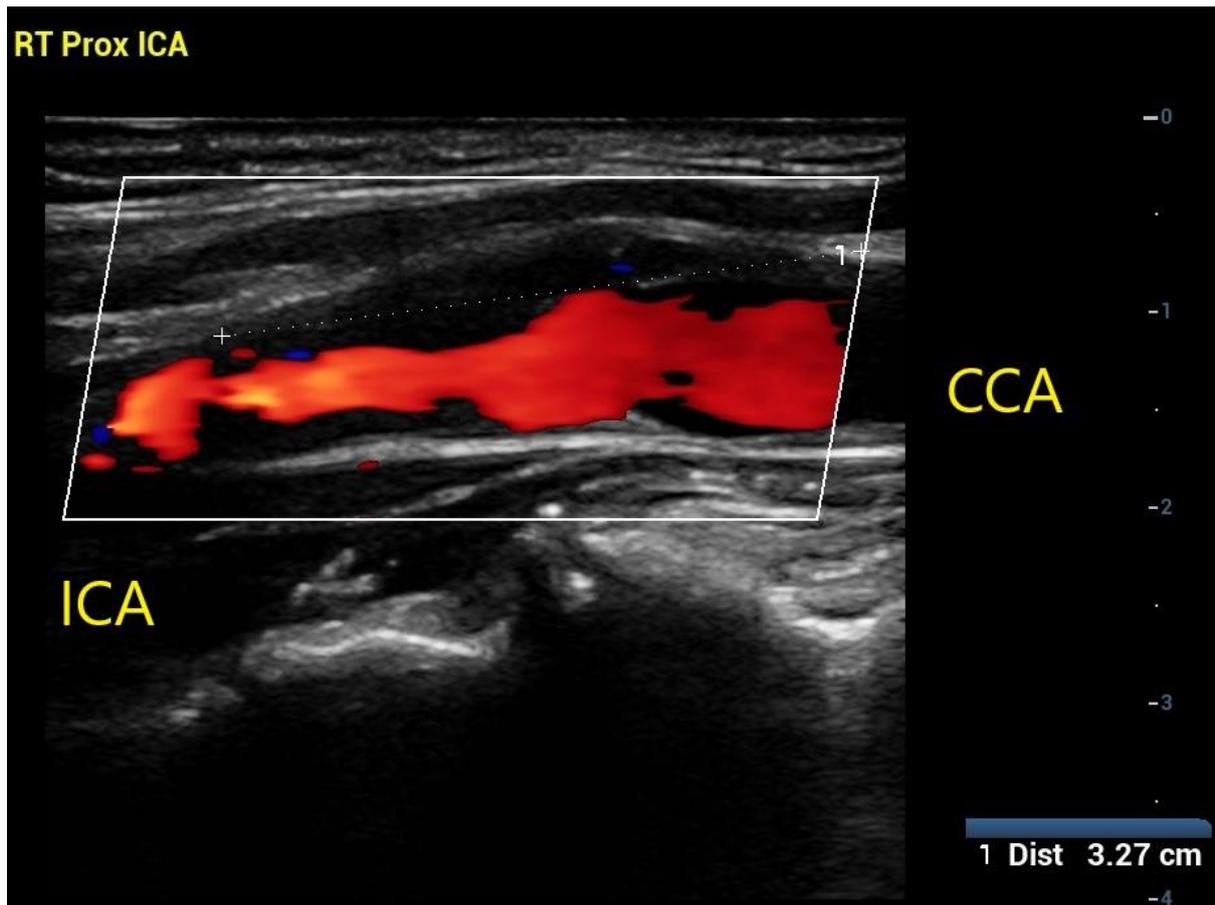


Figure 1: Colour duplex of right carotid bifurcation and internal carotid artery showing the plaque and blood flow.

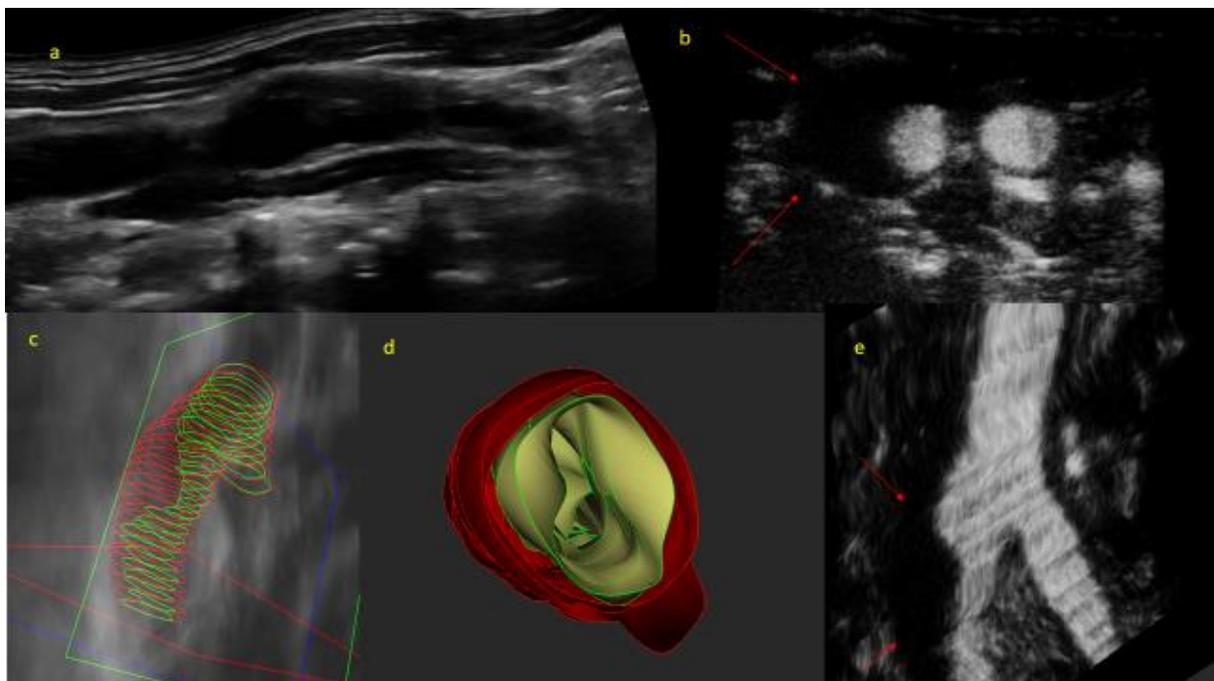


Figure 2: tUS and CEtUS images: a. Longitudinal B-mode view of common carotid artery (CCA) and internal carotid arteries (ICA). b. Transverse contrast enhanced image of ICA and external carotid artery (ECA) (Red arrows pointing to large volume plaque). c. Multi-slice reconstruction (1mm) of the artery outlined in red with lumen outlined in green to permit volume calculation. d. 3-D reconstruction of vessel. e. CEtUS longitudinal image showing large volume plaque (red arrows).

Discussion

Based on the clinical history of TIA and the identification of significant carotid stenosis contralateral to the patient's symptoms, prompt surgical management was unarguably the correct course of action in this case. However, the standard two-dimensional duplex did not fully appreciate the high-risk nature of this plaque, as unequivocally seen at endarterectomy.

In this unit, carotid plaque volume has been measured in 400 patients prior to endarterectomy. There are statistically significant differences between the volumes measured in symptomatic and asymptomatic plaques; symptomatic plaques having higher plaque volumes (6, Vascular Society, Nov 2018). This carotid plaque was in the highest quartile for volume, a feature which correlates with high risk plaque features, as was proved by the visual assessment completed by the surgical team.

Adding CPV to the information provided by standard duplex could supplement the clinical team's understanding of the risk of stroke from a plaque. Furthermore, tUS calculation of Carotid plaque volume can be accurately performed prior to surgery. CPV could be used to predict those symptomatic plaques at greatest embolic potential pre-operatively so that expedited surgical management can be arranged.



Figure 3: Endarterectomy specimen showing soft plaque and intraplaque haemorrhage in the lumen.

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