

Ultrasound in the Diagnosis of Carotid Web: Report of Two Cases and Review

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Introduction

Carotid web (CW) is a nonatherosclerotic disease of the extracranial carotid artery, described as an atypical, still little known, and poorly diagnosed focal fibromuscular dysplasia (FMD). CW has been associated with the occurrence of cerebral vascular accidents (CVAs) and transient ischemic attacks (TIAs), affecting young patients, with no other known causes.

Case report

Case 1: A 51-year-old female teacher, married, asymptomatic until September 2022, when she developed sudden motor deficit of left hemibody, and was admitted with the diagnosis of CVA. The patient reported complete regression of motor deficit one month after hospital discharge, and use of atorvastatin 40mg and aspirin 100mg. The patient has smoked for 30 years and denied diabetes and hypertension. Her mother has a history of cerebral aneurysm. Physical examination was normal (blood pressure: 120x80mmHg; heart rate = 76bpm).

The patient underwent laboratory tests, electrocardiogram (ECG), transthoracic and transesophageal echocardiograms, 24h Holter monitoring, and treadmill test, with normal results. Vascular ultrasound (VUS) of carotid and vertebral arteries revealed an echogenic image in left carotid bifurcation, projecting into the carotid artery lumen, apparently fixed, without significant stenosis, raising the possibility of CW. On the surface, there was a small pedunculated echogenic mobile mass, towards the flow, measuring 0.66 mm (possible thrombus) – Figures 1A-F. Computed tomography angiography (CTA) of cervical vessels corroborated the ultrasound findings, showing a luminal thin band or folding, at the bulb of the left internal carotid artery (Figures 2A and 2B). Contrast angiography

was performed, which revealed a filling defect, compatible with CW, projecting into the left bulb in a turbulent flow, and no intracranial changes (Figures 2C and D). A surgical intervention was indicated.

Case 2: A 42-year-old woman, service assistant, single. The patient was asymptomatic, with a history of hypertension, using losartan 75 mg/d, and preparing for elective hysterectomy. The patient underwent a cardiovascular *check-up* and reported that her mother had dyslipidemia and hypertension. The VUS of carotid and vertebral arteries showed an echogenic image in the posterolateral wall, near the right carotid bifurcation, projecting into the arterial lumen, apparently fixed, suggestive of CW, with flow disturbance, peak systolic velocity (PSV) = 134 cm/s and narrowing of the lumen by nearly 50%. A cross-sectional view reviewed that the membrane acted as a “web” (Figures 3A-F).

CTA of carotid arteries corroborated the ultrasonographic diagnosis, showing a filling defect in the right carotid bulb / origin of the right internal carotid artery, suggestive of CW (variant of FMD), and causing discrete stenosis (Figures 4A and B). The patient is still asymptomatic and clinically followed-up.

Discussion

CW was first described in 1968.¹ It consists of a little known and poorly diagnosed nonatherosclerotic disease of the extracranial carotid artery.² CW is described as a discrete membrane (web or net) defined as an intraluminal filling defect that usually affects the posterolateral wall of the carotid artery, more commonly in the proximal internal carotid artery. Of unknown cause, CW is considered an atypical focal carotid FMD, with intimal fibrous proliferation.^{2,3} CWs are more prevalent in proximal internal carotid artery and carotid bifurcation and may be unilateral or bilateral.³

CW may be the cause of CVA and TIAs, accounting for 9.4-37% of cryptogenic stroke, mainly in young patients.³⁻⁵ CW patients may be asymptomatic or develop recurrent neurological events.^{3,5} Sajedi et al.⁵ assessed cryptogenic stroke patients and demonstrated a CW prevalence of 21.2% (95% CI, 8.9–38.9%). Mean age was 38.9 years, and CW was more common among African American (86%) and women (86%). The mechanism by which CW leads to neurological events is not well established. Although CW does not commonly result in significant stenosis, flow disturbance may occur, with blood recirculation and stasis, which would increase the risk of platelet aggregation. CW is

Keywords

Carotid Artery Diseases; Carotid Arteries Ultrasonography; Fibromuscular Dysplasia.

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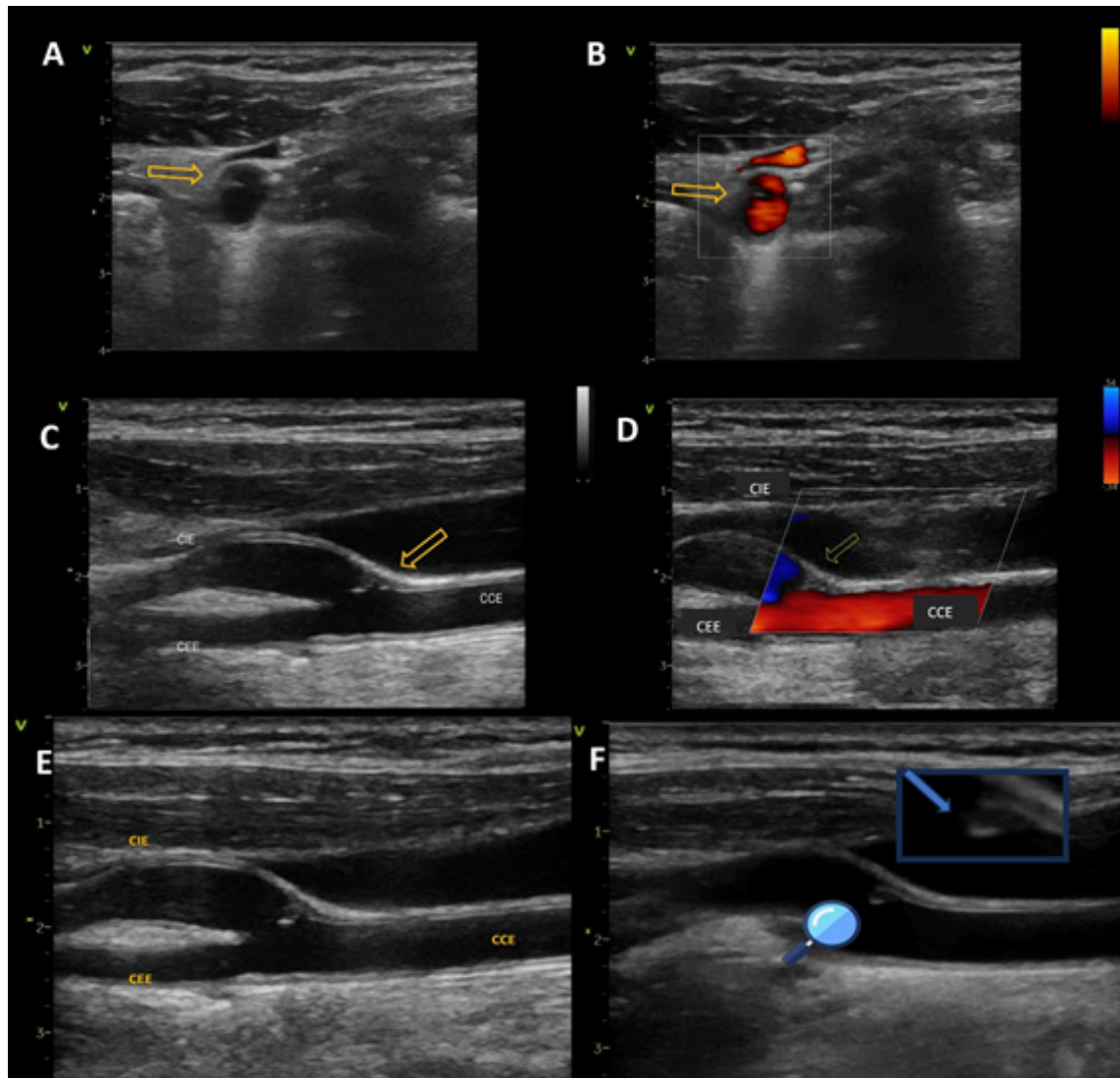


Figure 1 – Case 1 – Visualization of the carotid web (yellow arrows) by Vascular Ultrasonography; A – B mode cross section view; B- Power Doppler cross section view; C- B mode longitudinal section view; D – Color Doppler longitudinal section view; E- B mode longitudinal section view; F – Pedunculated and mobile image in the direction of flow (magnifying glass – suggests a small thrombus).

a shelf-like membrane that allows the blood to be retained and in longer contact with the endothelium, favoring thrombus formation and thromboembolic events.^{3,5} It is believed that the pattern of flow abnormalities caused by CWs differs from those caused by atherosclerotic plaques, since while CWs are focal lesions, atherosclerotic plaques may affect longer segments of the artery and have more irregular surface.⁶ The detection of a thrombus adherent to CW, similar to that found in our first case, was reported in 16.2% of the cases.⁷

CW may be diagnosed by CTA, contrast angiography, magnetic resonance angiography, or VUS.⁸ It is radiologically described as a focal protrusion, a tissue fold from the

posterior wall of the carotid bulb, on sagittal or on oblique sagittal image, also visible on the axial image as a septum.⁴

As described in the two cases presented here, VUS can detect CW. In the two-dimensional image, CW is seen as a thin membrane formed by an abnormal endothelial fold, with variable-diameter orifices, similar to a web, causing a partial flow in the carotid artery.^{4,6,9} The use of the VUS resources like color Doppler, power Doppler, and contrast VUS whenever possible, helps in MW visualization.⁹ Madaelil et al.⁶ reported a moderate agreement between VUS and contrast angiography ($k=0.62$; $p=0.01$). However, a more recent study reported an 85.7% agreement between CTA and contrast-enhanced VUS.⁸

Case Report

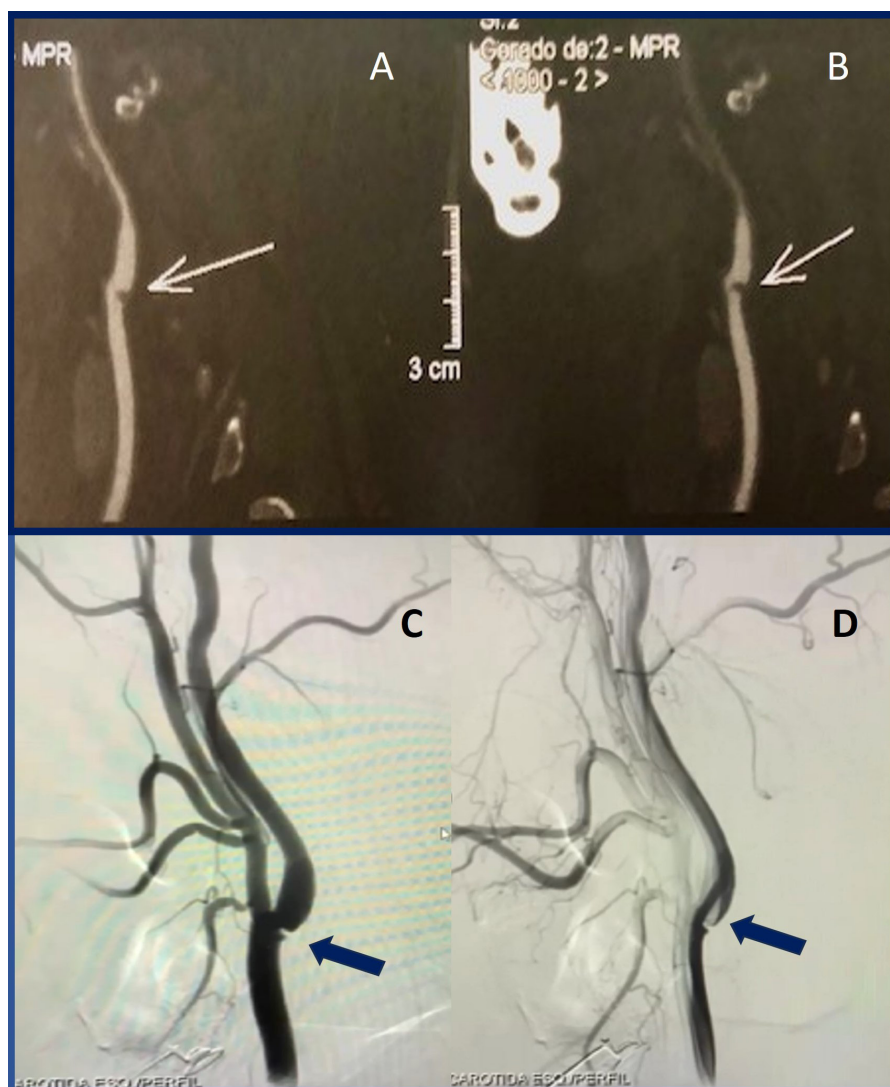


Figure 2 – A and B) Case 1: Carotid web visualization in the bulb-emergence of the left internal carotid artery by tomography angiography (white arrows); C and D) Case 1: filling failure on contrast angiography, compatible with carotid web with flow turbulence.

Due to its high resolution and images in multiple planes, CTA allows the identification of filling defect projecting from the carotid wall into the lumen, in addition to thrombi and calcium. It is useful for the exclusion of atherosclerosis and other vascular lesions and, so far, it is considered the method of choice for the diagnosis of CW.^{4,6-8}

Digital subtraction angiography can be used in the CW diagnosis, however, since CW usually affects the posteromedial and posterolateral carotid artery wall, different angiographic projections may be necessary, with the disadvantage of being an invasive procedure.⁷ Magnetic resonance angiography can evaluate the morphology and composition of CW, but there are few data in this regard.^{4,8}

Differential diagnoses of CW are atherosclerotic plaque, carotid dissection, and intraluminal thrombus.⁴ Fontaine et

al.¹⁰ compared ultrasound images (B-mode and microflow imaging) of 24 patients with CW and 24 patients with atherosclerotic plaques and reported that none of patients with atherosclerotic plaques presented ultrasonographic features suggestive of CW. The treatment of CW patients is still debatable. Therapeutic options include medical treatment with antiplatelet or anticoagulant agents, and/or interventions via stents or endarterectomy. Patel et al.⁷ conducted a systematic review of 289 symptomatic CW patients across 15 series. Interventional management was performed in 151 (52.2%) (stent implantation in 87 and carotid endarterectomy in 64) and medical management was performed in 138 (47.8%), including antiplatelet therapy and anticoagulants. Baseline characteristics and time from index CVA were similar between medical and interventional patients. In the interventional group, no

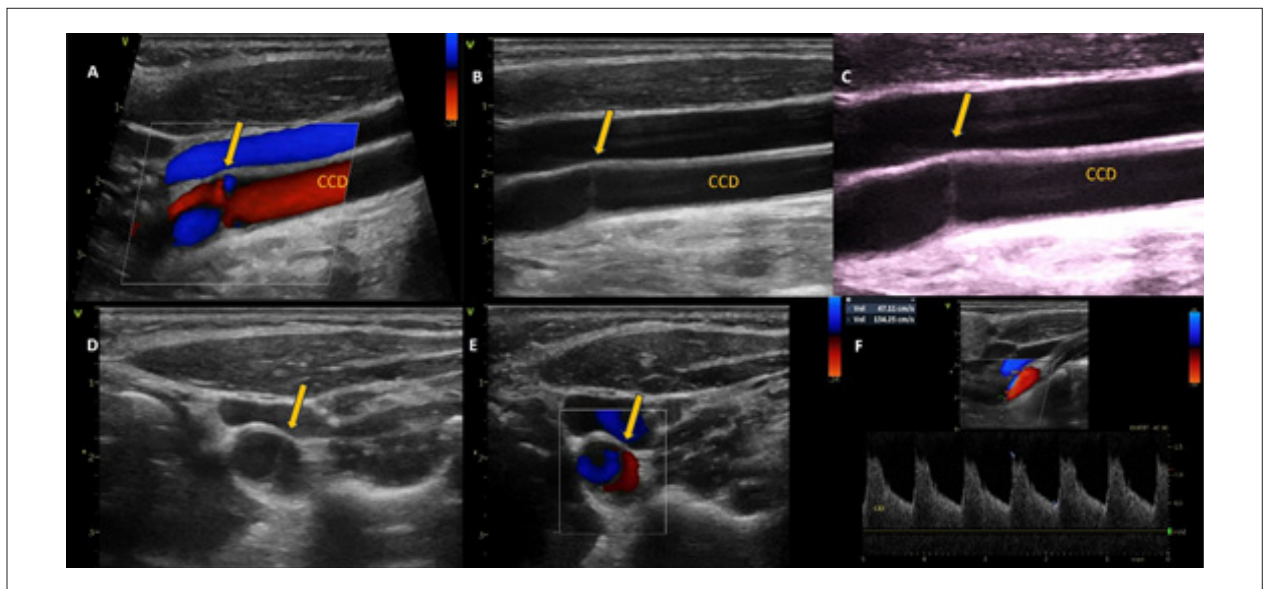


Figure 3 – Case 2: Visualization of the carotid web (yellow arrows) by Vascular Ultrasonography; A) Longitudinal section with color Doppler; B and C) B mode longitudinal section view; D) B mode cross section view; E) Color Doppler cross section view; F) Pulsed Doppler demonstrating flow turbulence (peak systolic velocity = 134cm/s).

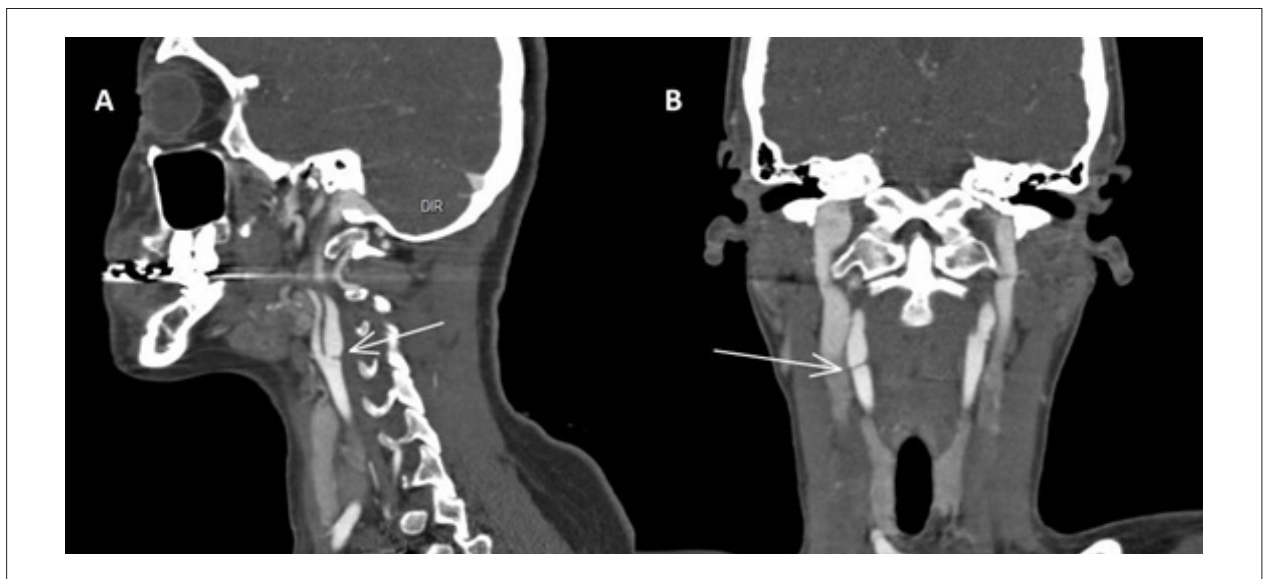


Figure 4 – A and B) Case 2: Visualization of the carotid web (white arrows) by CT angiography

recurrent ischemic events were observed over a follow-up of up to 60 months. In the medical group, over a follow-up of up to 55 months, recurrence rate was 26.8%, with no statistical difference between patients receiving any antithrombotic vs. no antithrombotic.

Therefore, the diagnosis of CW depends on a greater knowledge about the disease, to identify those patients with neurological events, frequently young patients, to provide proper treatment and prevent recurrence. In this context, VUS stands out as a low-cost, reliable, and accessible diagnostic method.

Author Contributions

Conception and design of the research: Petisco ACGP, Dourado JPA, Dourado LA; acquisition of data and analysis and interpretation of the data: Petisco ACGP, Dourado PM, Tebaldi RT; writing of the manuscript: Petisco ACGP; critical revision of the manuscript for intellectual content: Petisco ACGP, Dourado PM, Tebaldi RT, Dourado JPA, Dourado LA.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

Case Report

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Study Association

This study is not associated with any thesis or dissertation work.

Ethics Approval and Consent to Participate

This article does not contain any studies with human participants or animals performed by any of the authors.

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