



## Case Report

# Short-term recurrence of stroke following misdiagnosis of carotid web masked by thrombus

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## ABSTRACT

**Background:** Carotid webs are a potential cause of occult cerebral infarction. Although they occur frequently, proper diagnosis and treatment are crucial; surgery has been shown to provide a good outcome. Although thrombus on the carotid web have been reported, digital subtraction angiography (DSA)-confirmed cases of pre-dispersed thrombus are rare. In this study, we report a case in which a thrombus on the carotid web concealed a shelf-like defect, complicating its diagnosis.

**Case Description:** A 47-year-old woman without stroke risk factors presented to our hospital with aphasia and right hemiplegia. On arrival, the symptoms had improved. Magnetic resonance (MR) imaging showed left middle cerebral artery stenosis; however, there was no cerebral infarction. DSA was performed post-admission to examine middle cerebral artery stenosis, which showed no middle cerebral artery stenosis but left internal carotid artery (ICA) origin stenosis and contrast pooling. We diagnosed a transient ischemic attack due to artery-to-artery embolism caused by left ICA stenosis and accompanied by a contralateral carotid web. The same symptoms appeared 6 days later. MR imaging showed a new cerebral infarction and the left middle cerebral artery occlusion. A mechanical thrombectomy procedure revealed a change in ICA origin shape compared to the 1<sup>st</sup> time, with a shelf-like defect within the carotid web. She subsequently underwent carotid artery stenting and was discharged with mild dysesthesia in her right fingers (modified Rankin Scale of 1).

**Conclusion:** Thrombus on the carotid web conceals characteristic shelf-like defects and may cause misdiagnosis. However, contrast pooling and contralateral carotid web are important findings for early treatment.

**Keywords:** Carotid web, Misdiagnosis, Recurrence, Stroke, Thrombus

## INTRODUCTION

The carotid web is a shelf-like defect in the posterior wall of the internal carotid artery (ICA) bulb.<sup>[2]</sup> It is one of the causes of occult stroke in young patients without stroke risk factors.<sup>[3,10]</sup> A high recurrence rate has been reported with drug treatment alone for the symptomatic carotid web.<sup>[15]</sup> Conversely, carotid revascularization, such as carotid endarterectomy (CEA) and carotid artery stenting (CAS), has shown good outcomes.<sup>[10,15]</sup> Accurate diagnosis is crucial to prevent

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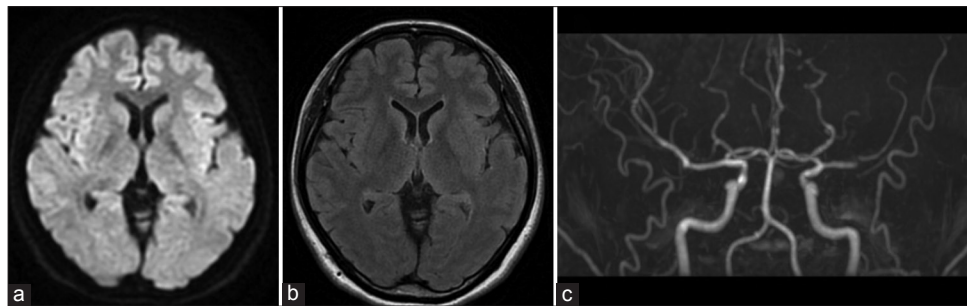
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recurrence. In this report, we describe a case of recurrent ischemic stroke misdiagnosed as atherosclerotic carotid stenosis due to an adherent thrombus obscuring the carotid web.

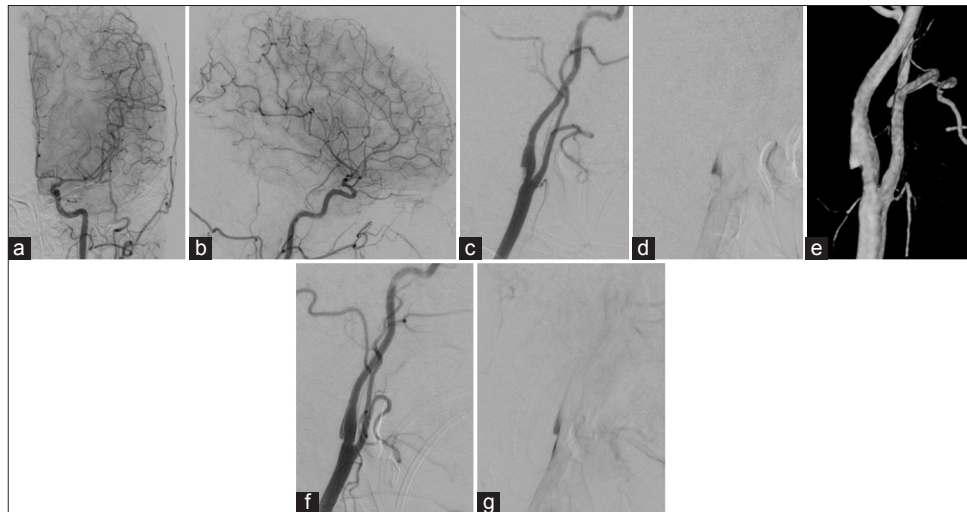
## CASE DESCRIPTION

A 47-year-old woman without medical history presented to our hospital with acute onset aphasia and right hemiplegia. The symptoms had improved by the time of the visit. Magnetic resonance (MR) imaging of the head showed left middle cerebral artery stenosis without infarction [Figure 1]. A transient ischemic attack (TIA) was diagnosed, and the patient was treated with antiplatelet medications post-admission. Digital subtraction angiography (DSA)

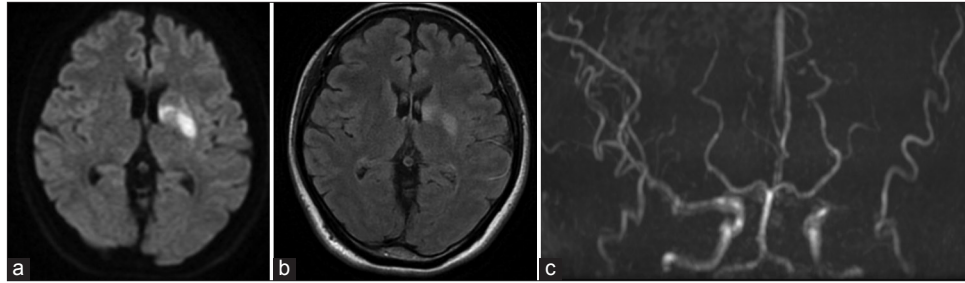
was performed to closely examine the left middle cerebral artery 4 days after the symptom onset. The left common carotid artery imaging showed no stenosis in the left middle cerebral artery [Figures 2a and b]; however, there was a mild stenosis at the origin of the left ICA. Contrast pooling was observed in the distal of the carotid stenosis [Figures 2c-e]. A shelf-like defect suspected to be a carotid web was observed at the contralateral ICA origin [Figures 2f and g]. After further examination, the Trial of Org 10172 in Acute Stroke Treatment classification was used to diagnose TIA due to artery-to-artery embolization caused by carotid artery stenosis. There were no further symptoms, and the carotid ultrasound showed no abnormalities. Therefore, the patient was discharged on single antiplatelet therapy with aspirin 6 days after



**Figure 1:** Magnetic resonance (MR) image at first attack. (a and b) No cerebral infarction in both diffusion-weighted imaging and fluid attenuated inversion recovery. (c) Suspected left middle cerebral artery stenosis on MR angiography.



**Figure 2:** Digital subtraction angiography performed to examine middle cerebral artery stenosis. (a and b) The angiography of the common carotid artery revealed no stenosis in the middle cerebral artery, previously seen on magnetic resonance imaging. (c) Left common carotid angiography shows stenosis at the origin of the internal carotid artery. (d) Contrast pooling in the left internal carotid artery distal to the web. (e) 3D reconstruction of the left internal carotid artery stenosis. (f) A shelf-like defect is also present in the posterior wall of the origin of the right internal carotid artery. (g) Carotid angiogram in late-phase shows pooling of contrast on the web distal.



**Figure 3:** Magnetic resonance (MR) image at the second attack. (a and b) Diffusion-weighted imaging fluid-attenuated inversion recovery shows the high-intensity area from the left caudate nucleus to the insular cortex. (c) Occlusion from the origin of the left middle cerebral artery in MR angiography.

experiencing symptoms. However, the symptoms recurred on the day of discharge, and the patient was immediately transported to our hospital. On presentation, she exhibited right hemiplegia and motor aphasia, resulting in a National Institutes of Health Stroke Scale score of 11. MR imaging revealed a new cerebral infarct from the left insular cortex to the caudate nucleus and a left middle cerebral artery occlusion [Figure 3]. Therefore, the patient underwent a mechanical thrombectomy, resulting in a thrombolysis in cerebral infarction score of 3. DSA at that time revealed a significant alteration in the shape of the left carotid artery, which was later identified as a carotid web due to a protruding shelf-like defect on the posterior wall of the ICA [Figure 4]. Dual antiplatelet therapy and heparin were administered, and CAS with a closed stent was performed 11 days after the first TIA to prevent recurrence. The patient was discharged 15 days after the first TIA attack without any postoperative complications or new neurological deficits with mild dysesthesia in her right fingers (modified Rankin Scale of 1).

## DISCUSSION

During a DSA procedure to investigate middle cerebral artery stenosis in a young woman without atherosclerosis risk factors, we failed to detect a carotid web obscured by a thrombus at the carotid artery origin. Notably, contrast pooling in the web and a contralateral carotid web, even if associated with a thrombus, are important findings in DSA.

The carotid web is frequently observed in young women who do not have the risk factors for atherosclerosis.<sup>[3,10]</sup> Medical treatment of this condition has been associated with high recurrence rates of  $\geq 50\%$ .<sup>[15]</sup> Conversely, surgical interventions such as CEA and CAS have resulted in good outcomes, with no reported complications or recurrences.<sup>[3,15]</sup> A systematic review found that the median time to recurrence of ischemic stroke while on medication was 12 months.<sup>[15]</sup> The patient's background in this report aligns with existing



**Figure 4:** Digital subtraction angiography during mechanical thrombectomy. (a) Left internal carotid angiography shows a shelf-like structure on the posterior wall of the origin of the internal carotid artery. (b) Carotid angiogram in late-phase shows pooling of contrast on the web distal.

reports; however, the recurrence occurred within 6 days after onset.

Computed tomography angiography (CTA), DSA, and carotid ultrasound have been reported to diagnose carotid web<sup>[5,14]</sup> with CTA and DSA being particularly effective for diagnosis.<sup>[7]</sup> In DSA, contrast pooling in the carotid web, seen in the late venous phase, is a characteristic finding in the distal part of the web.<sup>[4]</sup> This stasis is thought to be caused by the shelf-like structures in the carotid web, which accelerate thrombus formation, leading to cerebral infarction.<sup>[10,11]</sup> Computational fluid dynamics analysis recently suggested that flow turbulence and low wall shear stress led to new thrombus formation in the carotid web.<sup>[1,9]</sup> This result supports the hypothesis that thrombus formation is the cause of cerebral infarction. Thrombi adhering to the carotid web was found in 16.2–28% of cases.<sup>[3,10]</sup> Many reports indicated the presence of thrombus through procedures such as CTA,<sup>[3,12]</sup> carotid ultrasound,<sup>[6]</sup> and CEA.<sup>[13]</sup> It is rare to

identify a pre-scattered thrombus using DSA, as in this case. Notably, even when a thrombus is adherent, as in this case, the carotid web can confirm the finding of the blood flow stasis.

In addition, the carotid web may exist on both sides in 28–58% of cases.<sup>[3,8]</sup> Haussen *et al.* found that in bilateral cases, the length of the carotid web on the symptomatic side was significantly longer than that on the asymptomatic.<sup>[3]</sup> Here, the characteristic shelf-like structure of the carotid web was observed on both sides, with the web on the symptomatic side being longer than on the asymptomatic, which is consistent with previous reports.

These two findings typical of the carotid web were still present even with the thrombus on the web. DSA or CTA should be considered, particularly in young women with ischemic stroke in the absence of atherosclerotic factors due to the possibility of a carotid web. Early surgical intervention is necessary when thrombus adhesion is observed on the carotid web due to the possibility of recurrence in a short period.

## CONCLUSION

The carotid web should be appropriately diagnosed due to high recurrence rates with conservative treatment and reduced recurrence rates with surgical intervention. Although the thrombus adherence obscures the shelf-like defect, contrast pooling in the carotid web and the presence of the contralateral carotid web are important for establishing a diagnosis based on DSA. When observing these findings, it is crucial to include additional modalities such as CTA. This will help prevent misdiagnosis and facilitate early treatment.

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## Ethical approval

The Institutional Review Board approval is not required.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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## Conflicts of interest

There are no conflicts of interest.

## Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

## REFERENCES

- Compagne KC, Dilba K, Postema EJ, van Es AC, Emmer BJ, Majoie CB, *et al.* Flow patterns in carotid webs: A patient-based computational fluid dynamics study. *AJNR Am J Neuroradiol* 2019;40:703-8.
- Coutinho JM, Derkatch S, Potvin AR, Tomlinson G, Casaubon LK, Silver FL, *et al.* Carotid artery web and ischemic stroke: A case-control study. *Neurology* 2017;88:65-9.
- Haussen DC, Grossberg JA, Bouslama M, Pradilla G, Belagaje S, Bianchi N, *et al.* Carotid web (intimal fibromuscular dysplasia) has high stroke recurrence risk and is amenable to stenting. *Stroke* 2017;48:3134-7.
- Kim SJ, Nogueira RG, Haussen DC. Current understanding and gaps in research of carotid webs in ischemic strokes: A review. *JAMA Neurol* 2019;76:355-61.
- Liang S, Qin P, Xie L, Niu S, Luo J, Chen F, *et al.* The carotid web: Current research status and imaging features. *Front Neurosci* 2023;17:1104212.
- Luo X, Li Z. Ultrasonic risk stratification of carotid web. *Echocardiography* 2019;36:2103-7.
- Madaelil TP, Grossberg JA, Nogueira RG, Anderson A, Barreira C, Frankel M, *et al.* Multimodality imaging in carotid web. *Front Neurol* 2019;10: 220.
- Osehobo EM, Nogueira RG, Koneru S, Al-Bayati AR, de Camara CP, Nahab F, *et al.* Carotid web: An under-recognized and misdiagnosed ischemic stroke etiology. *J Neurointerv Surg* 2022;14:138-42.
- Ozaki D, Endo T, Suzuki H, Sugiyama SI, Endo K, Itabashi R, *et al.* Carotid web leads to new thrombus formation: Computational fluid dynamic analysis coupled with histological evidence. *Acta Neurochir (Wien)* 2020;162: 2583-8.
- Patel SD, Otite FO, Topiwala K, Saber H, Kaneko N, Sussman E, *et al.* Interventional compared with medical management of symptomatic carotid web: A systematic review. *J Stroke Cerebrovasc Dis* 2022;31:106682.
- Pereira BJ, Batista UC, Tosello RT, Ströher IN, Baeta AM, Piske RL. Web vessels: Literature review and neurointerventional management. *World Neurosurg* 2018;110:e907-16.
- Semerano A, Mamadou Z, Desilles JP, Sabben C, Bacigaluppi M, Piotin M, *et al.* Carotid webs in large vessel occlusion stroke: Clinical, radiological and thrombus histopathological findings. *J Neurol Sci* 2021;427:117550.
- Wang Y, Li HL, Xu XH, Ye JH, Li J. New asymptomatic thrombosis caused by carotid web during the acute period of cerebral infarction. *BMC Neurol* 2023;23:264.
- Yu Y, Wang B, Zheng S, Kou J, Gu X, Liu T. Carotid web and ischemic stroke: A CT angiography study. *Clin Imaging*

2020;67:86-90.

15. Zhang AJ, Dhruv P, Choi P, Bakker C, Koffel J, Anderson D, *et al.* A systematic literature review of patients with carotid web and acute ischemic stroke. *Stroke* 2018;49:2872-6.

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