


Contrast-enhanced transoral carotid ultrasonography for the evaluation of plaque protrusion after carotid artery stenting

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Abstract

A 67 year-old man was admitted to our hospital because of mild left hemiparesis and was diagnosed with cerebral infarction caused by right internal carotid artery stenosis. He was treated with dual antiplatelet therapy and scheduled for carotid artery stenting 14 days after onset. The preoperative right carotid angiogram showed 60% stenosis by the NASCET criteria, with an ulcer. The postoperative angiogram suggested protrusion in the stent, which could not be seen on conventional carotid ultrasonography because of its high location. On transoral carotid ultrasonography, clear delineation of the lesion was not possible due to color blurs. Contrast-enhanced transoral carotid ultrasonography (CETOCU) clearly demonstrated the protrusion and delineated the lumen within the stent.

KEYWORDS

contrast-enhanced ultrasonography, internal carotid artery, stenosis, stenting, transoral approach

1 | INTRODUCTION

Transoral carotid ultrasonography (TOCU) is a useful imaging modality for diagnosis of extracranial internal carotid artery (ICA) lesions.¹ Contrast-enhanced transoral carotid ultrasonography (CETOCU) provides a clear intraluminal image of the distal extracranial ICA that cannot be reached from the neck.²⁻⁴ We report the case of a patient with plaque protrusion after carotid artery stenting (CAS), in whom CETOCU offered clear and detailed images of the protrusion.

2 | CASE PRESENTATION

A 67-year-old man with no remarkable previous personal or family medical history was admitted to our hospital because of mild left hemiparesis. Magnetic resonance imaging (MRI) showed multiple cerebral infarctions in the right watershed area. He was diagnosed with cerebral infarction caused by right ICA stenosis and treated with dual antiplatelet therapy. The preoperative carotid angiography confirmed the presence of an ulcerated atherosclerotic plaque producing 60% stenosis according to the North American Symptomatic Carotid Endarterectomy Trials (NASCET) method (Figure 1). His symptoms recovered after

therapy, and he was scheduled for CAS 14 days after onset. We chose CAS rather than endarterectomy because the stenotic lesion was located very distally.

Because of the length of the stenotic lesion, we planned to use two stents. We placed the first stent (carotid Wall-stent 10 mm × 31 mm; Boston Scientific, Natick, Massachusetts) after balloon predilation, then a second stent (Precise 7 mm × 30 mm; Johnson & Johnson, Cordis, Miami, FL). We did not perform balloon post-dilation. The carotid angiogram immediately after stenting suggested plaque protrusion within the stents (Figure 2). Since the protrusion was observed immediately after the stent placement, a newly developed plaque or a thrombus within the stent seemed unlikely. 3D-CT angiography (CTA) on the day after CAS showed two protrusions in the stents (Figure 3). Conventional carotid ultrasonography failed to demonstrate the lesions because of their distal location and poor rendering of color-Doppler imaging in the stent lumen. TOCU with color-Doppler was performed, but did not clearly show the protrusions because the lesions were hypo-echoic (Figure 4). On the contrary, CETOCU clearly demonstrated plaque protrusions inside the stents (Figure 5 and video-clip). It enabled to evaluate in detail the size, morphology, and position of the protrusions. Based on the CETOCU images, anticoagulation was started in



FIGURE 1 Right carotid angiogram before carotid artery stenting. A, Anteroposterior view. B, Lateral view. Right carotid angiogram shows 60% stenosis of the right internal carotid artery by NASCET criteria, with an ulcer

in addition to the dual antiplatelet therapy to prevent secondary thrombus formation and occlusion. The patient remained asymptomatic, and the protrusions diminished. Thus, the patient was discharged 14 days after CAS.

3 | DISCUSSION

Contrast-enhanced carotid ultrasound (CEUS) with perfluorobutane microbubbles as a contrast agent can be used to assess the stability of



FIGURE 2 Right carotid angiogram after carotid artery stenting. A, Anteroposterior view. B, Lateral view. Right carotid angiogram after stenting suggesting plaque protrusion within the stent

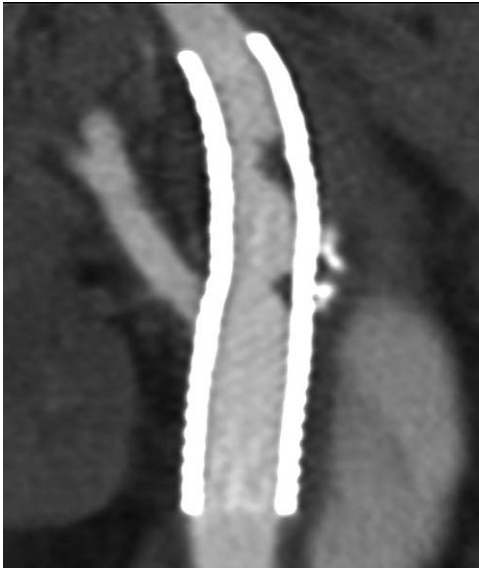


FIGURE 3 3-D CT angiography (CTA) of the right carotid artery after stenting, lateral view. CTA after stenting shows two plaque protrusions in the stent. There is a small protrusion at the bifurcation of the carotid artery, and the distal protrusion is larger than the proximal one

carotid atherosclerotic plaques.⁵ While CEUS is used to evaluate plaque stability, CETOCU, like CT and carotid angiography, is used to observe the vessels themselves. Moreover, it is capable of clearly visualizing hypoechoic lesions. Depending on the location of the lesion, CETOCU may deliver a more useful image than carotid angiography with the advantage of being less invasive.

Plaque protrusion in the stent is one of the serious complications that can lead to cerebral infarction after CAS. Intravascular ultrasound (IVUS) and CTA are currently the most used modalities for the evaluation of plaque protrusion in stents.^{6–8} Although these imaging modalities are minimally invasive, they cannot be repeated within a few days. The advantages of CETOCU over CTA are that it is less-invasive, and the contrast agent is non-nephrotoxic and less allergenic than the CT contrast agent. Unlike CTA and carotid angiography, there is no

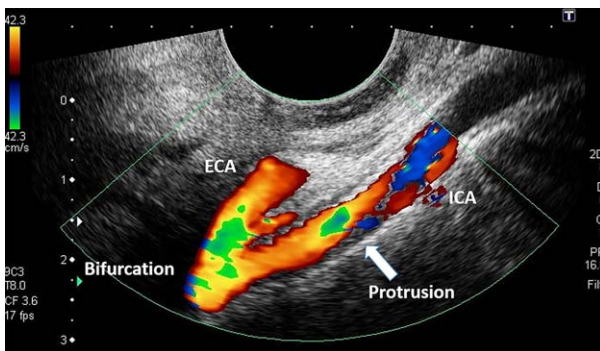


FIGURE 4 Transoral carotid ultrasonography (TOCU) with color Doppler imaging of the right carotid artery. TOCU of the right carotid artery after stenting suggests plaque protrusion in the middle of stent. However, the proximal protrusion detected by CTA is not visible

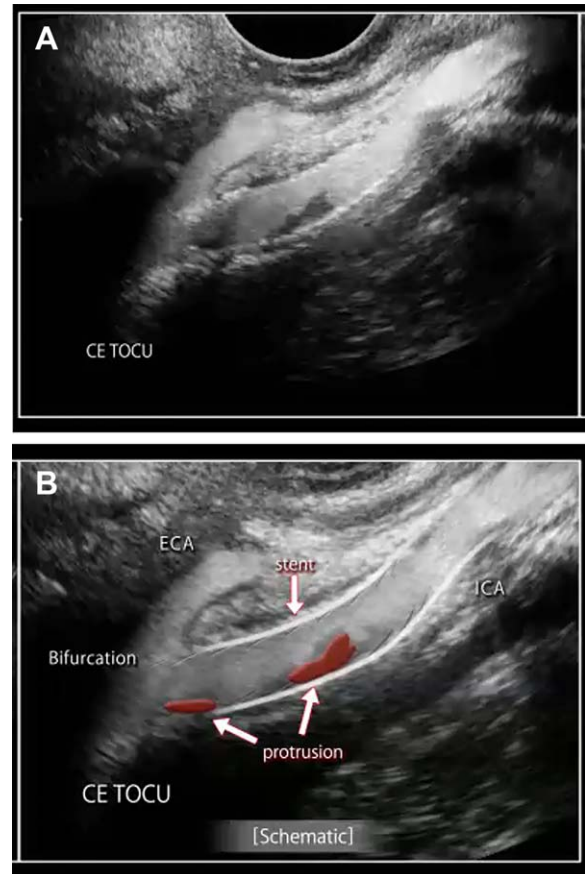


FIGURE 5 Contrast-enhanced transoral carotid ultrasonography (CETOCU) of the right carotid artery after stenting, with schematic images. Compared to the transoral carotid ultrasonography with color Doppler imaging shown in Figure 5, CETOCU clearly demonstrates the proximal and distal protrusions in the stent (video clip)

exposure to radiation in CETOCU. Moreover, CETOCU can be repeatedly performed with simple preparation at the bedside, even if the patient has renal impairment.

Conventional TOCU is well suited to observing lesions located in the upper extracranial ICA,¹ from the carotid bifurcation to the second cervical vertebra. It has the advantages of bedside availability, absence of exposure to radiation, minimal invasiveness, lower cost, and absence of significant contraindication. TOCU is particularly useful for patients with high-located carotid bifurcation. However, conventional color-Doppler imaging remains poor within the stent, and hypoechoic lesion can be missed or improperly delineated. On the contrary, contrast-enhanced TOCU offers a clear delineation between the plaque protrusion and the vessel lumen.

CETOCU is a useful method to evaluate plaque protrusion in stents, where it is preferable to repeated carotid angiograms and CTA.

ETHICAL APPROVAL

All procedures followed were approved by the St. Marianna University Bioethics Committee and performed in accordance with the Helsinki Declaration of 1964 and later versions.

INFORMED CONSENT

Informed consent was obtained from the patient for inclusion in this study.

CONFLICT OF INTEREST

The all authors have no conflicts of interest to declare.

DISCLOSURE

Dr. Yuta Hagiwara reports no disclosures.

Dr. Tomohide Yoshie reports no disclosures.

Dr. Takahiro Shimizu reports no disclosures.

Dr. Takayuki Fukano reports no disclosures.

Dr. Tatsuro Takada reports no disclosures.

Dr. Toshihiro Ueda reports no disclosures.

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SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

How to cite this article: Hagiwara Y, Yoshie T, Shimizu T, et al. Contrast-enhanced transoral carotid ultrasonography for the evaluation of plaque protrusion after carotid artery stenting. *J Clin Ultrasound*. 2018;00:1–4. <https://doi.org/10.1002/jcu.22599>