CASE REPORT

A lotus root-like appearance in carotid stenosis on optical coherence tomography

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SUMMARY

An 82-year-old man visited the outpatient clinic of our stroke centre because of dizziness. He had a previous history of stroke without definite sequelae. Severe stenosis in the left proximal internal carotid artery (ICA) was seen on Doppler sonography. Conventional angiography revealed focal severe stenosis with 'string sign' in the left proximal ICA and delayed distal run off. Optical coherence tomography showed multiple channels surrounding a narrowed central lumen (lotus root-like appearance). Carotid stent placement with a protection device was done without complications. The patient was discharged in good condition 5 days after the procedure.

BACKGROUND

Optical coherence tomography (OCT) is a relatively new technique which produces the highest resolution (10–15 µm) in vivo image of any currently available vascular imaging technique.^{1 2} It is an invasive intravascular imaging modality which can be used to accurately identify lipid, calcium, fibrous tissue, thin cap fibroatheroma, intraluminal thrombus, calcified nodules and vascular inflammation.^{1 2}

OCT is being increasingly used to examine the coronary arteries and is just beginning to be used to study the carotid artery.

Here, we describe an interesting vascular sign with OCT correlation.

CASE PRESENTATION

A 82-year-old man visited the outpatient clinic of our stroke centre because of dizziness. He had a previous history of stroke without definite sequelae. He had been taking aspirin and clopidogrel for several years.

Severe stenosis in the left proximal internal carotid artery (ICA) was seen on Doppler sonography. Carotid magnetic resonance angiography revealed severe stenosis in the left proximal ICA. The clinical examination was unremarkable except for a left neck bruit.

We offered the patient and his family either a carotid endarterectomy or carotid artery stent (CAS) placement; they chose CAS because of the shorter hospital admission time and minimally invasive procedure. The patient was admitted for the elective procedure and informed of the

potential risks and complications of the procedure (figure 1 and video 1).

TREATMENT

Conventional angiography revealed focal severe stenosis with 'string sign' in the left proximal ICA and delayed distal run off. An 8F Guide Softip XF guide catheter (Stryker Neurovascular, Fremont, California, USA) was placed in the left common carotid artery. A 4 mm Spider device (ev3, Plymouth, Minnesota, USA) was used for embolic protection. Before balloon angioplasty, OCT (C7 OCT imaging system, St Jude Medical, St Paul, Minnesota, USA) was carried out and revealed multiple channels surrounding a narrowed central lumen (lotus root-like appearance). A 4/30 mm Submarine balloon (Invatec, Brescia, Italy) was used for angioplasty and carotid stent placement was done with a 7–10×40 mm Cristallo Ideale stent (Invatec, Roncadelle, Italy). There were no immediate post-procedure complications.

OUTCOME AND FOLLOW-UP

The patient was discharged in good condition 5 days after the procedure.

At the first follow-up 2 weeks after discharge, the patient was in good condition with no definite neurological symptoms.

DISCUSSION

'String sign' in the carotid artery is defined as subtotal occlusion with a collapsed distal lumen.³ The distal lumen was not collapsed in this case, so it was not a true 'string sign'. However, there was a slight delayed distal run off, which indicated the artery would have narrowed in the future.

OCT is a light-based imaging technology for evaluating the cross-sectional and three-dimensional microstructure of blood vessels. The underlying concept of OCT is similar to that of ultrasound: by measuring the time delay of echoes reflected or backscattered from subsurface structures in biological tissues, information as a function of depth within the tissue can be obtained.⁴

Several coronary arteries with a 'lotus root-like appearance' have been visualised by OCT or intravascular ultrasound, but this is the first described carotid artery case to our knowledge.^{5–7}

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Figure 1 Conventional angiography of the common carotid artery (A) shows focal severe stenosis with 'string sign' in the proximal internal carotid artery (ICA; rectangle) and delayed distal run off. Longitudinal optical coherence tomography (OCT) (B) shows focal tight stenosis in the corresponding area. Axial OCT images of the proximal ICA (C–F) show the central lumen (stars) divided into several cavities (arrow heads) that are partitioned by intima-like walls and with organised thrombi (arrow). Despite the variability in the size of the cavities, microchannels are seen to communicate with each other. There are other thrombi (empty arrows) in the central lumen.

A 'lotus root-like appearance' is produced when thrombi undergo organisation or recanalisation to form lumens and neo-vascularisation produces variably sized, endothelium-lined vascular channels within the thrombus.

Although there is some debate about whether or not to treat carotid arteries with string sign, the nature of string sign is beginning to be elucidated with the help of OCT.³

Video 1 Axial optical coherence tomography images of the proximal internal carotid artery reveal the central lumen divided into several cavities that are partitioned by intima-like walls with organised thrombi. Despite the variability in the size of the cavities, microchannels are seen to communicate with each other. There are other thrombi (red thrombi, empty arrows) in the central lumen.

Competing interests None declared.

Patient consent Obtained.

Ethics approval Dong San Medical Centre IRB approved this study.

Provenance and peer review Not commissioned; externally peer reviewed.

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Learning points

- ▶ Intravascular optical coherence tomography (OCT) is an emerging technique which delivers the highest imaging resolution of any currently available intravascular imaging technique.
- ▶ Usually, OCT is used in the cardiac catheterisation laboratory to measure vascular dimensions for the characterisation of atherosclerotic plaques and identification of thrombus and plaque inflammation.
- ▶ In recent years there have been a few studies on OCT used to identify carotid stenosis.
- ▶ The neurointerventionist must be familiar with OCT findings.

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