Case report

Abnormality of retinal arterial velocity profiles using Doppler Fourier-domain optical coherence tomography in a case of Takayasu's arteritis with aortic regurgitation

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ABSTRACT

Purpose: To evaluate the retinal microcirculation using a segmental-scanning Doppler optical coherence tomography (DOCT) flowmeter in a patient with Takayasu’s arteritis (TA) with aortic valve regurgitation (AR).

Observations: We measured the retinal blood velocity (V), retinal blood flow (RBF), and retinal blood velocity profiles (RBVP) of the major retinal arterioles using a DOCT flowmeter. The arteries were measured at the straight portion 1 disc diameter from the optic disc. Horizontal velocity profiles were extracted to evaluate the RBVP during one cardiac cycle. A patient with TA with stage 2 Takayasu retinopathy (TR) and AR, had normal RBF and V, and the RBVP had a parabolic pattern in the systolic phase. However, the V was very slow and the RBVP had an abnormal pattern in the diastolic phase.

Conclusions and importance: The current study showed for the first time that segmental-scanning DOCT flowmeter enables evaluation of an abnormal flow pattern of the RBVP in the retinal arterioles in a patient with TA and AR. Measurement of the retinal arterial blood flow may detect aortic valve dysfunction and shed light on the pathogenesis of TR.

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1. Introduction

Takayasu's arteritis (TA) is an inflammatory arteritis involving the aorta and its major branches.1 Takayasu retinopathy (TR) is the best described ischemic ocular manifestation in TA and is classified stage 1: Dilations of small vessels, stage 2: Microaneurysm formation, stage 3: Arterio-venous anastomoses, stage 4: Ocular complications by Uyama.2 Aortic valve regurgitation (AR) in TA is an important risk factor for mortality in this disease.3 We reported that very slow retinal arterial blood velocity (V) during the diastolic phase using laser Doppler velocimetry (LDV) in a patient with TA with AR and abnormal diastolic V normalization after aortic replacement surgery indicated that retinal blood V findings in AR are related to aortic valve function.4 Although, using LDV, the V of a vessel at a given moment can be measured and retinal blood flow (RBF) calculated, it cannot be determined if the abnormal retinal arterial circulation is or is not parabolic. Recently, we developed a segmental-scanning Doppler optical coherence tomography (DOCT) flowmeter (Topcon Corp., Tokyo, Japan) with novel software, a segmental scanning method,5 that obtains automatically the absolute V value and retinal blood velocity profile (RBVP), i.e., a V profile of the red blood cells in the horizontal center of a vessel at a given moment.

To determine the status of the RBVP in TA with AR, we examined the V, RBF, and RBVP of the major retinal arterioles using a DOCT flowmeter. The arteries were measured at the straight portion 1 disc diameter from the optic disc. Horizontal velocity profiles were extracted to evaluate the RBVP during one cardiac cycle.

1.1. Case report

A 42-year-old man was presented with stagger and AR. His blood pressure was 132/52 mmHg in the right arm; blood tests showed elevated C-reactive protein (1.77 mg/dl; normal, <0.5 mg/dl). Carotid duplex ultrasound showed occluded common carotid arteries; X-ray computed tomography showed an obstructed left subclavian artery and brachiocephalic trunk artery. Aortography
showed grade II AR. TA was diagnosed based on the clinical manifestations and angiographic findings.

Bilateral funduscopic examinations showed microaneurysm in left eye and small vessel dilation in right eye (Fig. 1a). Fluorescein angiogram showed microaneurysms, slight fluorescein leakage from the peripheral vessels bilaterally (Fig. 1b), and delayed arm-to-retina time (21 seconds) in the right eye.

On the basis of all these findings we made the diagnosis of bilateral stage 2 TR. The DOCT flowmeter showed normal RBF (10.3 μL/min), with very slow V (2.3 mm/second) during the diastolic phase in the right superior temporal artery (Fig. 2a). During the systolic phase, the parabolic RBVP and its flow image were normal (Fig. 2b and c). During the diastolic phase, the RBVP was abnormal (Fig. 2d) and the flow image extremely weak (Fig. 2e).

2. Discussion

Using DOCT flowmeter, we first observed an abnormal RBVP during the diastolic phase and a parabolic RBVP during the systolic phase in a patient with TA with AR.

AR develops in 13%–25% of patients with TA. However, the relationship between AR and retinal circulation is unknown. We reported previously that the V is related to aortic valve function in TA with AR using LDV. Findings of the current case supported that study and we concluded that AR might result from blood leaking backward through the aortic valve immediately after the systolic phase followed by stagnated retinal peripheral blood flow. In addition, we speculated these findings might have caused retinal hypoperfusion during diastolic phase in the current early stage TR.

Fig. 1. a Color fundus photographs of both eyes at the first visit. A magnified view shows a microaneurysm (arrow) and a small vessel dilation (solid triangle). b Fluorescein angiogram showing microaneurysms (arrows) and slight fluorescein leakage from peripheral vessels (solid triangles) in both eyes. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)
patient. Taken together, it is important to analyze the V and RBVP during one cardiac cycle in patients with TA.

3. Conclusions

We revealed abnormal RBVP in a case of TA patient with AR for the first time. Our DOCT system enables measurement of the human retinal microcirculation and seems to reflect changes in the systemic circulation, i.e., aortic valve dysfunction.

3.1. Patient consent

The institutional review board and the ethics committee of Asahikawa Medical University approved this study. The study protocol adhered to the tenets of the Declaration of Helsinki. The patient’s legal guardian consented in writing to publication of the case.

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Authorship

All authors attest that they meet the current CMJE criteria for authorship.

Conflict of interest

Akitoshi Yoshida has financial/conflicting interests of Topcon, Japan (Patent).

The corresponding author (Tomofumi Tani) has no financial/conflicting interests to disclose.

Taiji Nagaoka has no financial/conflicting interests to disclose.

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