Differentiating Branch Retinal Artery Occlusion From Normal Tension Glaucoma With Optical Coherence Tomography Angiography

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Background: To describe a patient with branch retinal artery occlusion that was misdiagnosed as normal tension glaucoma (NTG)

Case Presentation: A female 76-year-old patient presenting inferior nasal visual field scotoma, neuroretinal thinning in the optic disk of the right eye with corresponding atrophy of superior retinal nerve fiber layer in optical coherence tomography (OCT). She was treated with latanoprost eye drops for NTG. However macular OCT angiography showed a localized thinning of the inner retina following the superior temporal branch retinal artery path, along with a superficial and medium capillary plexus reduction and superior macular ganglion cell layer atrophy. Further investigation with carotid arteries angio-tomography revealed an atheromatous lesion in the right and left carotid bulb with stenosis of 50–60%, in addition to aneurysms of the cavernous, pituitary and communicating segments of the left and right internal carotid artery, reinforcing the diagnosis of superior temporal branch retinal artery ischemic.

Conclusion: This case highlights the importance of establishing differential diagnosis in cases of presumed NTG and reinforces the use of the OCT angiography in clinical practice.

Key Words: normal tension glaucoma, retinal artery occlusion, visual field defect, nonglaucomatous optic disk cupping, case report

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BACKGROUND

Normal tension glaucoma (NTG) can represent a challenging diagnosis because it is characterized by progressive optic neuropathy characteristics, such as the retinal nerve fibers layer (RNFL) loss, associated or not with visual field defects, but with intraocular pressure (IOP) below 21 mmHg.[1] Among the main differential diagnoses that resemble NTG, we have posterior uveitis, macular dystrophies, compressive, hereditary or deficiency optic neuropathies, and optic disk ischemia.[1] Although the true glaucomatous lesion usually progresses, the ischemic insult has an acute and nonprogressive onset.

The occlusion of the central retinal artery or one of its branches is caused by an embolus originated from internal carotids atherosclerotic deposits.[2] In its acute ischemic

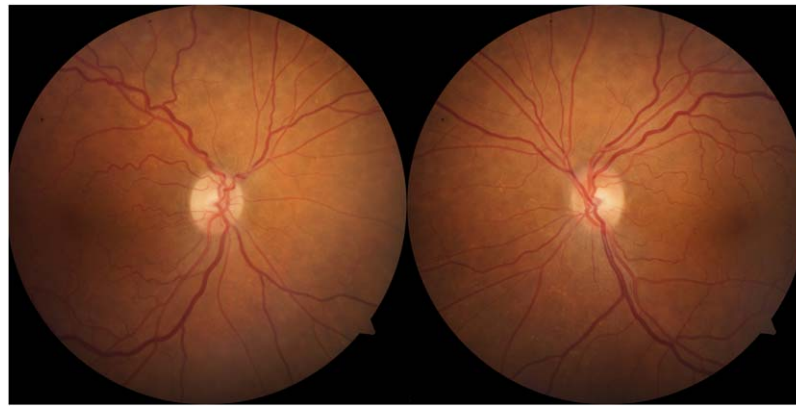

FIGURE 1. Images from retinography (Visucam 524, Carl Zeiss Meditec, Inc, Dublin, CA) showing optic nerve cupping and normal retina in both eyes.

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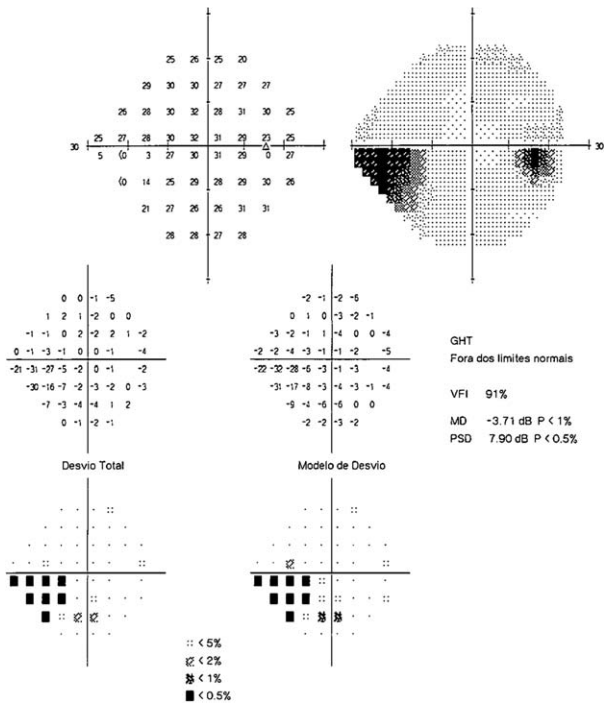

FIGURE 2. Standard automated perimetry were obtained using the Humphrey Field Analyzer II, model 750i (Carl Zeiss Meditec, Inc, Dublin, CA) showed inferior nasal step in the right eye.

phase, the affected retinal portion is whitish owing to intracellular edema of the nerve and ganglionic fiber layer.[3] However, in late phase, the retinal edema involutes, with atrophy of RNFL, evolving with paleness and/or notching of the neural rim, in addition to a corresponding visual field defect that may or may not respect the horizontal meridian, simulating a nasal step, paracentral scotoma, or even an arcuate defect, like glaucoma.

In these circumstances, we will discuss the case of a patient previously diagnosed as NTG, owing to presumed glaucomatous visual field defect associated with RNFL loss at optical coherence tomography (OCT) and an IOP within normal limits. However, due to the structural finding in OCT, the possibility of branch retinal artery occlusion (BRAO) was suggested as the cause of the structural and functional optic disk damage, mimicking the NTG.

CASE PRESENTATION

A 76-year-old, Caucasian, female patient with visual acuity of 20/20 in both eyes, with IOP of 10 mmHg in the right eye and 8 mmHg in the left eye. Dilated fundus examination and retinography (Visucam 524, Carl Zeiss Meditec, Inc, Dublin, CA) showed 0.5×0.5 optic nerve cupping in both eyes with subtle pallor in the temporal superior neuroretinal rim and absence localized rim thinning, arteriolar attenuation, arteriole sheathing, abnormal vasculature, or signs of Hollenhorst plaques (Fig. 1). Posner lens gonioscopy revealed an open angle (visualized up to the scleral spur at 360 degrees) in both eyes. Standard automated perimetry (SAP) were obtained using the Humphrey Field Analyzer II, model 750i (Carl Zeiss Meditec, Inc, Dublin, CA) showed a inferior nasal step in the right eye (Fig. 2).

We also observed RNFL and ganglion cell layer (GCL) thinning in the temporal superior quadrant of the right eye (Fig. 3) in OCT images (Avantis, Optovue, Fremont, CA). We initiated latanoprost eye drops prescription once a day in both eyes considering NTG as diagnosis. Spectral domain (SD)-OCT B scans (Spectralis; Heidelberg Engineering GmbH, Heidelberg, Germany) showed a normal foveal contour and GCL and inner plexiform layer atrophy along the superior temporal quadrant at perifoveal regions (Fig. 4A). No changes were observed in macular layers in the left eye (Fig. 4B). Decreased vascular density in

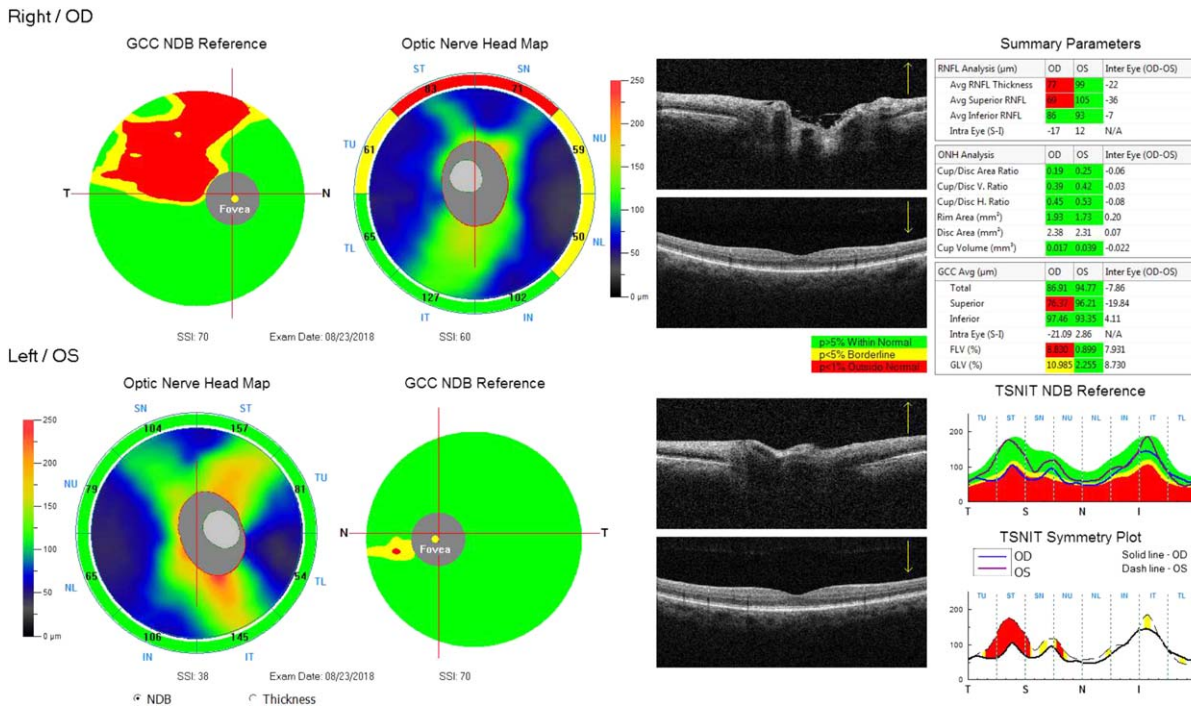

FIGURE 3. Optical coherence tomography (Avantis, Optovue, Fremont, CA) showing retinal nerve fiber layer and ganglion cell layer thinning in the temporal superior quadrant of the right eye.

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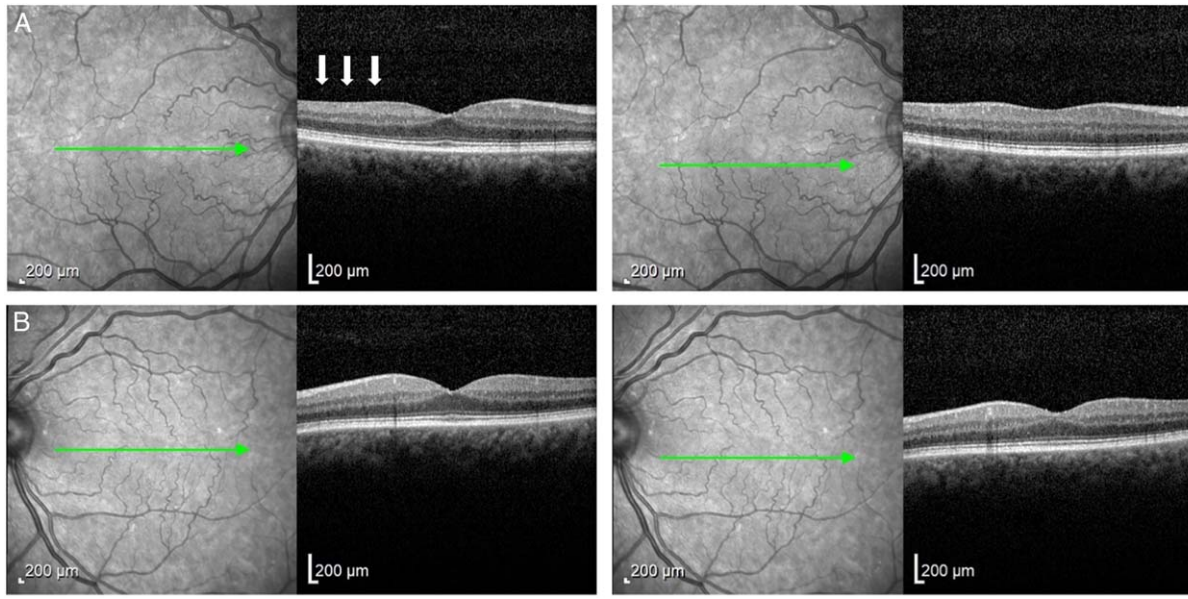

FIGURE 4. A, Optical coherence tomography (Spectralis; Heidelberg Engineering GmbH, Heidelberg, Germany) near infrared fundus images with the selected B scan-lines of the right macula with ganglion cell layer and inner plexiform layer thinning (with arrows). B, Optical coherence tomography (Spectralis; Heidelberg Engineering GmbH, Heidelberg, Germany) near infrared fundus images with the selected B scan-lines of the left macula.

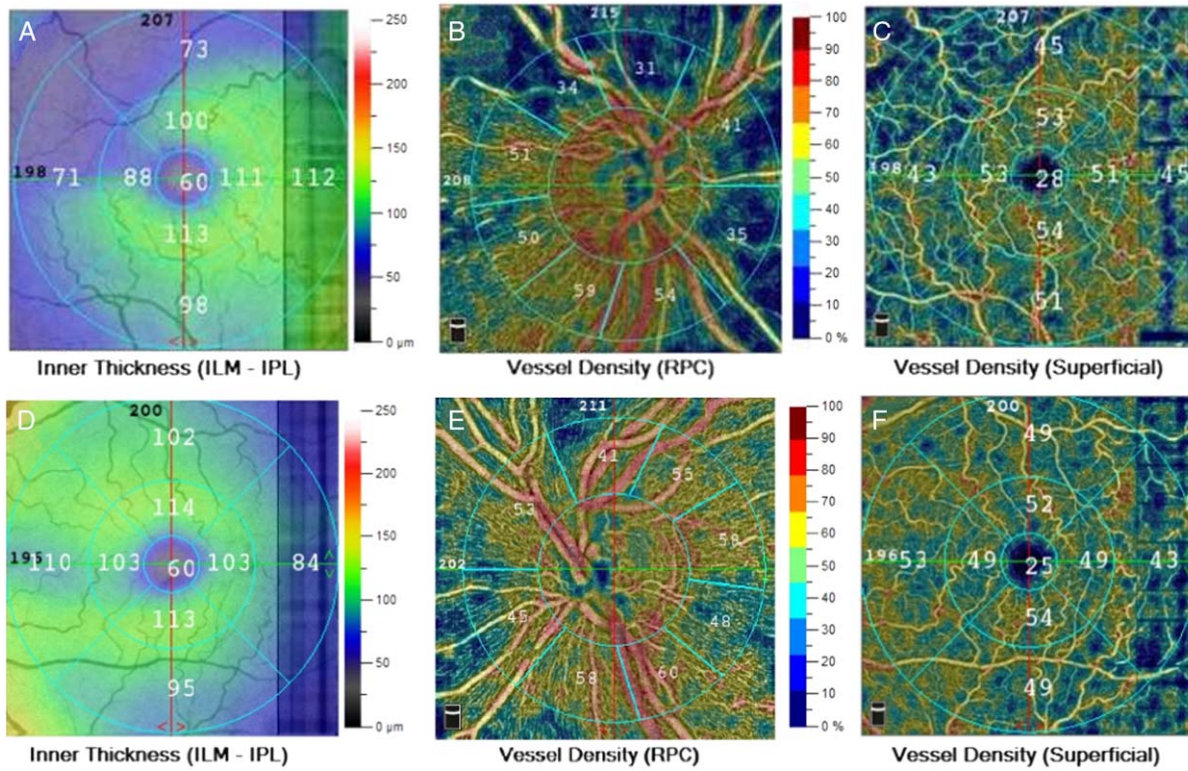

FIGURE 5. A, Macular optical coherence tomography (OCT) (Avantis, Optovue, Fremont, CA) thickness map, showing reduced inner retina thickness at the superotemporal region. B, Optic disk OCT angiography shows reduced papillary vascular density in the superotemporal and nasal regions. C, Macular OCT angiography shows superficial capillary plexus loss at superotemporal region. D, Left SD-OCT macular thickness map showing normal inner retina thickness. E, Left optic disk OCT angiography shows normal papillary vascular density. F, Normal superficial capillary plexus at left macula through OCT angiography.

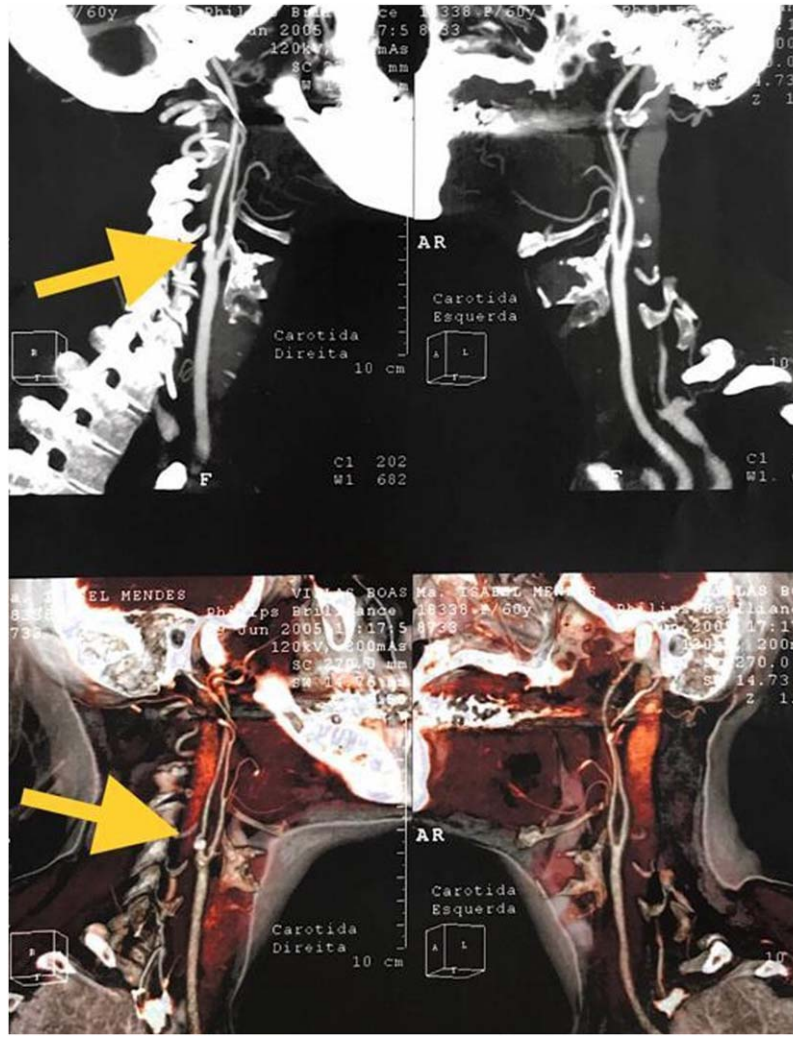

FIGURE 6. Carotid arteries angio-tomography showing an important atheromatous lesion in the right carotid bulbs, with stenosis of 50–60% of flow and no significant presence of atheromatous changes on the left carotid artery.

the superficial plexus demonstrates ischemia of the region supplied by the superotemporal branch of the retinal artery as observed on OCT angiography (OCT A). Macular superficial capillary density was reduced at superior and temporal regions when compared with the fellow eye (Fig. 5A). Peripapillary capillary density was reduced in the superotemporal and nasal regions (Fig. 5B). Thickness map depicted the area of inner retina thinning at the superior and temporal quadrants (Fig. 5C). Comparing with the left eye, no changes were observed in OCT angiography (Fig. 5D-F).

Owing to the superior macular GCL atrophy identified in OCT scans of the right eye with inner nuclear layers (bipolar cells), inner plexiform, and RNFL thinning (Fig. 4A), the diagnosis of BRAO was suspected. The patient was then referred to a cardiac consultation and returned with carotid arteries angio-tomography showing an atheromatous lesion in the right and left carotid bulbs with stenosis of 50–60% of flow (Fig. 6), in addition to aneurysms of the cavernous, pituitary and communicating segments of the internal carotid artery (ACI) left and right. Serial analysis of SAP and OCT from September 2019 to October 2021 showed no significant changes and we discontinued the ocular hypotensive medication. After the latanoprost washout, the patient maintained an IOP of 12mmHg in both eyes and SAP and OCT exams remained without changes.

DISCUSSION AND CONCLUSIONS

This case highlights the importance of performing differential diagnosis in cases of presumed NTG. We described a case of patient that was initially treated with prostaglandins for glaucoma owing to typical findings from the disease (nasal step with topographically corresponding RNFL loss) but during follow-up findings from OCT-A help to elucidate the correct diagnosis. This case report also reinforces the use of imaging devices such as OCT that can help to identify and distinguish patterns of structural loss from different pathologies.

At examination, a mild upper temporal sectorial pallor of the right eye neuroretinal rim was noted (despite not evident in Fig. 1), which is not common in glaucomatous disks. The probability of being a non-arteritic anterior ischemic optic neuropathy sequel was less likely due to the findings from OCT angiography (OCT-A), which showed important and localized structural thinning of the inner retina following the superior temporal branch retinal artery path, along with a superficial and medium capillary plexus reduction. The OCT scans also identified

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that the inner nuclear layers (bipolar cells), inner plexiform, and retinal nerve fiber layer were affected, which is not expected to occur in glaucoma. The carotid arteries angio-tomography confirmed the stenosis of 50–60% of the flow, in addition to aneurysms of the cavernous, pituitary, and communicating segments of the left and right ACI, reinforcing the diagnosis of BRAO in detriment of NTG. As the ischemic insult diagnostic hypothesis was considered and because of the high risk of new thromboembolic events, the cardiologist performed a carotid stent procedure and maintained the prophylactic use of statin associated with antiplatelet agents.

Patients presenting with a central retinal artery occlusion typically describe a sudden, painless decrease in the visual acuity and field of vision in one eye that can occurs over a period of seconds.[4] In BRAO cases, patient may not notice visual field loss and acute central visual loss may not occur. In addition, it is possible that the micro embolus caused a partial infarction, allowing the penumbra area recovery, allowing the relative ganglion, bipolar, horizontal, and amacrine cells preservation, making the scotoma be relative and not absolute, as usually found in retinal ischemia sequelae. Several studies have described the risk factors for developing BRAO, mostly related to aging, ethnicity, gender, lifestyle habits, and systemic diseases. Our patient shares a significant amount of them. Our patient presented age older than 65 years and a Caucasian descent. According to studies, Caucasian are more prone to develop extracranial carotid artery disease, leading to a thromboembolic event, than other populations, such as Hispanic and Asian persons.[5,6] Further key risk factors include her systemic conditions like hypertension and hyperlipidemia, which could have strongly contributed to atherosclerosis and carotid stenosis above 50%, significantly associated with increased odds of retinal emboli.[7,8]

It is well known that chronical atherosclerosis can progressively affect many blood vessels, including the ocular blood flow. With aging, this dysfunctional ocular blood flow and compromised perfusion could represent a risk factor for an artery occlusion, like a BRAO.[9,10] At the same time, dysfunctional ocular blood flow has also been raised as a significant factor in the pathogenesis of NTG.[11] The vascular failure, including small-vessel disease, autoregulatory dysfunction, or vasospasms, could lead to deficits on the perfusion of the optic nerve head and retina, causing the development of NTG.[12] Thus, we cannot discard the hypothesis of the patient present two concomitant diagnosis - BRAO and NTG. Differentiating these 2 diagnoses can be challenging. However, specific findings in her OCT scans do not suggest concomitant diagnosis of both diseases. The OCT angiography with decreased vascular density in the superficial plexus demonstrates ischemia of the region supplied by the superotemporal branch of the retinal artery, suggest the hypothesis for BRAO. In addition to that, the OCT B scans also identified a normal foveal contour with an area of GCL and inner plexiform layer thinning along the superior temporal quadrant at parafoveal and perifoveal regions, which is not expected to occur in glaucoma.

The use of imaging devices to differentiate glaucoma and retinal disorders is not new. In fact, Sullivan-Mee et al[13] previously compared clinical factors between in patients with primary open angle glaucoma (n = 52) and patients with BRAO (n = 11). They found that BRAO can be efficiently and effectively differentiated from primary open angle glaucoma using SD-OCT macular thickness parameters, corroborating our findings. In conclusion, the use of imaging devices, such as OCT angiography can help to identify and distinguish patterns of structural loss from different pathologies.

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