C A S E R E P O R T

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Color Doppler imaging features in patients presenting central retinal artery occlusion with and without giant cell arteritis

Karakteristike kolor dopler snimanja kod bolesnika sa okluzijom centralne retinalne arterije sa i bez arteritisa džinovskih ćelija

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Abstract

Introduction. Central retinal artery obstruction (CRAO) represents an abrupt diminution of blood flow through the CRA that is severe enough to cause ischemia of the inner retina with permanent unilateral visual loss. We presented the role of color Doppler imaging (CDI) of orbital vessels and of extracranial duplex sonography (EDS) in the etiological diagnosis of CRAO in two patients with clinical suspicion of unilateral CRAO. **Case report.** Patients were examined following the protocol which included CDI of orbital vessels and EDS. Both patients had no emboli visible on ophthalmoscopy. The B-scan ultrasound evaluation of the first patient found a small round, moderately reflective echo within the right optic nerve, 1.5 mm behind the optic disc (emboli of cholesterol). CDI of retrobulbar vessels revealed the normal right ophthalmic artery (OA) hemodynamic parameters, but the first patient had no arterial flow signal on CDI at the distance of 1.5 mm behind the right optic disc. In contrast, the left eye had the normal aspect on CDI of retrobulbar vessels. The right internal carotid artery EDS identified a severe stenosis at its origin as CRA's emboli source. The second patient had characteristic CDI findings for giant cell arteritis (GCA) with eye involvement: severe diminished blood flow velocities, especially end-diastolic velocities, in both CRAs. Less abnormalities were observed in the posterior ciliary arteries, and in the ophthalmic arteries. The second patient had no systemic symptoms or signs of GCA. **Conclusion.** In the presented cases, the ultrasound investigation enabled prompt differentiation between central retinal artery occlusion of embolic mechanism and CRAO caused by GCA.

Key words:
retinal artery occlusion; ultrasonography, doppler, color; giant cell arteritis; diagnosis, differential.

Apstrakt

Uvod. Opstrukcija centralne retinalne arterije (OCRA) predstavlja naglo smanjenje protoka krvi kroz CRA koje može da izazove ozbiljnu ishemiju unutrašnje retine trajnim jednostranim gubitkom vida. Cilj rada bio je da se proceni uloga kolor dopler snimanja (KDI) orbitalnih sudova i ekstrakranijalne dupleks sonografije (EDS) u etiološkoj dijagnostici OCRA. **Prikaz bolesnika.** Dva bolesnika sa kliničkom sumnjom na jednostrani desni OCRA ispitana su primenom složenog protokola uključujući i KDI orbitalnih sudova. Nisu ustanovljene embolije vidljive na oftalmoskopiji. Na B-sken ultrazvučnoj evaluaciji prvog bolesnika pronađen je mali krug, umereno reflektujući eho unutar desnog očnog živca, 1,5 mm iza optičkog diska. KDI retrobulbarnih krvnih sudova prikazao je normalne hemodinamičke parametre oftalmičke arterije (OA), bez prisustva signala arterijskog protoka na KDI na rastojanju od 1,5 mm iza desnog optičkog diska. Nasuprot tome, levo oko imalo je normalan KDI aspekt retrobulbarnih sudova. Ultrazvučnim pregledom na početnom delu desne *a. carotis intenae* identifikovana je velika stenoza, kao izvor CRA embolije. Drugi bolesnik imao je karakterističan KDI nalaz za arteritis džinovskih ćelija (GCA) sa učešćem oka: visok indeks otpora u svim retrobulbarnim sudovima (sa izrazitim smanjenjem brzine protoka krvi, posebno end-dijastolne brzine, u pogođenoj desnoj CRA). Bolesnik nije imao sistemske simptome, ni znake GCA. **Zaključak.** Ultrazvučna dijagnostika omogućuje brzu orijentaciju u pogledu digitalne dijgnoze između OCRA embolijskog mehanizma nastanka i OCRA izazvane prisustvom GCA.

Ključne reči:
okluzija retinalne arterije; ultrasonografija, dopler, kolor; arteritis, džinovske ćelije; dijagnoza, diferencijalna.

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Introduction

Central retinal artery obstruction (CRAO) is the result of an abrupt diminution of blood flow in the central retinal artery (CRA), severe enough to cause ischemia of the inner retina with permanent unilateral visual loss [1–3]. Frequently, the blockage is located within the optic nerve substance and for this reason, it is generally not visible on ophthalmoscopy [1–3]. We presented the role of color Doppler imaging (CDI) of orbital vessels and extracranial duplex sonography (EDS) in the etiological diagnosis of CRAO in two patients with clinical suspicion of acute unilateral right CRAO.

Case report

Two patients were examined at presentation in our ophthalmology and neurology departments in January 2012 with the following protocol: collection of detailed history of all previous or current systemic diseases, including arterial hypertension, diabetes mellitus, hyperlipidemia, atrial fibrillation (AF), valvular diseases, ischemic heart disease, stroke, carotid artery disease, systemic coagulopathies (including thrombophilias), and vasculitis, including giant cell arteritis (GCA); complete physical examination, including the temporal arteries (Tas), was performed by a neurologist and an internist in order to detect eventual temporal arteritis as part of GCA; comprehensive ophthalmic evaluation, conducted by an ophthalmologist by recording visual acuity with the Snellen visual acuity chart, visual fields with a Goldmann perimeter, relative afferent pupillary defect, intraocular pressure, slit-lamp examination of the anterior segment, lens and vitreous, direct ophthalmoscopy, and color fundus photography; laboratory workup, including erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), factor V Leiden mutation, etc; cranial computed tomography (CT) scanning, in order to identify whether stroke was associated with CRAO; CT-angiography (CT-A), performed at presentation, which allowed analysis of the arterial wall and the endoluminal part of the aorta and its branches; ECG, and transthoracic echocardiography (TTE), to detect eventual cardiac source of emboli; CDI of retrobulbar (orbital) vessels, performed with an ultrasound (US) equipment (Logic 500, GE) with a 9 MHz linear probe for detecting and measuring orbital vessel blood flow in the ophthalmic arteries (OAs), the CRAs, the superior ophthalmic veins, and the posterior ciliary arteries nasal and temporal (PCAs) [4, 5], EDS, performed with an US equipment (My Lab50 Esaote) with a 7.5–10 MHz linear array transducer to determine the carotid source of emboli and with a 10 MHz linear probe for the examination of the TAs. All CDI of retrobulbar vessels and EDS examinations were performed by the first two authors of the study. One investigator, who was unaware of the patients' diagnoses, looked only for detecting and measuring orbital and extracranial vessels blood flow. If their results disagreed, then the investigators would have examined the results together and would have reached a consensus on the findings; temporal artery biopsy (TAB) was assessed at 1 day after presentation when GCA was suspected, for the second case.

Case 1 – Central retinal artery obstruction with embolic mechanism

A 73-year old hypertensive woman presented with sudden and painless visual loss in the right eye. She had visual acuity of 20/20 in her left eye, and saw only hand movements in the right eye. Anterior segment examination was normal in both eyes. The fundus of the affected right eye presented ischemic whitening of the retina, cherry-red spot in the center of the retina, and the site of obstruction of the right CRA was not visible on ophthalmoscopy (no embolus was found).

B-scan ultrasound evaluation found a small round, moderately reflective echo within the right optic nerve, 1.5 mm behind the optic disc. This image suggested a cholesterol structure of the embolus (Figure 1a). CDI of retrobulbar vessels revealed normal right OA hemodynamic parameters, but the patient had no blood flow signal on CDI on the surface of 1.5 mm behind the right optic disc (Figure 1b). The arterial flow signal stopped at the level of emboli, and could not be recorded in front of it (right CRAO). In contrast, the left eye had the normal aspect on CDI of retrobulbar vessels, including left CRAO.

Right internal carotid artery (ICA) EDS examination, and CT-A identified a severe stenosis at its origin. TTE, the sonography of the TAs, and laboratory data were all normal, the only exception being an increased ESR (40 mm/hr). After eleven months, a diminished arterial flow signal could be detected at the level of the right CRA (Figure 1c).

Case 2 – Central retinal artery obstruction with vasculitis mechanism, due to occult giant cell arteritis

A 71-year old hypertensive man presented with CRAO of the right eye, with the abrupt painless severe loss of vision of the right eye (visual acuity 0.1), with normal anterior segment examination in both eyes, and a fundus of the right

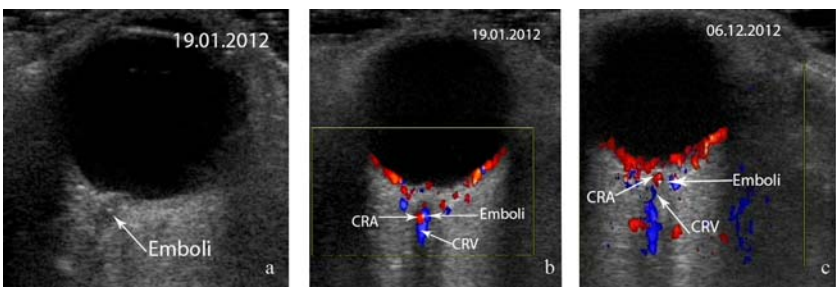

Fig. 1 – First patient: a) B-scan ultrasound evaluation of the right eye; b) Color Doppler imaging (CDI) of the right central retinal artery; c) CDI of the right central retinal artery after 11 months.

eye with ischemic whitening of the retina, and a cherry-red spot in its center. The site of obstruction of the right CRA was not visible on ophthalmoscopy.

The patient developed moderate right temporal headache, one week before presentation in our departments. The superficial TAs were normal at clinical examination, including TA's pulsation. He did not present associated systemic symptoms: fever, fatigue, and/or malaise.

A normal ESR (8 mm/hr), and the elevated CRP (6.4 mg/L) were revealed in this patient; the other laboratory data were all normal.

EDS investigated almost completely the whole length of the common superficial TAs, including the frontal and parietal branches [6, 7], and found only dark hypoechoic circumferential wall thickening (halo) around the lumen of a segment of the frontal branch of the right TA. Normal US patterns were found in all the other branches of the two external carotid arteries and for the other extracranial vessels (facial arteries, etc). TAB was guided by Doppler US of the TAs at the level of the affected segment of the frontal branch of the right TA. We observed characteristic lessions for GCA: intimal thickening, internal limiting lamina fragmentation, and chronic inflamatory infiltrate with giant cells [8].

Spectral Doppler analysis of retrobulbar vessels revealed in this case severely diminished blood flow velocities especially end-diastolic velocities (EDV) in both CRA (Figures 2a and 2b), normal values: peak systolic velocity (PSV) 17.3 ± 2.6 cm/s; EDV 6.2 ± 2.7 cm/s [4, 5], despite the fact that the left eye had the normal aspect at ophthalmoscopy. Less abnormalities were observed in the PCAs (Figures 2c and 2d), (normal values for temporal PCA: PSV: 13.3 ± 3.5 cm/s; EDV: 6.4 ± 1.5 cm/s; normal values for the nasal PCA: PSV: 12.4 ± 3.4 cm/s; EDV: 5.8 ± 2.5 cm/s) [4, 5], and in the OAs (normal values: PSV: 45.3 ± 10.5 cm/s; EDV: 11.8 ± 4.3 cm/s) [4, 5]. CT-A, and TTE were normal in this case. CT-scanning excluded strokes in both presented patients.

Discussion

Since there are no functional anastomoses between choroidal (nasal, and temporal PCAs) and retinal circulation (CRA), CRAO determines severe and permanent loss of vision, as mentioned in different studies [1–3, 9–16]. Therefore, it is very important to identify the cause of CRAO, in order to protect the contralateral eye [1–3, 9–16]. According to Gonzales-Gay [8], and Gonzales-Gay et al. [16] the majority of GCA patients with CRAO develop the classic clinical symptoms of GCA: new moderate bitemporal headache, scalp tenderness, and abnormal TAs on palpation (tender, nodular, swollen, and thickened arteries). However, in the case at hand, the second patient presented developed only new moderate right temporal headache.

Gonzales-Gay [8] and Gonzales-Gay et al. [16], along with Duker et al. [3], Connolly et al. [10], and Foroozon et al. [15] continue to argue that most of the patients with GCA and CRAO present systemic symptoms: fever, fatigue, malaise, and weight loss. Contrary to what they found, the second patient with CRAO due to GCA did not show systemic symptoms. Nevertheless, a study of Gonzales-Gay et al. [16] show that 21% of the patients with positive TAB for GCA have no systemic symptoms or signs and the only presenting sign was visual loss. He named this type of GCA occult GCA [8, 16], which matched the profile of our second patient.

Lopez-Diaz et al. [17] note that the ESR is often very high in GCA, with the levels more than 50 mm/hr (fairly suggestive of this disease). In interpreting the ESR, he observes that the levels of 40 mm/hr may be normal in the elderly [17] (as we found in our first case with CRAO due to embolic mechanism) and cases of biopsy-proven GCA have been reported in patients with ESR levels lower than 30 mm/hr [17]. In his study, approximately 20% of the patients who have a positive TAB for GCA present a normal ESR [17] (like in our second case). Lopez-Diaz et al. [17] concluded that "normal" ESR does not rule out GCA. CRP is generally raised in GCA (the normal range is < 5mg/L) [6, 8, 16]. It generally runs parallel with ESR, and may be helpful when the ESR is equivocal [6, 8, 16]. However, in some cases, Gonzales-Gay [8] and Gonzales-Gay et al. [16] demonstrated ESR elevation but not CRP. In their opinion, the combination of ESR and CRP together gives the best specificity (97%) for detection of GCA [8, 16].

Schmidt et al. [7], and Arida et al. [18] demonstrate that EDS examination of the TAs in temporal arteritis has garnered con-

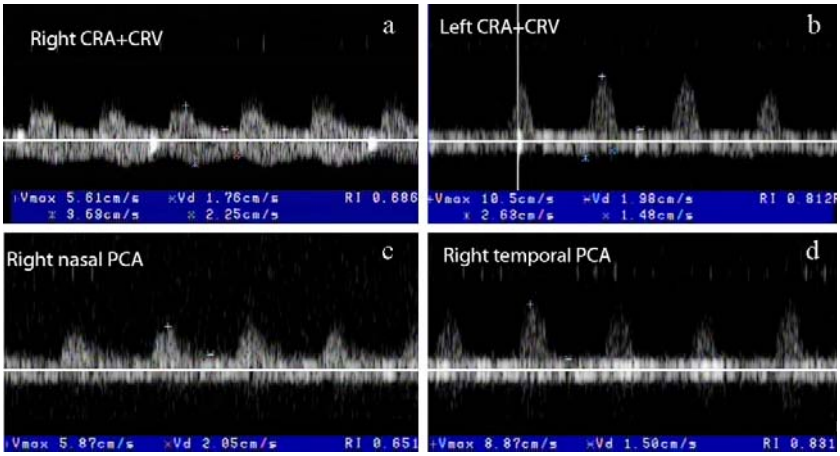

Fig. 2 – Second patient: a-d) Spectral Doppler analysis of retrobulbar vessels.

siderable interest as a GCA diagnosis tool, because it indicates segmental inflammation of TAs. A meta-analysis of Arida et al. [18] confirm that the halo sign in US is useful in diagnosing GCA. US may also detect inflamed TAs in patients with clinically normal TAs [6, 7, 18], as we observed in our second case.

Schmidt et al. [7] compared the results of TAs EDS examinations with the occurrence of visual ischemic complications (CRAO, arteritic anterior ischemic optic neuropathies, etc) in patients with newly diagnosed active GCA. However, findings of TAs EDS did not correlate with eye complications. For this reason, CDI of retrobulbar vessels is of critical importance. In Foroozon et al.'s [15] opinion, this technique is able to detect certain orbital vascular abnormalities in patients with CRAO, because it indicates the direction of blood flow, and allows calculation of the PSV, EDV, and the mean velocities of flow, and estimation of the resistence index (RI) of these vessels. These abnormalities are not detected by the standard diagnostic modalities now used to evaluate permanent monocular blindness [6, 15]. In the first case, diagnostic imaging (including CT-A, neurosonological investigations, ECG, TTE, etc) revealed a large-artery atherosclerosis etiology (ICA's severe stenosis) for CRAO [2, 3, 10, 11, 13, 15, 19].

According to Duker [3], less than one third of CRAO results from emboli. We did not perform prolonged cardiac monitoring in both cases for detection of paroxysmal AF, because, according to the Rabinstein study, there were no risk factors for paroxysmal AF detection (left dilatation on TTE, frequent premature atrial complexes on ECG, etc) [20].

Platelets and fibrin are the materials found in cardiac emboli [3, 19], which was not the case of our first patient (emboli of cholesterol). Duker [3] noted that cholesterol emboli typically emanate from atheromatous plaques of the ipsilateral ICA. In the first preseted case (CRAO with artery to artery embolism), detecting by B-scan US evaluation the retrobulbar embolic material interrupting the pixels of color of the right CRA was helpful in eliminating the diagnosis of GCA with eye involvment [15]. When CDI localizes retrobulbar embolus, the patient does not have to be subjected to high-dose corticosteroids, even if the ESR is elevated, like in the first case [3, 11, 15]. The patient received antiplatelet aggregating agents and statins before right carotid endarterectomy. In the second case (CRAO with vasculitic mechanism, due to GCA), the patient had the normal ESR without systemic/clinical symptoms, even a swollen TA (occult GCA) [8, 16]. His spectral Doppler analysis of the orbital vessels revealed characteristic CDI findings for GCA (severe diminished blood flow velocities, especially EDV, in retrobulbar vessels, especially in CRAs) [6, 11, 15]. In patients with CRAO due to occult GCA prompt recognition and early corticotherapy are crucial to prevent further visual loss in the controlateral eye [3, 6, 8, 10–15].

Conclusion

In the presented cases, ultrasound investigation enabled prompt differentiation (when no emboli are visible on ophthalmoscopy in the retinal circulation) between central retinal artery occlusion of embolic mechanism due to severe stenosis of the ipsilateral internal carotid artery and central retinal artery occlusion caused by vasculitis from ocult giant cell arteritis.

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