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Vascular Compression of the Anterior Optic Pathway: A Rare Occurrence?

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Abstract

Background: Vascular compression of the anterior optic pathway has been documented as an infrequent cause of visual impairments. Here we characterize such vascular compression using magnetic resonance imaging.
Methods: A total of 183 patients without pathologies affecting the optic pathways underwent T2-weighted or constructive interference steady-state sequence magnetic resonance imaging. Imaging data from coronal sections were analyzed.
Results: A vascular compression of the anterior optic pathway was identified in 20 patients (11%). They comprised 13 men and 7 women with a mean age of 60.8 years. The vascular compressions were observed at 22 sites, 15 on the optic nerve (ON) and 7 on the optic chiasm (OC). Twelve of them were on the right and 10 were on the left side. The offending vessels were the supraclinoid portion of the internal carotid artery in 86.4% and the A1 segment of the anterior cerebral artery in 13.6%. Compression sites at the ON and OC were variable, with the inferolateral surface being the most frequent (77.3% occurrences). In 2 patients (9.1%), the ON was compressed in a sandwich manner.
Conclusions: Vascular compression of the ON and OC may not be an infrequent occurrence in the cranial cavity. Progressive and unexplainable visual impairment might possibly be caused by vascular-compressive neuropathy.

Résumé

Contexte : Il a été établi que la compression vasculaire de la voie optique antérieure est une cause peu fréquente de déficiences visuelles. Nous souhaitons ici la caractériser à l'aide de l'imagerie par résonance magnétique.
Méthodes : Un total de 183 patients sans troubles des voies optiques ont subi un examen d'imagerie par résonance magnétique pondéré en T2 ou en séquence d'interférence constructive en régime stationnaire. Les données d'imagerie des coupes frontales ont été analysées.
Résultats : Une compression vasculaire de la voie optique antérieure a été décelée chez 20 patients (11 %), c'est-à-dire 13 hommes et 7 femmes d'un âge moyen de 60,8 ans. Des compressions vasculaires ont été observées à 22 endroits, soit 15 sur le nerf optique (NO) et 7 sur le chiasma optique (CO). Douze de ces compressions étaient situées du côté droit et 10, du côté gauche. Les vaisseaux en cause se trouvaient dans la portion supraclinoïdienne de l'artère carotide interne dans 86,4 % des cas et dans le segment A1 de l'artère cérébrale antérieure dans 13,6 % des cas. L'emplacement des compressions du NO et du CO variait, mais elles se trouvaient plus fréquemment sur la surface inférolatérale (77,3 % des cas). Chez deux patients (9,1 %) le NO était comprimé des deux côtés.
Conclusions : La compression vasculaire du NO et du CO pourrait être relativement fréquente dans la cavité crânienne. Des déficiences visuelles progressives et inexplicables pourraient être causées par une neuropathie due à la compression vasculaire.

Key Words: Magnetic resonance imaging; Optic chiasm; Optic nerve; Vascular compression

Vascular compression syndrome is a distinct clinical entity and generally known as manifestations of affected trigeminal, facial, vestibulocochlear, and glossopharyngeal nerves [1]. Vascular compression of the optic nerve (ON) and optic chiasm (OC) has been documented as an infrequent cause of visual loss, visual field defect, phosphenes, and photophobia. The compression may be caused by non-ruptured large cerebral aneurysms arising on the anterior cerebral artery (ACA), anterior communicating artery, or internal carotid artery (IC) [2−7]; dissecting aneurysm at the A1 segment of the ACA [8]; ectatic or elongated ACA and

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IC [9−11]; or vascular anomalies at the skull base [12]. In addition, a sandwich-type compression between the IC and anterior communicating artery was documented as a rare instance [13]. Jacobson [14] documented 24 patients with symptomatic ON compressions by the IC. These compressions were treated by microsurgical clip applications for the offending aneurysms or decompressive maneuvers for the ON and OC that mostly resulted in satisfactory outcomes [3,4,6−8,10−13,15]. In contrast, in a patient population presenting with compressive optic neuropathy by pituitary tumours and undergoing tumour resections, OC elevation, severity of ON compression, OC position, OC height, tumour height, or tumour volume did not differentiate patients with postoperative visual dysfunction from those with visual recovery [16].

Actual positions of the ON and OC in the cerebral cisterns are not well understood. Only a previous study suggested topographical variations of the OC position in vivo [17]. To our knowledge, there has been no report documenting the frequency and mode of the vascular compression of the anterior optic pathway. The present study aimed to characterize them in a population without pathologies affecting the optic pathways using magnetic resonance imaging (MRI).

Methods

This retrospective study included 183 consecutive patients who consulted at our hospital on an outpatient basis between August 2010 and September 2013. These patients presented with headache, dizziness, tinnitus, hearing disturbance, hemisensory disturbance, or seizure. Patients with cerebral aneurysms on the intracranial portions of the internal carotid artery, intracerebral hemorrhage, cerebral infarction, hydrocephalus, and brain tumours were excluded. There were no patients complaining of visual dysfunction on questionnaire checked before examinations with MRI. The patient population comprised 90 men and 93 women with a mean age of 51.7 years (range 9-81 years). Initial examinations using T1-weighted and T2-weighted images, T2 gradient echo, fluid-attenuated inversion recovery, and diffusion-weighted sequences confirmed that none of the 183 patients had any findings of pathologies affecting the optic pathways. The patients then underwent imaging with thin-sliced, T2-weighted sequences or coronal constructive interference steady-state (CISS) sequences, which had been selected for the 183 patients on the basis of their symptoms and findings on the initial MRI. A T2-weighted sequence was performed for 109 patients in 3 planes (axial, coronal, and sagittal) using the following parameters: repetition time (TR) 4038.35 ms; echo time (TE) 90.00 ms; slice thickness 2.00 mm; interslice gap 0.2 mm; matrix 300 × 189; field of view (FOV) 150 mm × 150 mm × 100 mm; flip angle (FA) 90°; and scan duration, 6 minutes 40 seconds. Coronal CISS images were obtained from 74 patients using the following parameters: TR 2000 ms; TE 311 ms; slice thickness 2.00 mm; interslice gap 0 mm; matrix 320 × 274; FOV 160 mm × 160 mm × 100 mm; FA 90°; and scan duration 5 minutes 30 seconds. All imaging sequences were performed using a 3.0T MR scanner (Achieva R2.6; Philips Medical Systems, Best, the Netherlands).

Imaging data were transferred to a workstation (Virtual Place Lexus 64, AZE, Tokyo, Japan) and the anterior optic pathway was independently analyzed by 2 of the authors (S.T. and Y.Y.). For thin-sliced, T2-weighted sequences, only imaging data of coronal sections were analyzed. The anterior optic pathway was divided into 2 parts, the intracranial portion of the ON and the OC. These parts were analyzed independently. When an OC or ON segment was unequivocally displaced or distorted by an adjacent intracranial major artery, it was considered as vascular compression.

The present study was performed in accordance with the guidelines of our institution regarding human research. Written informed consent was obtained from all patients prior to their participation in this study.

Results

Of 183 patients who were included in the present study, vascular compression of the anterior optic pathway was identified in 20 of them (11%). Seven of these patients (6.4%) underwent T2-weighted sequence and 13 patients (17.6%) underwent CISS sequence. These 20 patients comprised 13 men and 7 women with a mean age of 60.8 years (range 17-78 years). In these patients, vascular compressions were identified on 22 sites in the anterior optic pathway, 15 at the ON, and 7 at the OC. Twelve of them were found on the right and 10 were found on the left side. The segment of the offending vessel was the supraclinoid portion of the ICs in 86.4% of the 22 sites and the A1 segment of the ACA in 13.6%. In 52.6%, the offending ICs were on the dominant side, while all the 3 A1 cases showed an elongated ACA. These data are summarized in Table 1. The ON and OC were compressed at various points. Among them, compression at the inferolateral surface was the most frequent, comprising 77.3% of the 22 sites; compression at the superomedial and inferior surfaces were 9.1% and 4.5%, respectively (Figure 1). In 2 (9.1%) of the 22 patients, the ON was compressed in a sandwich manner where the affected ON portion was lying between the

Table 1
Demographics of the population with vascular compression

Men/women ratio	13:7
Age range	17−78 y
TCSs	22
ON	15
OC	7
Side	
Right	12
Left	10
SOV	
ICs	19
A1	3

A1 = A1 segment of the anterior cerebral artery; ICs = supraclinoid portion of the internal carotid artery; OC = optic chiasm; ON = optic nerve; SOV = segment of the offending vessel; TCSs = total compression sites.