Hyperbaric Oxygen Therapy in two patients with Non-arteritic Anterior Optic Neuropathy who did not respond to Prednisone

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Bojić L, Ivanišević M, Gošović G. Hyperbaric oxygen therapy in two patients with non-arteritic anterior optic neuropathy who did not respond to Prednisone. Undersea Hyper Med 2002; 28(2): 86-92. Recent advances in understanding the effects of hyperbaric oxygen (HBO) on retinal anoxia gave rise to new interest in the possibility of using it as therapeutic treatment for ischemic conditions of the retina and optic nerve. Two patients with non-arteritic anterior ischemic optic neuropathy due to a high-grade ophthalmic artery stenosis were treated with HBO at 2 atm abs in an effort to increase oxygen delivery for the eye. Both patients showed marked improvements of visual acuity and visual field 3-5 months following the event. Our results are intriguing although the achieved improvement could be coincidental.

NAION, hyperbaric oxygen, ophthalmic artery stenosis

INTRODUCTION

Age related degenerative changes of the ophthalmic artery or its branches are likely to play an important role in vascular eye diseases, particularly non-arteritic anterior ischemic optic neuropathy (NAION) (1), although high-grade ophthalmic artery stenosis in patients less than 60 years of age is uncommon.

The pathogenesis of NAION has not been firmly established, but a posterior ciliary vaso-occlusive process has been postulated as the initial event (2,3,4). Improvement in visual function is uncommon. So far, no therapy for NAION has been proven effective. The results from the Ischemic Optic Neuropathy Decompression Trial indicate that optic nerve sheath decompression surgery is not effective for NAION (5).

Hyperbaric oxygenation has been widely recommended, but the clinical use of hyperbaric oxygen in ophthalmology is still in dispute. Although one report describes partial response to this therapy (6), a pilot study by Arnold and associates found no significant improvement in visual acuity and visual field for patients with NAION treated with hyperbaric oxygen (7).
The favorable effects of hyperbaric oxygenation on microcirculation inspired us to treat with hyperbaric oxygen two patients with NAION due to a high degree ophthalmic artery stenosis, previously unsatisfactory treated by prednisone.

CASE 1

A 50-year old man with a history of controlled systemic hypertension suffered sudden painless loss of vision in his left eye. His ophthalmologist diagnosed NAION. The best-corrected visual acuity (+ 0.50 diopters) was 0.1 measured at 5 m with international visual chart with standard light. Visual fields testing by Goldmann perimetry showed marked constriction of the I-4-e isopter. Fundus examination revealed paled swollen optic disk with a flame-shaped haemorrhage in the left eye. No anterior or posterior vitreous inflammatory cell reaction was found. Results of colour vision testing were normal in each eye, but there was a left afferent pupillary defect. Eye motility was normal. Superficial temporal arteries were nontender and pulses were normal. Findings in the right eye were unremarkable. Computed tomographic scan of the head and orbits with contrast injection and vasculitis screening, including determination of the erythrocyte sedimentation rate was normal. Doppler ultrasonography of the carotids was normal. Computed subtractional digital cerebral angiography showed area with multiple circularly stenoses of the proximal part of the left ophthalmic artery (Figure 1).

Figure 1, Patient 1, left eye. Selective left internal carotid artery angiogram. Arrow indicates area with multiple sites of circularly stenosis of the proximal part of the ophthalmic artery.

After a four weeks regimen with high-dose prednisone his vision improved slightly, stabilising at 0.6.

Informed consent was obtained and five months later, the patient underwent total body hyperbaric oxygen treatment at a pressure of 2 atm abs for 90 minutes once a day for 21 days.
Visual acuity improved at 0.9, and Goldmann visual fields demonstrated marked expansion of the I-4-e isopter in the left eye (Figure 2). Fundus examination revealed slight optic disk atrophy. No change has occurred in the subsequent two years.

CASE 2
A 56-year old man suddenly lost a portion of the left central visual field. There was no associated pain and he waited for four more weeks hoping “it would get better on its own” before
consulting an ophthalmologist. At that time the best-corrected (+1.0 diopters) visual acuity was 0.1. There was a left afferent pupillary defect dischromatopsia and superiorly swollen left disk with peripapillary haemorrhages. No anterior or posterior vitreous inflammatory cell reaction was found. The right eye was normal with visual acuity 1.0. Eye motility was unremarkable. Superficial temporal arteries were nontender and pulses were normal. Visual fields testing by Goldmann perimetry demonstrated inferotemporal quadrantic defect involving fixation. Vasculitis screening, including determination of erythrocyte sedimentation rate produced normal findings. Results of a computed tomographic scan of the head and orbits with contrast injection were normal. Doppler ultrasonography of the carotids was normal. Computed digital subtractional cerebral angiography showed a high-degree of left ophthalmic artery stenosis (Figure 3). Three weeks of high-dose prednisone treatment did not appear to be effective, and visual activity has remained unchanged. On ophthalmoscopy the left optic disk became slightly pale.

Figure 3, Patient 2, left eye. Selective left internal carotid artery angiogram. Arrow indicates area of stenosis 20 mm distal to the take-off of the ophthalmic artery.
Informed consent was obtained and the patient underwent hyperbaric oxygen treatment at a pressure of 2 atm abs for 90 minutes once a day, three months later. The total number of sessions was eighteen. The best-corrected (+1.0 diopters) visual acuity improved to 0.3. Visual field testing performed by Goldmann perimetry showed moderate expansion of 1-4-e isopter (Figure 4). During the subsequent two years his visual acuity and visual fields were unchanged.

Figure 4, Patient 2, left eye. Goldmann visual field before and after HBO
DISCUSSION

Treatment for NAION is unsatisfactory. Early reports suggested that corticosteroids could improve visual outcome, but they were not confirmed by follow-up studies (8). The increase in the partial oxygen pressure in the lungs during hyperbaric oxygen therapy results in an increased uptake of oxygen in the arterial blood. It extends the oxygen diffusion distance within ischemic tissue enabling correction of limited hypoxia (9).

Exposure to hyperbaric oxygen increases the oxygen supply in chorioretinal perfusion (10,11). Hyperbaric oxygen has been proposed as a therapeutic modality for central retinal artery occlusion and radiation-induced optic neuropathy (12,13,14,15).

As most of the blood supply of the prelaminar region of the optic nerve head comes from branches of the short posterior ciliary arteries rather than peripapillary choroid (16), a decrease in blood flow created by ciliary artery vasoconstriction as a response to hyperoxygenation would be expected. Despite this, ischemia causes a vasogenic stimulus that may prevail over the vasoconstriction of hyper-oxygenation (17,18).

The improved visual acuity and visual field in these two patients with NAION treated with hyperbaric oxygen occurred 3-5 months following the event. The practical meaning of the visual improvement of the visual acuity of patient one, 0.6 to 0.9, and patient two, 0.1 to 0.3, with regard to quality of life was probably unnoticeable. However, this improvement is important because involvement of the second eye in NAION is common (2). These patients did not receive anticoagulants and vasodilators, which could influence the visual outcome. Based on our past experience with two patients receiving prednisone therapy, it is unlikely that their improvement was a late response to prednisone.

Although the difference in the visual fields presented in Figs. 2 and 4 could have resulted from random differences in a field chart on different occasions and learning effect, all visual studies including visual field testing were done under identical conditions. In order to minimize the learning effect, visual field testing was repeated before starting hyperbaric oxygen and the visual field was stable.

Arnold et al. previously reported no significant improvement in visual acuity and visual field in patients with NAION in a controlled study (7). The level of hyperbaric oxygen therapy (2 atm abs for 90 minutes once a day) and duration of treatment (case one 21 days, case two 18 days) was slightly different in our report in relation to Arnold's study. The late improvement seen in these two patients are not fully understood and cannot be compared to Arnold's study. Although these results are intriguing, it is acknowledged that the improvement of our two patients could be purely coincidental.

REFERENCES

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