Neuro-ophthalmology 0165-8107/93/US$ 3.50 (Accepted 20 June 1993)

Ocular vasospasm in children

HEDWIG J. KAISER, JOSEF FLAMMER* and PAUL GASSER

University Eye Clinic, Basel, Switzerland

ABSTRACT. The ocular vasospastic syndrome in adults has been described earlier. It is characterized by fluctuating visual field disturbances in patients with a tendency towards vasospasm in different organs. The main general symptoms are cold hands, migraine, and a tendency towards low blood-pressure. Some patients with ocular vasospasm may end up with a 'normal-tension glaucoma'.

In the present report the authors describe children with blurred vision and visual field defects, the cause of which, most probably, is vasospasm as well. The visual field defects disappeared or improved markedly after anti-vasospastic therapy.

Key words: visual field; vasospasm; calcium antagonists; serotonin blocker

INTRODUCTION

Not rarely do patients complain of visual disturbance, such as blurred vision accompanied by neither morphological or electrophysiological abnormalities nor any pathological findings on CT or NMR. Perimetrically, visual field defects can often be observed. Such patients offer the clinician a special challenge. He might suspect a so-called 'functional' disturbance, the cause of which can vary, one such being a neurotic personality[1]. Other patients are considered to be malingerers. We observed a number of children in whom vasospasm was the most probable cause of the visual disturbance. As this might occur quite often, we decided to describe this syndrome.

* *Correspondence to*: Josef Flammer, M.D., University Eye Clinic, Mittlere Strasse 91, CH-4056 Basel, Switzerland.

THE OCULAR VASOSPASTIC SYNDROME

A specific syndrome in adult patients was described earlier[2,3]. The characteristics of this syndrome are: otherwise not explained glaucoma-like fluctuating visual field defects in patients with a tendency towards cold hands (sometimes also cold feet), migraine, and systemic arterial hypotension[4].

The visual field defects can be provoked in some of these patients by coldness, in others by emotional stress[3]. These visual field defects are often dramatically improved by treatment with Nifedipine, a calcium-channel-blocker[5].

The visual field defects are very similar to those observed in glaucoma patients. Most of these patients have normal optic nerve heads. In other patients, however, the optic nerve heads were either slightly pale or even pathologically excavated. We therefore assume that a few of these vasospastic patients may end up with irreversible damage[6]. The structural correlate is

an excavated optic nerve head, which phenomenologically can be described as typical of 'normal-tension glaucoma'[7]. In some other patients, multiple sclerosis was primarily suspected, as they had slightly pale optic nerve heads and paresthesia in the fingers. Some of our patients with suspected multiple sclerosis turned out to have a vasospastic syndrome.

All earlier cases reported concerned adults. We observed similar findings in children, which will be described here.

OCULAR VASOSPASM IN CHILDREN

We observed a number of children in whom vasospasm was suspected to be the cause of visual field disturbance. The children were between ten and 16 years of age; the majority were girls. They had blurred vision or otherwise indeterminate visual disturbances. Clinical evaluation revealed visual field defects, combined with normal or only slightly reduced visual acuity, but entirely normal ocular morphology. The optic nerve heads, in particular, were always completely normal.

Neurological examination, including electrophysiology, CT, and NMR, did not explain the symptoms. In the majority of patients the visual field defects tended to be more diffuse; in some they were localized. These scotomas were mostly relative and only rarely absolute. The defects fluctuated from one day to the next, but were always present to some extent. When asked specifically, the young patients indicated that they often had cold hands, some had a history of migraine, and the blood pressure tended to be low. The diagnosis of vasospastic syndrome could be substantiated with the help of a cold-provocation test under video-nailfold-capillaromicroscopy[8]. A flow stop of more than 15 seconds was considered pathological[9].

The visual fields could be improved in some by administration of 10 to 20 mg Nifedipine (a calcium-channel-blocker), in others by a single-dosage of 20 mg Ketanserin (a serotonin-antagonist). These improvements were often very impressive and reproducible. In a few cases, however, improvement could be observed only after a treatment period of a few days or weeks.

If patients did not respond to specific treatment by normalization of the peripheral blood-flow, as measured with video-nailfold-capillaromicroscopy and as indicated by improvement of the visual fields, the treatment was changed.

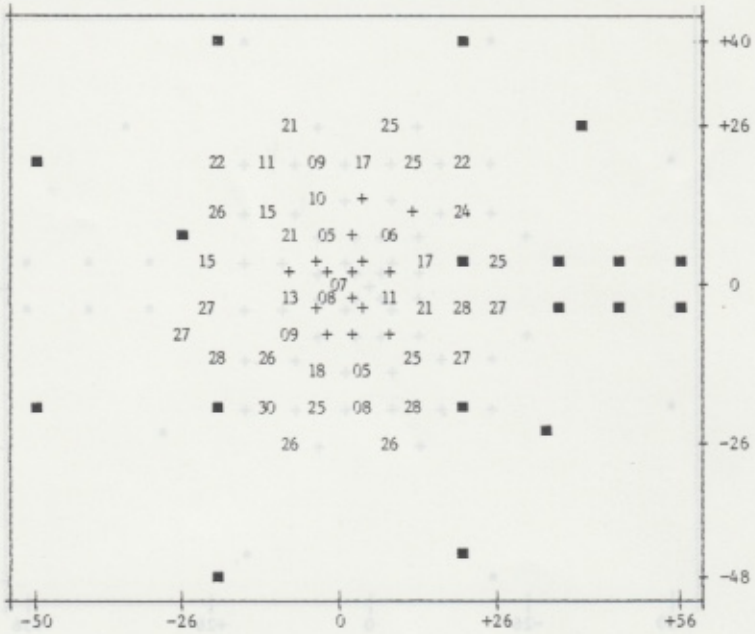
A few patients responded neither to calcium-channel-blockers nor to serotonin antagonists. Some of the non-responders improved considerably after treatment with 2 × 20 mg Propranolol a day.

In the following example, we would like to describe a child with presumed ocular vasospasm. As the appearance of the disease varies slightly among patients, such an example can only be representative to a certain extent.

CASE REPORT

A 14-year-old girl complained of repeated 'darkening' of the visual field of both eyes like 'dark walls' coming from both sides. These episodes, which occurred under psychological stress, were often combined with headache and the simultaneous occurrence of cold hands and feet. The episodes of 'darkening' lasted for days or weeks, sometimes even months. The child had been evaluated many times in different university centers without getting a diagnosis. On examination, the visual acuity was 20/20 in both eyes, and the ophthalmological examination revealed no morphological changes. Her visual fields measured with Octopus Program G1[10] were concentrically narrowed, and the central area was relatively depressed, as reported from earlier measurements (Fig. 1).

Video-nailfold-capillaromicroscopy revealed a 50-second stop of blood flow after cold provoca-



	MS	MD	LV	CLV	Q'	SF	RF
NORMAL		-2...+2	0...+6	0...+4	-3...+7	0...+2	
PHASE 1	14.8	14.9	(125.4)		(-0.6)		6
PHASE 2	14.5	15.2	106.0		(-0.5)		4
MEAN	14.6	15.1		(108.5)	(-0.5)	2.6	6

1

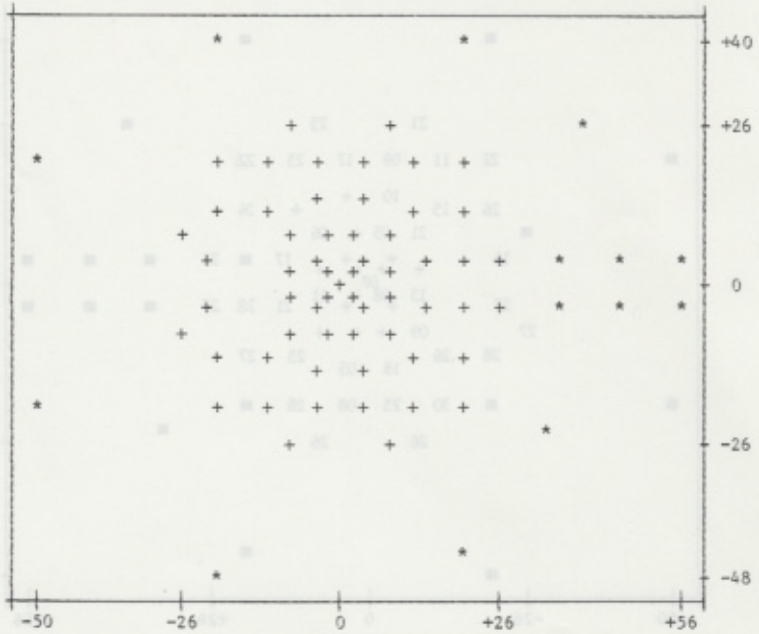
Fig. 1. Visual field of the left eye before treatment. To exclude learning effects, the test was repeated several times.

tion. One hour after a tablet of Ketanserin, the visual fields were normalized (Fig. 2), and no further flow stop in video-nailfold-capillaromicroscopy could be provoked. The patient was put on a long-term treatment with Ketanserin, 2 × 20 mg. The girl was free of symptoms for several weeks until the treatment was interrupted. A few days after cessation of treatment, the symptoms were present again. In a second treatment period, the child responded well to Inderal 2 × 20 mg.

DISCUSSION

Our observations indicate that one of the causes of 'unexplained' visual-field defects might be so-called 'ocular vasospasm'. Such spasm may already occur in children.

At present we do not know the exact location of these presumed spasms. Most probably, the posterior ciliary arteries, which also give rise to the optic nerve head circulation, are involved[11]. We know that a basal release of nitric oxide from the endothelial cells is necessary



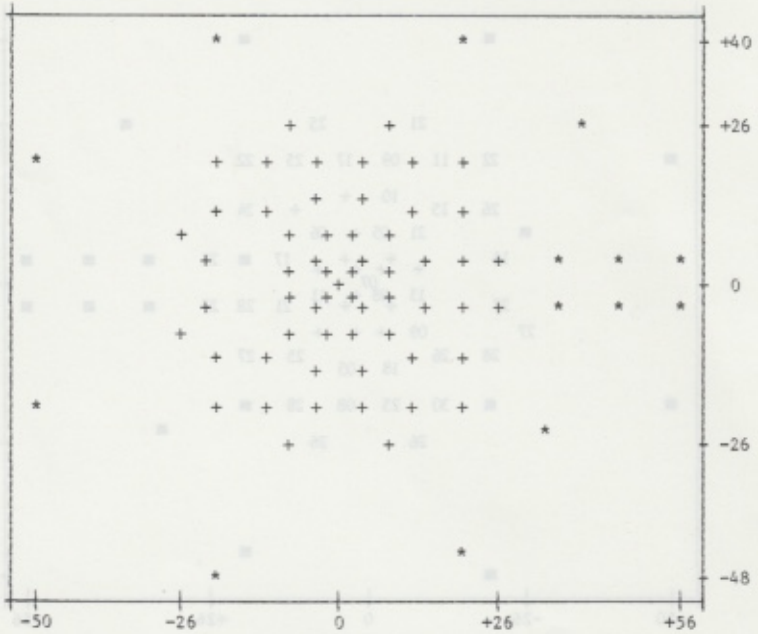
	MS	MD	LV	CLV	Q'	SF	RF
NORMAL		-2...+2	0...+6	0...+4	-3...+7	0...+2	
PHASE 1	30.8	-1.1	3.4		-0.4		5
PHASE 2	30.9	-1.2	3.1		-3.7		5
MEAN	30.8	-1.1		1.7	-2.0	1.2	5

2

Fig. 2. Visual field of the left eye after oral ingestion of a tablet containing Ketanserin.

to keep these small vessels open. Dilatation can be provoked by acetylcholine, bradykinin, and histamine. Endothelin, on the other hand, constricts these vessels markedly[12]. These effects are much more pronounced in the small ciliary arteries than in the larger arteries, such as the ophthalmic artery. These observations could indicate a possible involvement of these vessels in the vasospastic syndrome and why retinal circulation can be normal in such cases. The fact that the visual field defects are often comparable with those in glaucoma and the fact that some of these cases may end up with a so-called 'normal-tension glaucoma' indicate that the relevant circulatory insufficiency, most probably, lies in the optic nerve head. We do not know, however, whether spasm occurs in the papilla itself or in the feeding vessels. In rabbits, arterioles branching from the arterial circle around the optic nerve head are capable of constricting when the animals are treated with phenylephrine[13].

The causes of the spasm, in general, *e.g.*, coronary vasospasm, are not yet fully understood[14]. In genetically predisposed persons, provocations by cold[15,16], stress, and other factors might be important. We would like to point



	MS	MD	LV	CLV	Q'	SF	RF
NORMAL		-2...+2	0...+6	0...+4	-3...+7	0...+2	
PHASE 1	30.8	-1.1	3.4		-0.4		5
PHASE 2	30.9	-1.2	3.1		-3.7		5
MEAN	30.8	-1.1		1.7	-2.0	1.2	5

2

Fig. 2. Visual field of the left eye after oral ingestion of a tablet containing Ketanserin.

to keep these small vessels open. Dilatation can be provoked by acetylcholine, bradykinin, and histamine. Endothelin, on the other hand, constricts these vessels markedly[12]. These effects are much more pronounced in the small ciliary arteries than in the larger arteries, such as the ophthalmic artery. These observations could indicate a possible involvement of these vessels in the vasospastic syndrome and why retinal circulation can be normal in such cases. The fact that the visual field defects are often comparable with those in glaucoma and the fact that some of these cases may end up with a so-called 'normal-tension glaucoma' indicate that the relevant circulatory insufficiency, most probably, lies in the optic nerve head. We do not know, however, whether spasm occurs in the papilla itself or in the feeding vessels. In rabbits, arterioles branching from the arterial circle around the optic nerve head are capable of constricting when the animals are treated with phenylephrine[13].

The causes of the spasm, in general, *e.g.*, coronary vasospasm, are not yet fully understood[14]. In genetically predisposed persons, provocations by cold[15,16], stress, and other factors might be important. We would like to point

out to the clinician that vasospasm should be included in the list of the differential diagnoses of children presenting with 'unexplained' visual field defects. Evaluation with the help of video-nailfold-capillaromicroscopy and a treatment trial is recommended in such cases.

REFERENCES

1. Piper HF. Passagere Sehstörungen, betont durch mangelnde Krankheitsbewältigung. Klin Mbl Augenheilk 1991; 199:209–213.
2. Gasser P, Flammer J, Guthauser U, Niesel P, Mahler F, Linder HR. Bedeutung des vasospastischen Syndroms in der Augenheilkunde. Klin Mbl Augenheilk 1986; 188:503–504.
3. Guthauser U, Flammer J, Mahler F. The relationship between digital and ocular vasospasm. Graefe's Arch Clin Exp Ophthalmol 1988; 226:224–226.
4. Gasser P, Flammer J. Influence of vasospasm on visual function. Doc Ophthalmol 1987; 66:3–18.
5. Gasser P, Flammer J. Short- and long-term effect of Nifedipine on the visual field in patients with presumed vasospasm. J Int Med Res 1990; 18:334–339.
6. Flammer J, Gasser P, Prünte Ch, Yao K. Are factors other than IOP involved in the pathogenesis of glaucoma? In: Drance SM, Buskirk V, Neufeld AH, editors. Pharmacology of Glaucoma. Baltimore: Williams and Wilkins, 1992; 273–283.
7. Flammer J, Guthauser U, Mahler M. Do ocular vasospasms help cause 'low-tension glaucoma'? Doc Ophthalmol Proc Ser 1987; 49:397–399.
8. Mahler F, Saner H, Würbel H, Flammer J. Local cooling test for clinical capillaroscopy in Raynaud's phenomenon, unstable angina, and vasospastic visual disorders. VASA: Z für Gefässkrankh 1989; 18:201–204.
9. Gasser P. Capillary blood cell velocity in finger nailfold. Characteristics and reproducibility of the local cold response. Microvasc Res 1990; 40:29–35.
10. Flammer J, Jenni A, Keller B, Bebie H. The Octopus glaucoma program G1. Glaucoma 1987; 9:67–72.
11. Yao K, Tschudi M, Flammer J, Lüscher Th. Endothelium dependent regulation of vascular tone of the porcine ophthalmic artery. Invest Ophthalmol Vis Sci 1991; 32:1791–1798.
12. Haefliger IO, Flammer J, Lüscher TF. Nitric Oxide and Endothelin-1 are important regulators of human ophthalmic artery. Invest Ophthalmol Vis Sci 1992; 33:2340–2343.
13. Sugiyama K, Bacon DR, Cioffi GA, Fahrenback WH, Van Buskirk EM. The effects of phenylephrine on the ciliary body and optic nerve head microvasculature in rabbits. J Glaucoma 1992; 1:156–164.
14. Gasser P, Flammer J, Guthauser F, Mahler F. Do vasospasms provoke ocular diseases? Angiology 1990; 41:213–219.
15. Drance SM, Douglas GR, Wijsman K, Schulzer M, Britton RJ. Response of blood flow to warm and cold in normal and low-tension glaucoma patients. Am J Ophthalmol 1988; 105:35–39.
16. Gasser P, Flammer J. Blood cell velocity in the nailfold capillaries of patients with normal-tension and high-tension glaucoma. Am J Ophthalmol 1991; 111:585–588.