

## LETTERS TO THE EDITOR

**Ocular symptoms due to organophosphorus gas (Sarin) poisoning in Matsumoto**

EDITOR,—Sarin (isopropylmethylphosphonofluoridate) is one of the organophosphorus nerve gases and was developed from the organophosphorus pesticides by German scientists.<sup>1,2</sup> By blocking the activity of cholinesterase (ChE), Sarin causes muscarinic action, nicotine action, and central nervous effect.<sup>3</sup> At midnight on 27 June 1994, acute gas (Sarin) poisoning occurred in Matsumoto city, Nagano prefecture.<sup>4</sup> This accident finally left seven people killed, 56 hospitalised, and more than 500 injured.

We report the typical case of a 24-year-old man who suffered from Sarin poisoning and the ocular symptoms and findings of 51 patients who were examined at our hospital and eye clinics in Matsumoto city.

## CASE REPORT

On the morning of 28 June a 24-year-old man suffering from acute gas poisoning was referred to us. The principal symptoms that the patient noticed after the attack were dimming of his vision and rhinorrhoea. His best corrected visual acuity, measured by Landolt ring, was 1.2 in both eyes. Pupil diameter was 1.5 mm. The pupillary light reflex was barely discernible. A major observation on slit-lamp biomicroscopy was conjunctival hyperaemia and no superficial punctate erosions of the cornea (Fig 1). Fundus examination with an undilated pupil was normal. A Goldmann visual field was performed which showed generalised contracture of the isopters. Serum ChE was 124 IU/l (normal 109–249). Despite the normal ChE, acute organophosphorus poisoning was suspected. Topical steroid ophthalmic drops were prescribed for the conjunctival hyperaemia. Goldmann visual fields were improved the following day, while the pupillary diameter was still 1.5 mm, and the light reflex was sluggish. After 3 days his pupil diameter was 3.0 mm, but the light reflex was still slightly slow. Conjunctival hyperaemia was absent.

Ocular signs and symptoms were analysed in 51 patients involved in the Sarin poisoning incident in Matsumoto city. The ages of the patients ranged from 15 to 76 years, with a mean of 37 years. The patients indicated that the following conditions resulted from Sarin poisoning: dimmed vision (39%), ocular pain while looking at light and near objects (21%), red eye (16%), blurred vision and discomfort

when attempting to read near object (14%), out of focus (14%), small pupil (12%), vitreous floater (8%), itching (8%), photophobia (8%), narrow view (6%). On examination, by history and chart review, the patients also manifested the following: miosis (less than 4 mm 80%; less than 2 mm 41%), conjunctival hyperaemia (41%), contraction of the visual field (25%), lower intraocular pressure (21%). The pupillary diameter was initially small and it increased with passage of time (Fig 2). In those patients who underwent physical examination, including visual fields, conjunctival hyperaemia and concentric contraction of the visual fields were common within the first 4 days following the accident; but these conditions generally improved. Visual acuity did not appear to be diminished in most patients. The mean intraocular pressure measured immediately after Sarin exposure was 3.0 mm Hg lower than that after a few days. Patients with ocular symptoms had normal plasma cholinesterase. Miosis was easily reversed with either a topical atropine or a tropicamide-phenylephrine hydrochloride mixture. Dilating the pupil also relieved the ocular pain of ciliary spasm that was experienced by several of the patients. Only two patients had superficial punctate erosions of the cornea and conjunctiva. There were no abnormalities of the posterior pole in any of the patients. The usual ophthalmic medications consisting of topical steroids, artificial tears, mydriatics, and antibiotic drops were prescribed for the patients.

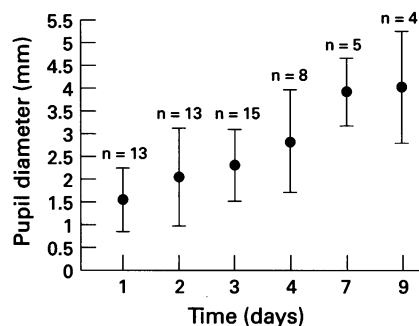


Figure 2 The pupillary diameter was small and appeared to increase with passage of time (mean (SD)).

## COMMENT

Although the literature contains some references<sup>3,5-7</sup> to experiments on patients who agreed to be exposed to Sarin, there are few reports<sup>2,8,9</sup> of accidental exposure to this poison. To our knowledge, this incident was the first where Sarin was used against a civilian population. In this single attack, seven people died and over 500 were injured. Miosis of acute organophosphorus poisoning has been attributed to suppressed activity of cholinesterase in the iris sphincter muscle. The change of pupillary diameter after Sarin exposure is very similar to the change reported in some papers.<sup>5,6,9</sup>

The most common complaints of the victims were dimmed vision and constriction of the visual field. It is interesting to note that Sarin had been reported to affect the central nervous system<sup>7</sup> and the retina, specifically the rods and cones.<sup>5</sup> We speculate that the

dimmed vision and constriction of the visual fields may not have resulted solely from the miosis, but perhaps may reflect the damaging effect of Sarin on the retina and the optic nerve.

We feel that low intraocular pressure resulted from decreased resistance to the outflow of the aqueous humour. We also feel that Sarin directly affected the ciliary muscle by causing ciliary spasm and ocular accommodation palsy. There have been no long term reports on the effect of Sarin on ocular symptoms. The patients are being followed for observation.

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MASAHIKO NOHARA  
KATSUZO SEGAWA  
Department of Ophthalmology,  
Shinshu University School of Medicine,  
Matsumoto, Japan

Correspondence to: Masahiko Nohara, MD, Department of Ophthalmology, Shinshu University School of Medicine, Asahi 3-1-1 Matsumoto 390, Japan.  
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**Achiasmia in a case of midline craniofacial cleft with seesaw nystagmus**

EDITOR,—We present a child with a midline craniofacial defect who had a nasoethmoidal encephalocele and seesaw nystagmus. Monocular flash visual evoked potentials (VEPs) showed an asymmetrical occipital distribution which reversed when the other eye was stimulated (crossed asymmetry) indicating a chiasm abnormality. No chiasm was detected on magnetic resonance imaging (MRI).

## CASE REPORT

A female infant presented at 4 months of age for assessment of a midline craniofacial cleft.

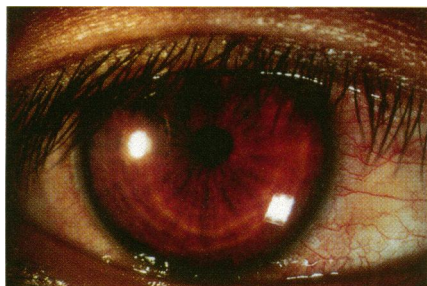
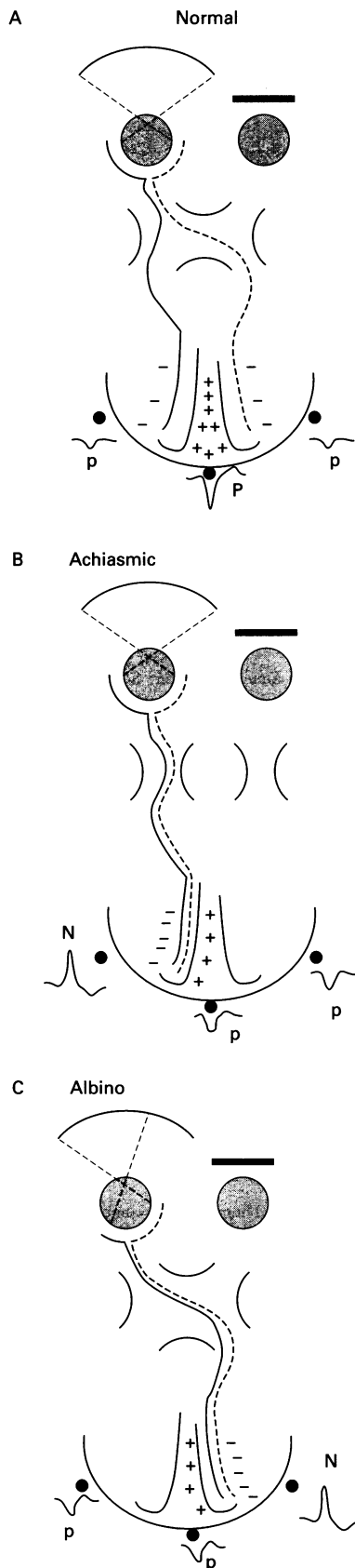
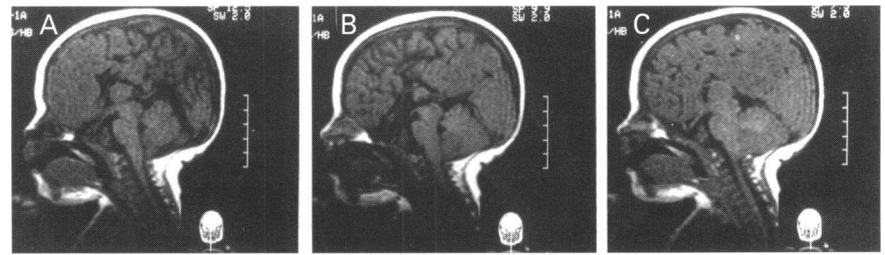


Figure 1 Right eye; pupil diameter was 1.5 mm and conjunctival hyperaemia was observed.



**Figure 1** Schematic representation of the visual pathway. Visual fibres arising from the temporal retina are shown by the continuous line, and those from the nasal retina by a broken line. The flash visual evoked potential waveform recorded at three occipital electrodes is also shown. (A) In a normal control, both hemispheres are activated and the main positivity is largest at the occipital midline. (B) In the achiasmic, relatively smaller positivities are recorded at the midline and the electrode contralateral to the stimulated eye. However, in the albino (C) the positivities are recorded in the midline and the electrode ipsilateral to the stimulated eye.



**Figure 2** Sagittal magnetic resonance imaging cuts taken through the midline (B) and right (A) and left (C) of the midline. (A) and (C) show the optic nerves passing backwards. (B) shows the prolapsing encephalocele descending between the two nerves with no optic chiasm demonstrated.

She was born at term plus 2 weeks after an uneventful pregnancy. Her general development was normal for age. Presence of the midline cleft lip led to further investigations including an MRI, which revealed a midline craniofacial cleft with a nasoethmoidal encephalocele, and agenesis of the corpus callosum with absence of the falx cerebri. The intracranial malformations were thought to be consistent with a mild form of holoprocencephaly.

On examination, she fixed and followed well, though a marked seesaw nystagmus was present. Slit-lamp biomicroscopy was normal. Funduscopy showed healthy looking discs and maculae. No squint was detected, and visual field examination to confrontation appeared normal.

Eye movement oculography with simultaneous video recording clearly demonstrated pendular seesaw nystagmus, with the elevating eye intorting, and extorting of the depressing eye. No horizontal nystagmus was present. Horizontal optokinetic nystagmus, smooth pursuit, and vestibular nystagmus induced by constant rotation in the dark were all normal. The flash electroretinogram (ERG) was normal, but the flash VEP was abnormal, showing a crossed asymmetry when comparing responses for each eye. In controls, the unocular VEP is normally present over both hemispheres (Fig 1A) owing to the decussation of about 50% of fibres in the optic chiasm, and the main positivity is largest in the midline. In albinism (Fig 1C) approximately 75% of optic nerve fibres cross at the chiasm, and the main positivity is usually paradoxically lateralised over the *ipsilateral* visual cortex following unocular stimulation.<sup>1</sup> In our patient, the main positivity was recorded over the *contralateral* visual cortex (Fig 1B). Two possible explanations can be invoked for our VEP findings: either there is a bitemporal hemianopia (this was not detected clinically), or all the fibres from one eye project to the ipsilateral hemisphere.

VEP results led to review of the MRI scan. Unfortunately, the available films were not ideal for examination of the optic chiasm; however, the sagittal cuts of the midline and adjacent planes showed the optic nerves had a straight course—no chiasm was demonstrable and there was an encephalocele prolapsing down between the two optic nerves in the midline (Fig 2A, B, and C).

Our patient was found to have specific growth hormone deficiency on endocrine function tests, and her growth rate has improved since commencement of growth hormone treatment. A repair of the encephalocele has been performed, and she continues to show normal developmental progress.

#### COMMENT

Two cases of achiasmia have been previously reported by Apkarian *et al.*<sup>2</sup> which like our

case had full fields and seesaw nystagmus, and were first suspected because of VEP asymmetry. However, Apkarian *et al.*'s cases had no other brain abnormalities demonstrable on MRI. Seesaw nystagmus can be an important sign indicating a parasellar mass; and there is an earlier report of it being associated with septo-optic dysplasia in which the possibility of achiasmia was considered.<sup>3</sup> The origin of seesaw nystagmus is unclear—both sensory and structural explanations have been proposed<sup>4</sup>; however, it is worth noting that our patient did not have horizontal nystagmus associated with an early onset sensory defect, and that she had normal horizontal OKN.

Autosomal recessive achiasmia has been found in a breed of Belgian sheepdog.<sup>5</sup> Their lateral geniculate nuclei (LGN) have representations of non-congruent mirror image maps of visual space in adjacent layers. This indicates an affinity between nasal and temporal retinal axons and specific LGN layers even when fibres originate from the same eye. The form of the cortical representation in achiasmia and its implications for visual perception has not been delineated, but as in albinism, the cortex appears able to deal with the mirror reversal of the representation, possibly by keeping two maps, or by 'rewiring'.<sup>6</sup>

We agree with Apkarian *et al.*<sup>2</sup> that seesaw nystagmus is an important feature of achiasmia and, indeed, that some patients classified as having idiopathic nystagmus may have achiasmia. Our case indicates that it also occurs associated with midline craniofacial clefts, but detection of achiasmia is greatly aided by adopting an appropriate VEP technique, and careful MRI assessment of the chiasm.

R J LEITCH  
D THOMPSON  
CM HARRIS  
K CHONG  
I RUSSELL-EGGITT  
A KRIS

Department of Ophthalmology,  
Great Ormond Street Hospital for Children NHS Trust,  
London WC1N 3JH

Correspondence to: Miss RJ Leitch.  
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