Cyclic oculomotor paralysis

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Clewett Price, D. M., and Trounce, D. Q. (1973). *Archives of Disease in Childhood*, 48, 881. **Cyclic oculomotor paralysis.** Cyclic oculomotor palsy is a rare condition that is usually either congenital or presents in early childhood. Its essential features consist of paralysis of the oculomotor nerve supplying one eye with cycles of involuntary spasm and relaxation of the sphincter pupillae, and usually also of some of the extra-ocular muscles supplied by the oculomotor nerve of the affected eye.

Two further typical examples of the condition are reported. Its aetiology remains conjectural since no case has come to necropsy. Most authors conclude, however, that there is partial aplasia or destruction of the oculomotor nucleus sparing those ganglion cells which control the muscles involved in the cyclic movements and that there is also a supranuclear lesion allowing automatic rhythmic impulses originating in a diencephalic centre to act on the intact cells of the oculomotor nucleus and bring about the cyclical phenomena.

Cyclic oculomotor paralysis is a very rare disorder. It was first recognized in 1884 by Rampoldi who gave an account of 2 cases, and since then we have found reference to only 47 cases published mainly in ophthalmic journals, a few paediatric or neurology texts mentioning it. Its essential features are paralysis of the oculomotor nerve supplying one eye with cycles of involuntary spasm and relaxation of the sphincter pupillae and frequently also of some of the paralysed extra-ocular muscles supplied by the oculomotor nerve of the affected eye.

The condition was well reviewed by Hicks and Hosford (1937) and more recently by Burian and Van Allen (1963). The following summary of the characteristics of the condition is taken mainly from their reports. It is usually either congenital or it arises in the first 6 months of life, though in a few cases onset was in mid-childhood. Occasionally the oculomotor paralysis has occurred many years before the onset of the cyclic phenomenon. It appears to affect females more than males and there is a family history of the disorder in only one recorded case where both mother and son were affected (Bonnet, 1941). In a typical case during the phase of relaxation (or paralysis), which lasts from 1 to 2 minutes, there is complete or nearly complete oculomotor paralysis with ptosis and outward and downward deviation of the globe,

together with dilatation of the pupil and relaxation of accommodation. This is followed by the spastic phase when the upper lid retracts, the eye converges to the midline, the pupil contracts, and there is spasm of accommodation. This phase lasts from $\frac{1}{2}$ to $1\frac{1}{2}$ minutes and in turn gives way to the phase of relaxation. The cycles of spasm and relaxation repeat themselves with great regularity. The spastic phase may be intensified and prolonged by attempted adduction of the affected eye while abduction enhances the phase of relaxation. The sphincter is involved in the cyclic phenomenon in every case, and in a number of instances this is the only muscle affected. Next in frequency is the levator palpebrae superioris, and occasionally the medial rectus muscle takes part in the cycles of spasm and relaxation. In most cases the oculomotor paralysis is complete, but in a few instances there is only partial paralysis of the extraocular muscles. The pupil of the affected eye does not respond to light either directly or consensually, nor is there any response to convergence. Miotics and mydriatics, except for cocaine, are reported to abolish the pupillary cycle and to cause the usual pupillary effects. Cocaine does not stop the cycle but causes dilatation of the pupil which does not constrict as much in the spastic phase as it does without the use of the drug. Adrenalin has no effect on the size of the pupil or the pupillary cycle. The cycles continue during sleep but are abolished by general anaesthesia. Once the condition is fully

developed there is little chance of either regression or the development of other neurological signs.

As yet there has been no pathological examination of the brain in patients with this condition and in only one reported case has an underlying cause been found. This case was unusual in that symptoms started at the age of 25 years in a woman in whom cycles of complete right oculomotor paralysis could be induced by looking to the right. The cyclic oculomotor palsy stopped after 7 months. 3 months later she was found to have bilateral papilloedema, and as a result of further investigation was diagnosed as having a glioma of the pons (Stevens, 1965). Some degree of amblyopia in the involved eye has been found in the majority of cases tested for visual acuity. In one case described by Levy (1968), a 5-month-old boy developed left cyclic oculomotor paralysis and was discovered 5 years later to have ipsilateral optic atrophy with vision reduced to perception of hand movements at 1.2 m. Extensive investigations failed to find a cause.

The rarity of the condition justifies the reporting of 2 further cases which have presented in the area of one district hospital during the last few years.

Case reports

Case 1. A female whose birth history was normal. Birthweight 2.5 kg. She was thought by her mother to have had unequal pupils from birth. At the age of 8 months she had a febrile convulsion which lasted 20 to 30 minutes and was caused by otitis media. The ptosis and cyclic phenomena were noticed from the time of the convulsion and have since persisted unchanged. The degree of ptosis increases when she is tired or unwell. There have been no further convulsions. She is now aged 11 years and is otherwise well and of normal intelligence. There is no family history of similar disorder.

The cyclic changes proceed as follows. During the relaxation (or paralytic) phase (Fig. 1a) the right eye shows an almost complete ptosis which can be slightly reduced by voluntary contraction of the occipitofrontalis muscle. When the lid is lifted the globe is seen to be slightly deviated outwards. There is total loss of upward and partial loss of medial and downward movements of the eye. Functions of the 4th and 6th cranial nerves remain intact. The pupil is dilated and measures about 7 mm in diameter (Fig. 1b); it does not respond to light either directly or consensually, nor to accommodation. The paralytic phase lasts from 5 to 15 seconds, and is followed over the space of about 4 seconds by the spastic phase when the ptosis completely disappears, the globe moves inwards to the midline, the right pupil constricts to a diameter of about 3 mm and for a short time becomes smaller than the left pupil (Fig. 1c). The spastic phase lasts from 20 to 80 seconds and is followed by a return of the ptosis and dilatation of the

FIG. 1.—Case 1. (a) Relaxation or paralytic phase showing ptosis of right upper eyelid. (b) Relaxation phase showing dilatation of right pupil. (c) Spastic phase showing no ptosis and right pupil contracted and smaller than left pupil. (d) Spastic phase prolonged by attempted adduction of right eye. (e) Paralytic phase prolonged by abduction of right eye.

pupil. Attempted adduction of the right eye (Fig. 1d) prolongs the spastic phase up to 90 seconds, whereas abduction (Fig. 1e) curtails the spastic phase and increases the paralytic phase up to 35 seconds. Movement of the jaw does not affect the ptosis. During sleep the cyclic pupillary changes persist but the lid remains slightly open and does not vary in position. The globe itself, media, and fundus show no abnormality. The

left eye is normal in every respect. The visual acuity in the right eye varies from 6/9 in the spastic phase to 6/24 in the paralytic phase. Left vision is 6/4. There are no other abnormal neurological signs.

Investigations. Blood Wasserman reaction negative. X-ray of skull normal. EEG both resting and sleep records within normal limits, and there were no changes in the EEG associated with either the spastic or paralytic phase of the cycle.

Case 2. A female whose birth history was normal. Birthweight 3.28 kg. She was first noticed to have a right ptosis at the age of 18 months, some 2 months after having uncomplicated measles. The ptosis was initially mild but it slowly increased and was pronounced by the age of 2 years when the cyclic movements were first noticed. Later, at the age of 3 years, the right eye was noticed to be divergent. These findings have persisted unchanged and are more marked when the child is tired or unwell. Movements of the jaw do not affect the ptosis. There is no apparent diplopia, and she is otherwise well and of normal intelligence. There is no family history of ocular disorder.

The cyclical changes are as follows. During the relaxation phase, which lasts from 25 to 50 seconds, there is almost complete ptosis (Fig. 2a) and the right eye is

FIG. 2.—Case 2. (a) Paralytic phase showing ptosis of right upper eyelid. (b) Spastic phase showing partial right ptosis and slight divergence of right eye.

deviated laterally. The pupil dilates to a diameter of 7.5 mm and reacts slightly to light, and there is also a small consensual reflex from the left eye. Light reaction to the left pupil is normal. Accommodation is absent in the right eye but normal in the left eye. At the conclusion of the paralytic phase the upper eyelid shows a few twitches and then quickly rises to herald the spastic phase during which there is a partial right ptosis, the lid being about a quarter closed. The eye is slightly divergent (Fig. 2b) and there is a total loss of upward, downward, and medial gaze. Functions of the 4th and 6th cranial nerves remain intact. The left eye shows

normal movements. In addition, the right pupil constricts to about 4 mm in diameter and becomes smaller than the normal left measurement of 6 mm. The spastic phase lasts for 10 to 20 seconds and then gives way to the next paralytic phase. Attempted adduction and abduction of the right eye does not seem to affect the cycle or the duration of its various phases. During sleep the left eye is closed while the right eye remains slightly open with a static ptosis. On lifting the eyelid the eye is turned outwards but the cyclic pupillary changes persist. Visual acuity, R 6/24 L 6/6. The globe itself, media, and fundus show no abnormality. There are no other abnormal neurological signs.

Investigations. Blood Wasserman reaction negative. X-ray of skull normal. Toxoplasmosis dye test negative. CSF no cells. Protein 10 mg/100 ml. Air encephalogram normal, showing no evidence of a midbrain lesion. EEG—the resting and sleep records were within normal limits, and there were no changes in the EEG in association with the spastic or paralytic phase of the cycle, nor with movements of the eyes to the right or left.

Discussion

Although generally known as cyclic oculomotor paralysis, the condition is probably more correctly named cyclic oculomotor spasm, as was suggested by Lowenstein and Givner (1942).

Both these children present as typical examples of this disorder. They both show almost complete oculomotor paralysis, and in both children the levator palpebrae superioris muscle is involved in the cyclical movements. However, Case 1 shows a less severe degree of ptosis, and in her case the medial rectus muscle takes part in the cycles so that during the spastic phase the eye converges to the midline.

According to Stevens (1965), only rare reference is made in published reports to any neurological or other phenomenon associated with cyclic oculomotor paralysis. However, the antecedents concerned in our 2 cases have both been reported previously. The 17-year-old girl reported by Petrovic and Tschemolossow (1931) developed bilateral cyclic oculomotor paralysis after a series of convulsions. Some years later the left eye became normal but the condition persisted in the right eye. The girl reported by Greeves (1913) developed typical left cyclic oculomotor palsy after an attack of measles at the age of 7 years.

The aetiology of the condition remains conjectural since no case has come to necropsy. Most authors conclude that the lesion involves the oculomotor nucleus. Fuchs (1893) suggested that rhythmic variations in its blood supply might be responsible for the cyclic phenomena. Hicks and Hosford (1937) attributed it to a noninflammatory

degeneration of the nucleus with sparing of ganglion cells at the caudal end which respond weakly to afferent stimuli from subcortical areas. They also postulated that supranuclear pathways just above the nucleus are also affected, thus removing the cerebral contact to the affected muscles. Burian and Van Allen (1963) concluded that there is a partial destruction of the oculomotor nucleus, those parts supplying the sphincter pupillae, and frequently those supplying the levator muscle of the upper lid, and occasionally those supplying the medial rectus muscle remaining intact. They also suggested that there is destruction of adjacent supranuclear inhibitory structures which allows rhythmic impulses originating in an automatic centre in the diencephalon to act upon the nucleus directly and cause the cyclic component. Duke-Elder (1964) also considered that there is a partial aplasia or degeneration of the 3rd nerve nucleus, the vitality of the remaining cells possibly depending on an anomalous blood supply. He also concluded that there is probably a supranuclear lesion at the level of the basal ganglia. The automatic periodicity of the phenomenon can be explained on the one hand by fatigue affecting the partially destroyed oculomotor centre, and on the other by an increased irritability of the intact constrictor elements after recovery from this fatigue. This is due to a lack of the normal inhibitory control from the damaged supranuclear centre allowing small stimuli arising subcortically, which are normally subliminal, to produce periodic discharges by summation. Alternatively, the supranuclear lesion may release a fundamental diencephalic rhythm.

Crone and Horsten (1970) described a typical example in an 8-year-old boy in whom EEG showed paroxysmal activity in the ipsilateral temporal cortex coinciding with the spastic phase of the cycle, and from this suggested that there is a mesencephalic centre whose rhythmical impulses cause the cyclical activity of the oculomotor nucleus and also activate the temporal cortex. However, in neither of our cases was there any correlation between the EEG pattern and the phase of the cycle.

Treatment of cyclic oculomotor paralysis is at

present unsatisfactory, though in some cases correction of a squint has been performed with some success. Treatment of the ptosis, which is the most disfiguring element, defies operation, as its correction is likely to cause excessive exposure of the globe during the spastic phase of the cycle with the added risk of corneal damage as well as being cosmetically more unsightly than a slight ptosis. Treatment of static ptosis with a spring implanted into the upper lid is now being considered and research into this form of treatment seems to offer some hope for these children in the future.

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REFERENCES

- Bonnet, P. (1941). Le phénomène cyclique du moteur oculaire commun. Syndrome probablement congénital caractérisé par un paralysie totale du moteur oculaire commun, sans cesse et rythmiquement interrompue par la vive contraction de certains muscles paralysés. *Journal de Médecine de Lyon*, **22**, 209.
- Burian, H. M., and Van Allen, M. W. (1963). Cyclic oculomotor paralysis. *American Journal of Ophthalmology*, **55**, 529.
- Crone, R. A., and Horsten, G. P. M. (1970). Cyclische oculomotoriusverlamming met cyclische veranderingen in het EEG. *Nederlandsch Tijdschrift voor Geneeskunde*, **114**, 1885.
- Duke-Elder, W. S. (1964). *System of Ophthalmology*, Vol. III, Part 2. *Congenital Deformities*, p. 1004. Kimpton, London.
- Fuchs, E. (1893). Association von Lidbewegung mit seitlichen Bewegungen der Auges. *Beitrage zur Augenheilkunde*, **11**, 12.
- Greeves, R. A. (1913). Case of partial oculomotor paralysis, with synchronous clonic contractions of muscles supplied by the third cranial nerve. *Proceedings of the Royal Society of Medicine, Section of Ophthalmology*, **6**, 23.
- Hicks, A. M., and Hosford, G. N. (1937). Cyclic paralysis of the oculomotor nerve. *Archives of Ophthalmology*, **17**, 213.
- Levy, M. R. (1968). Cyclic oculomotor paralysis with optic atrophy. *American Journal of Ophthalmology*, **65**, 766.
- Lowenstein, O., and Givner, I. (1942). Cyclic oculomotor paralysis (spasmus mobilis oculomotorius). *Archives of Ophthalmology*, **28**, 821.
- Petrovic, A., and Tschernolossow, A. (1931). Zur Frage der rhythmischen Angiospasmen im Gebiete der Augenkerne. *Klinische Monatsblätter für Augenheilkunde*, **86**, 491.
- Rampoldi, R. (1884). Singolarissimo caso di squilibrio motorio oculopalpebrale. *Annali di Ottalmologia e Clinica Oculistica*, **13**, 463.
- Stevens, H. (1965). Cyclic oculomotor paralysis. *Neurology*, **15**, 556.

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