

Mechanistic considerations when contemplating a diagnosis of non-accidental injury in an infant with vitreous haemorrhage and retinopathy of prematurity

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Comment on: Kwok *et al.*
Can vitreous haemorrhage indicate non-accidental injury if mild retinopathy of prematurity is present?
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In recent years there has been increasing awareness of the contribution that ophthalmologists can make to the multidisciplinary field of child protection. Two major reviews on the clinical features and causation of non-accidental eye injury have been published in recent issues of *Eye*.^{1,2} In October 2000 a case report was published of a premature infant presenting with vitreous haemorrhage which was subsequently investigated for physical child abuse.³

Any ophthalmologist can be confronted with an infant with intraocular haemorrhages, or other signs which may raise the suspicion of physical child abuse, and nowadays ophthalmologists are increasingly asked to give an expert opinion on the ophthalmic findings in children with suspected abuse. Green *et al.*⁴ and Jayawant *et al.*⁵ have both recommended that ophthalmologists examine children with suspected physical abuse, so that important ophthalmic signs are not missed, and that they are properly documented. Medical evidence involving ocular findings forms an important component of legal proceedings, be they civil proceedings related to child placement orders or criminal proceedings against the alleged perpetrators.

In most cases of physical child abuse, the three main questions are:

1. *What level of trauma was inflicted?* The ophthalmologist can indicate that an injury has occurred to the eyes, and whether the injury is consistent with a particular mechanism of inflicted trauma, such as blunt trauma, shaking injury, heat or chemical injury.
2. *Who was the perpetrator?* The ophthalmologist cannot say directly who the perpetrator was, but occasionally information concerning the timing of the injury may be specific enough to indicate that a certain party had the opportunity to inflict the injuries.
3. *Is the affected child or siblings at risk of further abuse?* The ophthalmological evidence will be added to the evidence of other specialists within the multidisciplinary team, at the case conferences which assess the risk to the child. In the October 2000 issue of *Eye*, Kwok *et al.*³ presented an infant with vitreous haemorrhage, and posed the question as to whether this was due to mild retinopathy of prematurity (ROP) or whether it indicated child abuse. The journal published this paper as it raised a number of extremely important issues relating to a diagnosis that would have profound implications for the affected child and family members.

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Kwok *et al.*³ presented the case of a premature infant who developed ROP, and subsequently vitreous haemorrhage at 5 weeks of age (corrected age). Consideration was rightly given to the possibility that the haemorrhage indicated physical child abuse. A multidisciplinary investigation ensued, and a case conference concluded that this was a case of child abuse. What, then, are the fundamental issues raised by this case?

The pathology that we see in the eye as a result of trauma depends on both the level and the mechanism of the inflicted trauma, and on the susceptibility of the affected tissue to that trauma. In the vitreous and retina, this susceptibility to trauma may be increased if there is pre-existing disease, particularly if that disease involves alterations to the retinal vasculature, as in ROP. In the infant reported by Kwok *et al.*³ we were told that the eyes were normal at birth, which excludes birth-related trauma (the commonest cause of intraocular haemorrhages in a neonate) and congenital abnormalities. When the vitreous haemorrhage was first noted in the left eye at approximately 4 months of age (corrected age about 5 weeks) we were told that stage 2 zone 2 ROP was present. Stage 3 disease had been described in the right eye 1 month earlier. It is not possible to state that the vitreous haemorrhage occurred with stage 2 disease without first considering the possibility that stage 3 disease developed in the left eye and regressed transiently in the weeks between examinations. However, we think this is very unlikely.

Could stage 2 ROP result in 'spontaneous' vitreous haemorrhage? Again, we think this is very unlikely, and believe that another mechanism has to be invoked. Intuitively, it seems more likely that stage 2 ROP would cause intraocular haemorrhage if the child were subjected to additional trauma. If this is true, how much additional trauma would be required, and how can we help to determine this? Under normal circumstances, when there is no pre-existing retinal disease, minor trauma does not cause any intraocular haemorrhage. In order to produce intraocular haemorrhages in a normal eye, severe trauma must be inflicted (this can either be direct trauma to the eye or indirect trauma inflicted by a mechanism such as violent shaking). The extent of injury increases with the level of violence inflicted, and we can use the extent of injury to define the level of violence inflicted in physical child abuse.

If we postulate that the intraocular haemorrhages were due to direct ocular trauma, then we would expect to see additional clinical signs such as periorbital haematoma, corneal abrasions, hyphaema or lens damage. Even if these were absent, blunt trauma alone would be most unlikely to produce vitreous haemorrhage without extensive retinal haemorrhage or at the very least commotio retinae (a manifestation of concussive retinal injury). None of these occurred in this infant, which indicates that the vitreous haemorrhage could not have been due to severe direct trauma.

If we now postulate that the intraocular haemorrhages were due to indirect ocular trauma caused by repeated cycles of violent shaking, we would also expect associated injuries to the eye and brain. Although the sparse retinal haemorrhages in this child could have been due to a shaking injury, it would be highly improbable that the affected child would be left without severe cerebral oedema and at least subdural haemorrhage; the studies of Green *et al.*⁴ and Wilkinson⁶ have shown a direct correlation between eye and brain injuries in children who have been shaken, related to the fact that both organs are subjected to the same violent movements. Green *et al.*⁴ found that shaken children with vitreous haemorrhage had additional extensive retinal haemorrhages; they also had severe brain injuries such as cerebral lacerations, intracerebral and subarachnoid haemorrhages in addition to subdural haemorrhages. These were not seen in the child under consideration, and therefore it is very unlikely that the child could have been subjected to the high level of trauma that would cause these injuries in a child with normal eyes and brain.

It seems that in this infant, stage 2 ROP must have predisposed to vitreous haemorrhage, but only at a level of trauma that is lower than that required to cause vitreous haemorrhage in a child with a normal eye. This reasoning suggests that this child had not been subjected to a level of trauma defined as abusive. However, this 'low level' of force might act on abnormal blood vessels associated with ROP, causing them to bleed into the retina or vitreous.

It is our firm belief that the vitreous haemorrhages in the infant are directly related to the abnormal retinal vessels present as a result of the ROP. It is perfectly possible that minor trauma experienced in the life of any infant could have precipitated bleeding from such vessels. We suggest that there is nothing in the ophthalmic findings alone to indicate that the infant experienced a level of trauma that could be considered abusive. However, as ophthalmic practitioners, we also accept that other non-ophthalmic information may have been produced at the multidisciplinary case conference, which indicated that physical child abuse had occurred in this child.

References

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