

Can convulsions alone cause retinal haemorrhages in infants?

Ajai K Tyagi, Steve Scotcher, Nikos Kozeis, Harry E Willshaw

Abstract

Aim—To evaluate the likelihood that, in children under the age of 2 years, convulsions alone may cause retinal haemorrhages.

Methods—Children under the age of 2 years admitted to hospital following convulsions, were examined within 48 hours of admission. The convulsions were classified by a paediatric neurologist and detailed ocular examination, including indirect ophthalmoscopy, was performed by an ophthalmologist. Statistical analysis was undertaken using Hanley's rule of three.

Results—32 consecutive children admitted with convulsions were examined; 10 of them were admitted following epileptic seizures and 22 following febrile convulsions. Two of the children with febrile convulsions were admitted in status epilepticus. None of these children had retinal haemorrhages. Therefore, using Hanley's rule of three, the upper limit of 95% confidence interval of retinal haemorrhages following convulsions in children under the age of 2 years, is less than 10/100.

Conclusions—In children under the age of 2 years convulsions alone are unlikely to cause retinal haemorrhages. By combining the results of this study with those previously reported from this unit in older children, the upper limit of 95% confidence interval of retinal haemorrhages, following convulsions in children under the age of 14 years, is less than 5/100. Therefore, the finding of retinal haemorrhages in a child admitted with a history of convulsion should trigger a meticulous search for other causes of these haemorrhages, particularly non-accidental injury.

(*Br J Ophthalmol* 1998;82:659-660)

Birmingham and
Midland Eye Centre,
Dudley Road,
Birmingham B18 7QU
A K Tyagi
S Scotcher

Birmingham
Children's Hospital
NHS Trust,
Birmingham B16 8ET
N Kozeis
H E Willshaw

Correspondence to:
Mr Harry E Willshaw, The
Birmingham Children's
Hospital NHS Trust,
Ladywood Middleway,
Ladywood, Birmingham
B16 7ET.

Accepted for publication
22 January 1998

Retinal haemorrhages in infancy are a cardinal sign of non-accidental injury (NAI) and may result from direct head trauma, severe chest compression, or the acceleration/deceleration forces generated by severe shaking of the head.^{1,2} However, a variety of other potential causes² must be excluded before attributing the haemorrhages seen in any child to NAI. When birth trauma, blood dyscrasias, and infections have been excluded it is important to eliminate other traumatic events as a cause of the haemorrhages. In light of previous reports, the possibility that cardiopulmonary resuscitation³

or seizures^{4,5} may have caused the retinal haemorrhages must be considered.

A previous study from our department reported no incidence of retinal haemorrhages following convulsions in a series of 32 children with a mean age of 46.9 months (range 4 months to 14 years).⁶ However, the vascular system of infants is thought to be more vulnerable to sudden changes in central venous pressure.⁷ Therefore, this study was undertaken to evaluate the likelihood that convulsions alone may cause retinal haemorrhages in children under the age of 2 years.

Methods

This was a prospective study of sequential admissions to Birmingham Children's Hospital. Over a 9 month period 32 children under the age of 2 years were admitted with history of convulsions. A detailed history was obtained from each family including specific questions about associated vomiting, trauma, or cardiopulmonary resuscitation. The convulsions were categorised by a paediatric neurologist based on the international classification of epileptic seizures. Any child with a history of associated head trauma or cardiopulmonary resuscitation would have been excluded from the study.

Within 48 hours of their admission the children had a detailed ocular examination, including indirect ophthalmoscopy performed by one of the authors. All children in this study had their pupils dilated with 0.5% or 1% tropicamide eye drops. No child was excluded from the study on the grounds that pupil dilatation was considered inappropriate by the supervising paediatrician.

Statistical analysis was undertaken using Hanley's rule of three.^{8,9} If none of the "n" patients showed the event about which we are concerned, we can be 95% confident that the chance of this event is at most 3 in n (that is, 3/n). In other words, the upper 95% confidence limit of a 0/n rate is approximately 3/n.

Results

A total of 32 children under the age of 2 years were examined. These included 15 males (46.87%) and 17 females (53.13%). Their ages ranged from 1 month to 23.5 months with a mean age of 12.2 months and median of 14 months. The types of convulsions and the classification of epileptic seizures are summarised in Tables 1 and 2. Symptomatic epilepsy was due to brain malformation in three children and to cerebral palsy, spontaneous brain haemorrhage, and hydrocephalus respectively, in the other three. Two children with

Table 1 Type of seizures

Type	Numbers (n=32)
Epilepsy	
Idiopathic	4 (12.50%)
Symptomatic	6 (18.75%)
Febrile	22 (68.75%)

Table 2 Classification of epileptic seizures

Type	Numbers (n=10)
Generalised:	
Tonic-clonic	4
Tonic	1
Clonic	1
Infantile spasms	1
Partial:	
Simple	1
Complex	2

febrile convulsions were admitted in status epilepticus (6.25%). Vomiting was associated with convulsions in five children (15.62%). No child admitted with seizures in this period had suffered direct head trauma or required cardiopulmonary resuscitation.

No retinal haemorrhages were found in any of the children in this study. Therefore, using Hanley's rule of three, we can be confident (to an upper limit of 95%) that the chance of retinal haemorrhages occurring as a result of convulsions alone is at the most 10 in 100 or 10%.

Discussion

Retinal haemorrhages in infants can be a benign finding in the neonatal period or it may signify some serious underlying systemic disorder. In infancy, the major cause of concern is non-accidental injury.² Retinal haemorrhages can occur in up to 89% of infants with NAI and recent reports have emphasised that such haemorrhages may be strictly unilateral.¹⁰ However, in suspected NAI it is essential to exclude the possibility that associated events such as cardiopulmonary resuscitation and convulsions might be responsible for the observed haemorrhages. Previous studies, both clinical and experimental, have shown that cardiopulmonary resuscitation alone is unlikely to cause retinal haemorrhages.¹¹⁻¹³

Theoretically, convulsions might potentially cause retinal haemorrhages in children as a result of a sudden rise in retinal venous pressure, following a rise in central venous pressure secondary to an increase in intrathoracic pressure.² A sudden rise in intrathoracic pressure can occur with a Valsalva type manoeuvre associated with seizures, cardiopulmonary resuscitation, vomiting, and bouts of coughing.

In our study, none of the 32 children under the age of 2 years were found to have retinal haemorrhages within 48 hours of their admission following convulsions. This study included two (6.2%) infants with status epilepticus and five (15.6%) with vomiting. Statistical analysis of this study shows that in children under the age of 2 years convulsions alone are unlikely to cause retinal haemorrhages, although the possibility cannot be completely ruled out.

A study previously published from our unit failed to find retinal haemorrhages following convulsions in 32 children under the age of 14 years (mean 46.9 months).⁶ By combining the results of our present study with those previously reported, we have not found retinal haemorrhages following convulsions in any of the 64 children. Therefore, using Hanley's rule of three, the upper limit of 95% confidence interval of retinal haemorrhages following convulsions in children under the age of 14 years, is less than 5/100.

We conclude, therefore, that convulsions alone are unlikely to cause retinal haemorrhages in children under the age of 2 years. The finding of retinal haemorrhages in a child with a history of convulsion should trigger a meticulous search for other causes of these haemorrhages, particularly non-accidental injury.

- Smith SM, Hanson R. One hundred and thirty four battered children: a medical and psychological study. *BMJ* 1974;3:666-70.
- Kaur B, Taylor D. Fundus haemorrhages in infancy. *Surv Ophthalmol* 1992;37:1-17.
- Caffey J. On the theory and practice of shaking infants. *Am J Dis Child* 1972;124:161-9.
- Meldrum BS. Pathophysiology. In: Rickens LJ, ed. *A textbook of epilepsy*. New York: Churchill Livingstone, 1982: 456-87.
- Henkind P, Wise GN, Dollery CT. Clinical and microscopical features of retinal lesions. *The retinal circulation*. Philadelphia: Harper & Row, 1971:167-78.
- Sandramouli S, Robins R, Tsaloumas M, et al. Retinal haemorrhages and convulsions. *Arch Dis Child* 1997;76: 449-51.
- Tongue AC. Discussion of: "Traumatic retinoschisis in battered babies," by Greenwald MJ et al. *Ophthalmology* 1986;93:618-25.
- Eypasch E, Lefering R, Kum CK, et al. Probability of adverse events that have not yet occurred: a statistical reminder. *BMJ* 1995;311:619-20.
- Hanley JA, Lippman-Hand A. If nothing goes wrong, is everything alright? *JAMA* 1983;259:1743-5.
- Tyagi AK, Willshaw HE, Ainsworth JR. Unilateral retinal haemorrhages in non-accidental injury. *Lancet* 1997;349: 1224.
- Kanter RK. Retinal haemorrhages after cardiopulmonary resuscitation or child abuse. *Pediatrics* 1986;108:430-32.
- Gilliand MGF, Luckenbach MW. Are retinal haemorrhages found after resuscitation attempts? A study of the eyes of 169 children. *Am J Forensic Med Pathol* 1993;14:187-92.
- Fackler JC, Berkowitz ID, Green WR. Retinal haemorrhages in newborn piglets following cardiopulmonary resuscitation. *Am J Dis Child* 1992;146:1294-6.