Observations on retinal haemorrhages in the newborn

E. M. R. CRITCHLEY

*From the Department of Neurology, University of Kentucky,
Lexington, U.S.A.*

Several considerations serve to exclude the study of retinal haemorrhage from the routine neurological assessment of the newborn: (1) the lack of any clearly demonstrated correlation between cerebral trauma and the incidence of retinal haemorrhage; (2) or even between subsequent ocular abnormalities and retinal haemorrhage; (3) the speedy absorption of retinal haemorrhage beginning before the infant becomes neurologically 'stable'; and (4) the wide variation in the reported incidence of retinal haemorrhage. Even so, these haemorrhages cannot be totally ignored in the pathophysiology of childbirth, and, as our knowledge of specific developmental defects increases, it is tempting to seek new correlates and to re-open an aspect of neuropaediatrics which has fallen into disrepute in the past. The principal method of examination has been direct ophthalmoscopy of the posterior pole. The data and the method itself are reviewed historically and in the light of personal experience.

REVIEW OF PREVIOUS STUDIES

INCIDENCE OF HAEMORRHAGE The figures given for the incidence of haemorrhage range from 2.6% (Chace, Menitt, and Bellows, 1950) to 40% (Giles, 1960). Even if the literature on this subject be arranged chronologically, a clear pattern does not emerge. There has been no apparent increase in skill in observation or decline in frequency with change in obstetric technique or perinatal care. The mean incidence would appear to be just below 20%—a very similar figure to that found by Kauffman (1958), 18.2% of 7,727 infants he personally examined.

Comparison between different series is quite unreliable, but comparisons made within a particular series may be highly significant, although the exact figures may not be reproducible: thus, Giles (1960) found a decline in the percentage of observable haemorrhages from 36% at 24 hours, to 25% at 48 hours, and 20% at 72 hours, and Schenker and Gombos (1966) noted a relationship between retinal haemorrhages and the mode of delivery—0% with

Caesarian section, 8.3% with breech, 31% with forceps, and 52% with vacuum extraction.

THEORIES OF PRODUCTION There is, as yet, no accepted theory to explain the mode of production of retinal haemorrhage. Most hypotheses relate either directly or indirectly to obstetrical trauma. The incidence of haemorrhage does not bear a direct relationship to the duration of labour (Giles, 1960). Some of the postulates are listed below.

1. *Postulates unrelated to obstetrical trauma* These invoke (a) toxæmia of late pregnancy (Kauffman, 1958), (b) the first act of respiration (Koenigstein, 1881).

2. *Postulates partially related to obstetrical trauma* These invoke (c) loops of cord around the neck (Paul, 1900), (d) hypertensive changes secondary to anoxia (Belmonte Gouzáiz, 1947), (e) asphyxia and venous congestion (Schleich, 1884), (f) a haemorrhagic diathesis (Ehrenfest, 1922), (g) hypoprotrombinaemia (Lucas, Dearing, Hoobler, Cox, Jones, and Smyth, 1921).

3. *Postulates directly related to obstetrical trauma* These invoke (h) the use of forceps (Eades, 1929) and the type of delivery (Schenker and Gombos, 1966), (i) the use of pituitrin during labour (Rowland, 1935), (j) the result of unequal pressure distribution during birth (Kauffman, 1958), (k) spastic contraction of the lower part of the uterus (Sanchez Ibañez, Belmonte Gonzalez, and Navarro Martinez, 1963), (l) the sudden release of extracranial pressure with consequent change in intracranial pressure, dependent on the rapidity or control of the delivery (Giles, 1960).

TYPES OF HAEMORRHAGE The varieties of haemorrhages found are subject to dispute. Most classifications list flame-shaped haemorrhages, radiating from the disc, parallel and superficial to the vessels. These are resorbed within 24 to 48 hours (Giles, 1960). They often coexist with small, round, or elongated deep red haemorrhages with sharp outlines, found adjacent to the disc and the macular area, at varying distances from the vessels. These

usually disappear within three days (Schenker and Gombos, 1966). Large, round haemorrhages are found mostly near the disc and range in size between 1-2 disc diameters. They remain for up to seven to 10 days (Giles, 1960). Kauffman (1958), quoting Richman (1936-1937), describes them as bright red and situated in the deeper layers of the retina or even in the choroid. Subhyaloid haemorrhages form a fourth group. Some observers—for example, Juler (1926)—make a sharp distinction between these and sheet-like haemorrhages extending radially from the disc to the periphery. These usually disappear within three to six days (Giles, 1960). Giles regards them as somewhat rare; Kauffman (1958) and Schenker and Gombos (1966) do not mention them, but Juler (1926) wrote that 'the most common distribution of the blood is in thinnish sheets in the nerve fibre layer, spreading out from the optic disc, and sometimes overlapping it. Such sheets are similar in colour to the choroid, which in the newborn is less pigmented than in the adult and, hence, the haemorrhage may escape notice, except with careful observation'.

PATHOLOGICAL SIGNIFICANCE Retinal haemorrhage is one form of extravasation of blood into the central nervous system at the time of birth. The cerebrospinal fluid of the newborn often contains bilirubin and a few erythrocytes (Roberts, 1925); and a bloody or blood-tinged fluid is obtained in 9-13% of babies (Sharpe, 1924; Otila, 1948). Buchanan (1926) has written that squinting, ptosis, and nystagmus may be associated with intracranial or intraocular damage from haemorrhage in the perinatal period. This hypothesis still awaits detailed study.

As stated, there is little direct evidence to relate abnormalities within the eye to retinal haemorrhage. Two possible sequelae are mentioned by Maumenee, Hellman, and Shettles (1941): 'pseudoglioma' which has been proved to be due to a massive retinal haemorrhage, and amblyopia; but here the association has not been so well established. It is possible (Wolff, 1907; Edgerton, 1934) that a large perinatal haemorrhage in the macular area could produce a temporary separation of the retinal elements with resultant impairment of vision. Pajor, Szabó, and Puskás (1964) in a three-year longitudinal study found granular, macular changes, which could cause reduced visual acuity, in 11% of 227 children with retinal haemorrhage at birth.

Opinions are equally guarded in relating brain damage and retinal haemorrhage. Sykes (1931) and Kauffman (1958) consider that there is a general but no definite relationship between retinal haemorrhage and signs of intracranial trauma. Schenker

and Gombos (1966) state that there is no direct relationship between retinal haemorrhage and brain damage; 'however, it is quite possible that central nervous system trauma associated with delivery is so minimal that it cannot be evaluated immediately after birth, but only in the later stages of life.' But from post mortem studies of perinatal deaths (Cruikshank, 1923; Jacobs, 1928) it is apparent that intraocular haemorrhage can coexist with massive intracranial trauma and that in a considerable proportion of these cases (Buchanan, 1926) the child died, not in consequence of the haemorrhage but of some disease independent of it.

The association of intraocular and intracranial haemorrhage can occur beyond the neonatal period. The finding of retinal or subhyaloid haemorrhage in early life is strongly suggestive of subdural haematoma or subarachnoid haemorrhages; thus, Hollenhorst and Stein (1958) found intraocular haemorrhages in 28 cases (60%) of 47 proven cases of subdural haematoma, subdural hygroma, and subarachnoid haemorrhage in young children.

The morphological type of haemorrhage seen may reflect different mechanical circumstances and thereby possess differing pathological significance. Schenker and Gombos (1966) associate flame-shaped haemorrhages with anoxia and foetal distress, small haemorrhages with quick, easy labour, and larger haemorrhages with prolonged delivery or vacuum extraction. Perhaps the large round haemorrhages, the subhyaloid haemorrhages, and the sheet-like haemorrhages, all of which persist longer than the flame-shaped and small haemorrhages, are most closely related to intracranial trauma and a search for them could well be incorporated into the routine neurological examination of the neonate within the first four days after delivery.

PRESENT STUDY

A personal study was made of 600 infants in the first four days of life. Ophthalmoscopy was performed as part of the neurological assessment of the newborn. As a general rule mydriatics were not used. The lighting in the nursery was reduced and the babies allowed to lie supine with minimal restraint. They were allowed to suck on a disposable teat; this procedure was usually sufficient to encourage opening of the eyes and within a few seconds to permit free retraction of the eyelids with the fingers. By this means, all possible trauma—chemical or physical—to the eyes was avoided. If the method was not at first successful the baby was partially dressed and a further attempt made at fundusoscopic examination.

RESULTS

Throughout the series the presence of congenital anomalies, variations in the shape of the disc and in

the calibre of the veins were noted without difficulty; and yet, not until over 300 babies had been examined could the writer claim the ability to recognize retinal haemorrhages in the newborn with certainty. In the second half of the series it became apparent that the incidence of haemorrhage did not differ appreciably from that found in earlier reports. Twenty-nine (13%) of the last 220 children examined showed retinal haemorrhages. Furthermore, it was apparent that this was an underestimate of the true incidence. To be sure of the presence or absence of retinal haemorrhages one must be able to examine all of the posterior pole—fundus, macula, and the surrounding retina—and if necessary pass and re-pass over the same area to obtain a better look. In 26 of the 220 children an adequate examination was not possible. Mostly this was a factor of ease of examination, though other reasons, such as conjunctivitis secondary to Crede prophylaxis, were sometimes present. It appeared in retrospect that the smaller babies were the more difficult ones. It is instructive to compare the details of the 29 in whom retinal haemorrhages were seen, the 26 babies in whom examination was unsatisfactory, and the control group.

It would appear from comparison of the figures that the group which could not be adequately examined contained the greatest proportion of 'at risk' babies (see Table).

Retinal haemorrhages were most frequently seen in the heavier children. This observation has been made previously, notably by Edgerton (1934). It is questionable whether this represents a true increase in frequency or merely that the larger baby is more mature and the eye-grounds are more readily scanned. Maumenee *et al.* (1941) state that it is generally agreed that the incidence of retinal haemorrhages is increased in premature infants. They do not substantiate this. In contrast, Kauffman (1958) writes that very few prematures reveal retinal haemorrhages.

A remarkable feature of the present series has been the striking preponderance of males with retinal haemorrhages. Other series have found a higher incidence among males than females, but not in the ratio 21:8. The explanation is not readily apparent.

One factor which has been commented upon many times in the past is that haemorrhages in the retina are speedily absorbed in the first days of life. This fact did not appear to affect the frequency with which haemorrhage was observed in the present series. Twelve per cent of the babies examined on the first day showed haemorrhages, 8.8% on the second day, and 25.5% of those examined on days 3 and 4. These were not sequential observations. It

TABLE I
CONTRAST OF POPULATIONS

	Retinal haemorrhages present	Inadequate examination	Control group
Totals (No.)	29	26	166
Abnormalities ¹ (%)	14	15	5
APGAR ² 7+ (%)	86	62	85
Average birth weight (kg)	3.14	2.50	3.29
Premature (less than 38 weeks) (%)	0	31	12
Caesarean section (%)	7	15	6
Sex ratio (male/female)	21:8	7:6	11:10
Primigravida (%)	38	35	43
Large families, (5+) (%)	13	15	13
High forceps ³ (%)	4	10	5
Abnormal length of labour ⁴ (%)	19	20	26

¹Abnormalities listed as follows: *retinal haemorrhage group* (mongolism, obstructive jaundice, albinism, anomalies associated with growth retardation); *inadequate examination group* (extra digits, (?) cretinism, severe jaundice, micrognathia); *control group* (2 micrognathia, 2 extra digits, ichthyosis, branchial cleft, uncurred ears, haemangioma left cheek, cardiac abnormality).

²APGAR scores: In 1953, Dr. Virginia Apgar (Apgar, 1953) introduced a practical method of evaluation of the condition of the newborn infant one minute after birth. A rating of 10 points described the best possible condition with two points each given for respiratory effort, reflex irritability, muscle tone, heart rate, and colour. The predictive value, established by a study of 15,348 infants, was the subject of a second article (Apgar, Holaday, James, Weisbrot, and Berrien, 1958). In some hospitals the APGAR score is reassessed at 10 min after birth. In this article the 1-min score has been used. This was recorded routinely by the delivery-room staff.

³The totals used were somewhat less than in the earlier part of the Table—26, 10, and 146 respectively—and excluded the Caesarian section cases.

⁴Abnormal length of labour was defined as under 4 hr duration or over 16 hr.

is, unfortunately, not possible to compare these findings with other series, as for example with Giles's (1960) series, for it would appear that the sequential observations reported were confined to those babies found to have retinal haemorrhages one hour after birth.

SUMMARY

Retinal haemorrhages were observed in 13% of 220 newborn babies. It is probable that with more refined techniques a higher figure would have been obtained. The sex distribution was 21:8, male to female.

Direct ophthalmoscopy cannot be used to obtain an accurate measure of the incidence of retinal haemorrhage; but within a series techniques or environmental factors may be readily compared.

It is possible that the group most at risk may be that most difficult to assess by this method.

Neuropaediatricians may find most profit in the longitudinal observation of children with particular morphological types of haemorrhages and an attempt to relate these to syndromes of minimal cerebral damage apparent at school age.

A further study using indirect ophthalmoscopy is planned.

I wish to thank Dr. David B. Clark, professor of neurology, for advising me on this study; Dr. John E. Greene, professor of obstetrics, Dr. Warren E. Wheeler, professor of pediatrics, and Dr. Robert A. Beargie and staff of the newborn and premature nurseries; also Dr. Roger Robinson, Dr. Michael McQuillen, Dr. Johnathan Wirtschafter, and Dr. David B. Clark for their helpful comments on the manuscript.

REFERENCES

- Apgar, V. (1953). A proposal for a new method of evaluation of the newborn infant. *Anesth. et Analg.*, 32, 260-267.
- , Holaday, D. A., James, L. S., Weisbrot, I. M., and Berrien, C. (1958). Evaluation of the newborn infant: Second report. *J. Amer. med. Ass.*, 168, 1985-1988.
- Belmonte González, J. (1947). Hemorragias retinianas del recién nacido. *Rev. espan. Oto-neuro-oftal.*, 6, 323-338 and 393-408.
- Buchanan, L. (1926). Discussion on birth injuries of the eye. *Trans. ophthalm. Soc. U.K.*, 46, 32-42.
- Chace, R. R., Merritt, K. K., and Bellows, M. (1950). Ocular findings in the newborn infant. *Arch. Ophthalm.*, 44, 236-242.
- Cruikshank, J. N. (1923). Haemorrhages of the newborn. *Lancet*, 1, 836-839.
- Eades, M. F. (1929). Retinal hemorrhages of the newborn. *New Engl. J. Med.*, 201, 151-155.
- Edgerton, A. E. (1934). Ocular observations and studies of the newborn. *Arch. Ophthalm.*, 11, 838-867.
- Ehrenfest, G. (1922). *Birth Injuries of the Child*. Appleton, New York.
- Giles, C. L. (1960). Retinal hemorrhages in the newborn. *Amer. J. Ophthalm.*, 49, 1005-1011.
- Hollenhorst, R. W., and Stein, H. A. (1958). Ocular signs and prognosis in subdural and subarachnoid bleeding in young children. *Arch. Ophthalm.*, 60, 187-192.
- Jacobs, M. W. (1928). The frequency in the newborn of intraocular hemorrhages and their relationship to intracranial trauma. *Trans. Amer. Acad. Ophthalm. Otolaryng.*, 33, 218-226.
- Juler, F. (1926). Retinal hemorrhage in the newborn. *Trans. Ophthalm. Soc. U.K.*, 46, 42-52.
- Kauffman, M. L. (1958). Retinal hemorrhages in the newborn. *Amer. J. Ophthalm.*, 46, 658-660.
- Koenigstein, L. (1881). Untersuchungen aude augen neugeborenen Kinder. *Wien. Med. Jahrb.*, 47.
- Lucas, W. P., Dearing, B. F., Hoobler, H. R., Cox, A., Jones, M. R., and Smyth, F. S. (1921). Blood studies in the newborn. *Amer. J. Dis. Child.*, 22, 525-559.
- Maumenee, A. E., Hellman, L. M., and Shettles, L. B. (1941). Factors influencing plasma prothrombin in the newborn infant. The effect of antenatal administration of Vitamin K on the incidence of retinal hemorrhage in the newborn. *Bull. Johns Hopk. Hosp.*, 68, 153-168.
- Otila, E. (1948). Studies on the cerebrospinal fluid in premature infants. *Acta Paediat. Uppsala*, 35, No. 8.
- Pajor, Rezsó, Szabó, Zoltán., and Puskás, Ernő. (1964). Control examination at 3 years of age in 227 infants with retinal hemorrhages at birth. *Orv. Hetil.*, 105, 78-783.
- Paul, C. A. (1900). Ueber einige Augenspiegelbefunde bei Neugeborenen. Inaug. Disert. Halle.
- Richman, F. (1936-1937). Retinal haemorrhages in newborn. *Proc. roy. Soc. Med.*, 30, 277-280.
- Roberts, M. H. (1925). The spinal fluid in the new-born. *J. Amer. med. Ass.*, 85, 500-503.
- Rowland, W. D. (1935). Ocular pathology of the newborn: an end results study. *Amer. J. Ophthalm.*, 18, 647-650.
- Sanchez Ibanez, J. M., Belmonte Gonjalez, N., and Navarro Martinez, A. (1963). Retina-Hämorrhagien beim Neugeborenen nach Vakuum-Extraktion. *Gynaecologia (Basel)*, 156, 172-186.
- Schenker, J. G., and Gombos, G. M. (1966). Retinal hemorrhage in the newborn. *Obstet. and Gynec.*, 27, 521-524.
- Schleich. (1884). Mittheil Ophthi Kin in Tubingen. *Zbl. prakt. Aug. penheilk.*, 308. (Abstract.)
- Sharpe, W. (1924). Brain injuries and especially intracranial hemorrhage and cerebral edema in the newborn. *Illinois med. J.*, 45, 264-268.
- Sykes, C. S. (1931). A study of the retinal findings in the newborn. *Tex. St. J. Med.*, 26, 878-883.
- Wolff, B. (1907). Injuries to the eyes of the child during labour. *Ophthalmoscope*, 5, 484-492.