

Incidence and Rate of Disappearance of Retinal Hemorrhage in Newborns

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Objective: To determine the prevalence, associated biometric factors, and rate of disappearance of neonatal retinal hemorrhage.

Design: Cross-sectional and natural history study.

Methods: Healthy newborns (n = 149) at an urban hospital were examined using indirect ophthalmoscopy within 30 hours of birth. Newborns with retinal hemorrhage were reexamined biweekly until hemorrhage resolved.

Main Outcome Measures: Neonatal and maternal biometric factors, and incidence and rate of resolution of retinal hemorrhage.

Results: Intraretinal hemorrhage was present in 34% of newborns and varied from a single dot hemorrhage in one eye to bilateral widespread hemorrhages, occasionally with white centers. The incidence of hemorrhage was higher for vacuum-assisted (75%) than for spontaneous vaginal deliveries (33%) and was least for infants delivered by cesarean section (7%). The mean maternal age was greater for infants with retinal hemorrhage. By 2 weeks after birth, retinal hemorrhage resolved in 86% of eyes, and at 4 weeks no intraretinal hemorrhage was detected, although a single subretinal hemorrhage persisted until 6 weeks after birth.

Conclusions: Intraretinal hemorrhages are common in the immediate postnatal period and resolve by 1 month of age. Retinal hemorrhage in infants older than 1 month should heighten suspicion that the hemorrhage is associated with factors other than birth. *Ophthalmology* 2001;108:36–39 © 2001 by the American Academy of Ophthalmology.

Since their initial detection in 1861,¹ several investigators have confirmed the presence in healthy newborns of retinal hemorrhages presumably related to the birth process. Reported incidences of neonatal retinal hemorrhage vary widely, between 2.6% and 50.0%.^{2–15} Previous investigations are also inconclusive regarding ophthalmoscopic features of neonatal retinal hemorrhages and their relationship to neonatal and maternal biometric factors.

Although birth-related retinal hemorrhage does not by itself cause subsequent visual or neurologic deficits,^{16–18} retinal hemorrhage in infants may be associated with systemic and other ocular pathologic factors, including intracranial disorders, hematologic disturbances, chorioretinal infections, and retinal vascular diseases.¹⁹ Intraretinal hemorrhages also occur in association with postnatal accidental or intentional trauma and are a key feature of the shaken baby syndrome.^{20–22} Characteristics that distinguish between hemorrhages resulting from birth or to trauma may be

critical in assessment of possible child abuse. The time course for spontaneous clearing of birth-related hemorrhage may facilitate differentiation of traumatic from birth-related retinal hemorrhage, but this has not been systematically evaluated.

In this study, we characterized the incidence, ophthalmoscopic features, and relationship to maternal and birth-related factors of neonatal retinal hemorrhages and determined their rate of disappearance.

Patients and Methods

This study was conducted with institutional approval for human investigations. Babies admitted to the newborn special care unit or with known or suspected systemic or ocular disease or congenital malformation were excluded. Infants considered for enrollment were a cohort of 402 consecutive births over a period of 65 weekdays admitted to the Well-Baby Nursery at the Children's Hospital of Yale-New Haven Medical Center determined by the pediatrics service to be free of any medical problems. One or both parents were verbally invited to participate in this study, and written informed consent was sought from one or both parents of each infant; permission was obtained also from the infant's pediatrician before enrollment in the study.

Enrolled newborns (n = 149) were initially examined within 30 hours of birth, 30 minutes after topical instillation of phenylephrine 2.5% and tropicamide 0.5%. Examination was performed by a fellowship-trained retinal specialist using a pediatric eyelid speculum, binocular indirect ophthalmoscopy, and scleral depression with proparacaine 0.5% topical anesthetic. If no retinal hemorrhage was detected within 30 hours of birth, further evaluation was

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Table 1. Demographic Features of the Patient Population

Method of delivery	
Spontaneous vaginal	120 (80.5%)
Vacuum extraction	12 (8.1%)
Cesarean section	15 (10.1%)
Forceps assisted	2 (1.3%)
Mean maternal age (yrs)	27.8 ± 6.25
Mean maternal parity	1.0 ± 1.2
Mean length of stage II labor (min)	48.4 ± 42.8
Mean birthweight (kg)	3.48 ± 0.50
Mean gestational age (wks)	37.8 ± 1.2
Mean Apgar score (min)	
1	8.6 ± 0.8
5	9.0 ± 0.2
Mean head circumference (cm)	34.4 ± 1.9
Race	
White	86 (61.0%)
Black	36 (25.5%)
Hispanic	13 (9.2%)
Asian	6 (4.3%)
Gender (male:female)	76:73 (51%:49%)
Episiotomy (yes:no)	39:110 (26.2%:73.8%)
Induction of labor (yes:no)	85:64 (57.0%:43.0%)
Maternal analgesic (yes:no)	99:50 (66.4%:33.6%)
Maternal anesthetic (yes:no)	34:115 (22.8%:77.2%)

not scheduled. If hemorrhage was present, indirect ophthalmoscopy was repeated every 2 weeks until hemorrhage was no longer evident.

Hemorrhages were classified according to location in three retinal regions. Zone I encompassed one disc diameter around the optic nerve head and fovea, zone II extended from the anterior boundary of zone I to the equator, and zone III was anterior to zone II, extending to the ora serrata.²³

Degree or severity of hemorrhage was designated by the number of hemorrhages per eye:²⁴ grade I, one or two hemorrhages; grade II, 3 to 10 hemorrhages; and grade III, more than 10 hemorrhages. The shapes, location, and other associated features of the hemorrhages were noted for each eye in a fundus drawing.

The following factors were assessed before the initial examination and were unknown to the examiner: time since delivery, length of labor, method of delivery, use of forceps, gestational age, Apgar score, birthweight, head circumference, maternal parity, and occurrence of episiotomy, maternal analgesic, maternal anesthetic, and induction of labor.

Results

Of 402 consecutive newborns eligible for enrollment, parental consent was obtained for the 149 infants who were enrolled in this study, and each underwent an initial retinal examination. Demographic features of the infant population are given in Table 1.

Retinal hemorrhage was found in 34% (50/149) of newborns. Of the 50 newborns with hemorrhage, 26 (52%) had hemorrhage in both eyes, so that 26% (76/298) of eyes examined contained hemorrhage. Hemorrhages were dot blot or flame shaped; larger blot hemorrhages often contained white centers (Fig 1). Hemorrhage was intraretinal in all infants except one, who had, in addition to intraretinal blood, a single zone I subretinal hemorrhage approximately 350 μ m in diameter.

Of the 76 eyes with hemorrhage, 73 (96%) had hemorrhage in zone I, and three (4%) had hemorrhage in zone II only ($n = 2$) or both zones II and III ($n = 1$). Of the 73 eyes with hemorrhage in

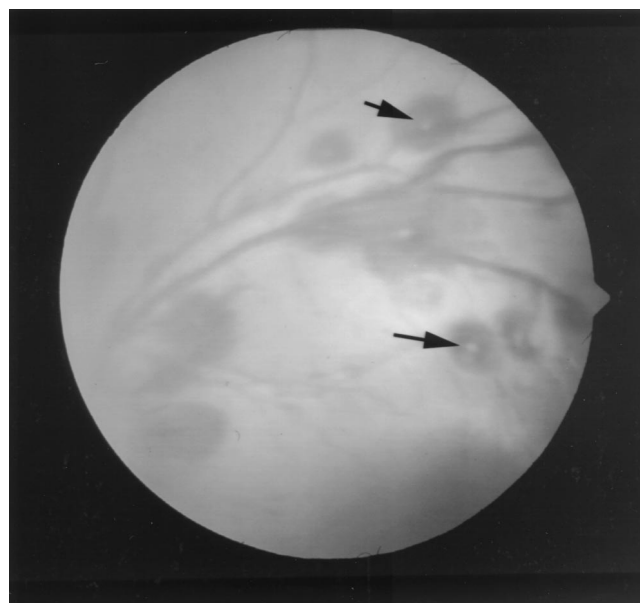


Figure 1. Fundus photograph of zones I and II, grade III, retinal hemorrhages in a baby girl 21 hours after birth. Note several of the larger hemorrhages contain white centers (arrows).

zone I, 19 (26%) had hemorrhage in zone I only; 29 (40%) had hemorrhage in zones I and II only; 24 (33%) had hemorrhage in zones I, II, and III; and one (1.3%) had hemorrhage in zones I and III only.

Of the 24 newborns with one affected eye, hemorrhages appeared in zone I in 22 cases (92%). Hemorrhage was confined to zone I in 11 patients (46%), zones I and II in six patients (25%), and was present in all zones in four patients (17%). One newborn (4%) had hemorrhage in zone II only, and one (4%) in zones II and III only.

Of the 26 infants with bilateral hemorrhage, 14 (54%) exhibited the same zonal distribution of hemorrhage in both eyes: zone I only in two (8%), zones I and II in six (23%), or all zones in six (23%). Three infants (12%) had hemorrhage in zone I only in one eye and multiple zone involvement in the fellow eye. One newborn (4%) had hemorrhage in zone I and II in one eye and in zone II in the other eye, and eight newborns (31%) had hemorrhage in zones I and II in one eye and in all zones in the fellow eye.

The severity of hemorrhage was grade I in 17 of 76 eyes (22%), grade II in 18 of 76 eyes (24%), and grade III in 41 of 76 eyes (54%). Of infants with hemorrhage in one eye only, 13 (54%) had grade I severity, six (25%) had grade II severity, and five (21%) had grade III severity. Of newborns with bilateral hemorrhage, 23 (88%) had grade III severity in at least one eye, and 17 (65%) had bilateral hemorrhage. The remaining infants had, in the two eyes, grades I and II ($n = 1$), grades I and III ($n = 4$), grades II and III, and grade II bilaterally ($n = 1$). Severity of hemorrhage in one eye did not correlate with presence or severity of hemorrhage in the fellow eye ($r = +0.2$; $P = 0.07$).

The incidence of hemorrhage was greatest for vacuum-assisted deliveries (75%; 9/12), intermediate for spontaneous vaginal births (33%; 40/120), and least for cesarean section deliveries (7%; 1/15; $P < 0.001$; Table 2). Two babies born by forceps-assisted delivery exhibited no retinal hemorrhage.

Maternal age was higher for infants with retinal hemorrhage than those without (29.1 ± 5.7 years vs. 27.1 ± 6.4 years; $P < 0.04$, Student's t test). The incidence of retinal hemorrhage was not associated with race, parity, episiotomy, use of maternal anal-

Table 2. Incidence of Retinal Hemorrhage by Maternal and Neonatal Biometric Data

	RH(+)	RH(-)
Method of delivery		
Spontaneous vaginal*	40 (33%)	80
Vacuum extraction*	9 (75%)	3
Cesarean section*	1 (6.7%)	14
Forceps assisted	0 (0%)	2
Maternal age (yrs) [†]	29 ± 5.7	27 ± 6.4
Maternal parity	1.0 ± 1.0	1.0 ± 1.3
Length of stage II labor (min)	45 ± 40	49 ± 44
Birthweight (kg)	3.4 ± 0.45	3.5 ± 0.53
Gestational age (wks)	37 ± 1.1	37 ± 1.2
Apgar score (min)		
1	8.5 ± 0.9	8.7 ± 0.8
5	9.0 ± 0.2	9.0 ± 0.3
Head circumference (cm)	34 ± 1.5	34 ± 2.1
Race		
White	34 (39%)	52
Black	10 (27%)	26
Hispanic	3 (23%)	10
Asian	2 (33%)	4
Gender (male:female)	24:26	52:47
Episiotomy (yes:no)	13:37	26:73
Induction of labor (yes:no)	19:31	47:52
Maternal analgesic (yes:no)	14:36	36:63
Maternal anesthetic (yes:no)	39:11	78:21

RH = retinal hemorrhage.

* $P < 0.001$, chi-square test.

[†] $P < 0.04$, Student's t test.

gesic or anesthetic, induction of labor, length of active labor, gestational age, Apgar scores, birthweight, head circumference, or gender (Table 2). There was no relationship between method of delivery and maternal age ($P > 0.3$).

Twenty-six of 76 eyes (17 of 50 patients) with retinal hemorrhage were lost to follow-up. At 2 weeks after birth, retinal hemorrhages had disappeared entirely in 86% of eyes (43/50), or 85% of patients (28/33). Intraretinal hemorrhages persisted in 14% of eyes (7/50) and were markedly faded in comparison with their appearance on initial examination. All seven eyes with persistent hemorrhage 2 weeks after birth had grade III severity initially.

Five of the seven eyes (three of five patients) with hemorrhage at 2 weeks were reexamined 4 weeks after birth. In four of these eyes, all hemorrhage disappeared within 4 weeks of birth. The only persistent hemorrhage was the single subretinal hemorrhage observed in the study; 2 weeks later, or 6 weeks after birth, this subretinal hemorrhage also was not detected.

Discussion

The incidence of retinal hemorrhage in newborns in this study (34%) is comparable with several reported values (30%,⁴ 34%,¹⁴ 35%,³ 37.5%,⁵ 40%,⁸ 42.1%,¹¹ and 50%⁷), but greater than values given in several studies (2.6%,⁶ 10.2%,¹⁰ 14.5%,¹² 15%,² 18.2%,⁹ 18.9%,¹⁵ and 19.2%¹³). Variation in reported values may be the result of different patient demographics, variable time periods between birth and initial examination, inclusion of children with systemic diseases, and use of pupillary dilation, lid speculums, direct or indirect ophthalmoscopy, and scleral depression.

In most eyes, hemorrhages were located in the posterior pole (zone I), although they were also often found in more anterior regions. In a small number of newborns, hemorrhage was evident only anterior to zone I, and hemorrhage in this zone is unlikely to be detected without indirect ophthalmoscopy. Although in some infants isolated dot or flame-shaped hemorrhage was seen, most eyes exhibited more than 10 hemorrhages, and in some cases hemorrhages were confluent or too numerous to count. The severity of hemorrhage in one eye, however, was not predictive of presence or severity of hemorrhage in the fellow eye. White-centered hemorrhage was commonly noted (18/76 eyes; 24%).

Factors associated with a greater risk of retinal hemorrhage in this study were vacuum-assisted delivery and increased maternal age. Delivery by cesarean section appeared protective. Other maternal factors related to pregnancy, labor and delivery, or neonatal features such as race, gender, gestational age, birthweight, head circumference, and Apgar scores, were unrelated to the incidence of retinal hemorrhage. These results are in agreement with previous reports.^{2,4,5,8,10,15,25-28}

In contrast to our results, other studies reported a greater likelihood of retinal hemorrhages in association with primiparous mothers,^{13,15} decreased length of active (stage II) labor,²⁶ low Apgar score,^{5,29} low birthweight,²⁶ and increased head circumference.⁵ Studies evaluating use of forceps during delivery as a risk factor for retinal hemorrhages found either a greater risk,¹⁵ a lesser risk,^{4,27} or no effect.^{8,25} In our study, infants delivered with forceps lacked retinal hemorrhage, but their small number precludes statistical evaluation. The effect of maternal age is also controversial.^{15,25} We found a statistically significantly greater maternal age for infants with retinal hemorrhage, but the difference was slight and of doubtful clinical meaning.

The greater incidence of hemorrhage in babies born from vacuum-assisted vaginal delivery and the frequent occurrence of unilateral hemorrhage implicate a mechanical effect on retinal vessels during passage through the birth canal, perhaps by direct compression on the globe, in creation of retinal hemorrhage. However, if this were the sole mechanism, factors such as parity, episiotomy, head circumference, and duration of labor may be expected to be associated with hemorrhage. Thus, maternal and fetal hemodynamic and rheologic changes during labor and delivery may also participate in the genesis of retinal hemorrhage, a suggestion consistent with hemorrhage in babies born via cesarean section and with the occurrence of white-centered hemorrhages.

Approximately 90% of intraretinal hemorrhages detected birth resolved within 2 weeks, and none were detectable by 4 weeks after birth. One subretinal hemorrhage (which occurred in 1/298 eyes), persisted up to 6 weeks after birth. Retinal hemorrhage in newborns of induced labors also resolve by 5 weeks of age.¹⁴

Birth-related retinal hemorrhages have been considered in the differential diagnosis of retinal hemorrhages associated with child abuse.^{20,30} Both birth-related and traumatic retinal hemorrhages may be present in all retinal zones. However, traumatic hemorrhage may occur in intraretinal,

subretinal, and preretinal compartments,^{19,21,22} whereas in our study, no preretinal or vitreous blood was evident, and subretinal hemorrhage was rare and isolated. Our data indicate that intraretinal hemorrhage detected in infants older than 1 month is not likely related to birth, a finding that may be useful in the evaluation of suspected physical abuse or other ocular and systemic diseases.

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