Newborn retinal hemorrhages: A systematic review

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PURPOSE To systematically review the characteristics, prevalence, evolution, and obstetric associations of retinal hemorrhages (RH) in newborns.

METHODS A systematic review, searching 10 databases (1970-2011), identified 45 studies, which underwent two independent reviews via the use of standardized critical appraisal. Studies meeting the following criteria were included: examination by an ophthalmologist, use indirect ophthalmoscopy, and first examination conducted within 96 hours of birth and before hospital discharge.

RESULTS Thirteen studies were included, representing 1,777 infants. The studies revealed that 25.6% of newborns born via spontaneous vaginal deliveries had RH. In contrast, infants delivered by vacuum extraction had a 42.6% rate of RH (OR, 2.75; 95% CI, 1.32-5.70), and infants delivered by double-instrument deliveries (forceps and vacuum) had a 52% rate of RH (OR, 3.27; 95% CI, 1.68-6.36). The hemorrhages are commonly bilateral (59%), of varying severity, from "mild" (22%-56%) to "severe" (18%-37%), and predominantly intraretinal and in the posterior pole. The majority of RH (83%) resolved within 10 days; isolated cases persisted to 58 days.

CONCLUSIONS Birth-related RH in infants occurs in one-quarter of normal deliveries and are far more common after instrumental deliveries. Commonly bilateral, they were predominantly intraretinal, posterior, resolved rapidly, and very rarely persisted beyond 6 weeks. (J AAPOS 2013;17:70-78)

Abusive head trauma remains the leading cause of death from child abuse,[1] with the peak incidence in infants less than 6 months.[2-5] The finding of retinal hemorrhage (RH) in a child <3 years of age with an intracranial injury has a positive predictive value of 71% and an odds ratio (OR) of 3.504 (97.5% CI, 1.088-11.280) for abusive head trauma.[6] In the youngest infants, the question may arise as to whether hemorrhages could be a consequence of birth rather than abusive head trauma.[7] In a recent Cochrane review[8] that addressed the outcomes of instrumental delivery, the authors reported increased RH after instrumental delivery. In a number of studies authors have proposed that the circumstances around birth, such as prolonged labor[9] and induction of labor,[10] may be influential variables. However, previous studies have been aimed primarily at obstetric management, with no systematic evaluation of the specific *retinal features* found in newborn infants.

If a young infant is found to have RH, then RH as a consequence of birth may be a possibility. To date, there is no comprehensive review of the prevalence or characteristics of such RH or what obstetric factors may be associated with RH in the newborn. In an era of increasing controversy surrounding the diagnosis of abusive head trauma,[11] it is incumbent upon professionals who identify RH in a young infant to consider all differential diagnoses.[12] We have conducted a systematic review to determine the prevalence of newborn RH, to describe the associated obstetric factors, and to identify the pattern of RH found in infants after birth.

Methods

Ten databases were systematically searched by the use of extensive keywords/phrases and without language restrictions for the period 1970-2011 (Figure 1; Appendices 1-3, e-Supplement 1, available at jaapos.org); "snowballing" techniques enhanced the identification of additional relevant articles. Of 935 abstracts identified, 45 studies were subjected to standardized critical appraisal by 2 independent trained reviewers, with a third review for disagreements.

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Study conducted at the Department of Primary Care & Public Health, School of Medicine, Cardiff University, Cardiff, United Kingdom.
Submitted April 18, 2012.
Revision accepted July 16, 2012.
Published online January 30, 2013.
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1091-8531/$36.00
http://dx.doi.org/10.1016/j.jaapos.2012.07.012

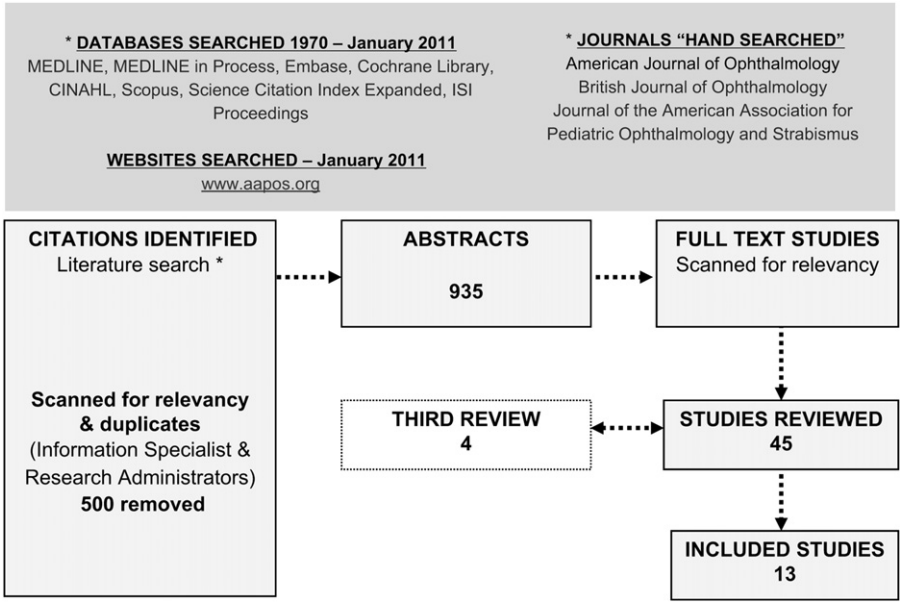

FIG 1. Systematic review search strategy and review process.

Table 1. Inclusion and exclusion criteria

Inclusion criteria
- Retinal examination performed by an ophthalmologist within a maximum of 120 hours (5 days) of birth and before discharge from obstetric unit
- Retinal examination with the pupils dilated using the indirect ophthalmoscope
- Retinal examination conducted using a RetCam where the images were reviewed by an ophthalmologist
- Studies conducted within Organization for Economic Cooperation and Development countries to attain greatest consistency in obstetric practices

Exclusion criteria
- Animal studies
- Cases with confirmed or suspected child abuse
- Preterm infants born prior to 32 weeks' gestation
- Birth weight <1500 g of any gestation
- Infants with any organic disease, eg, hematological abnormalities
- Infants who have undergone ophthalmic surgery
- Postmortem studies
- Infants with congenital eye conditions and/or established organic eye disease including retinopathy of prematurity
- Infants not examined before they were discharged from hospital
- Studies in which the ophthalmological examination was performed by anyone other than an ophthalmologist, regardless of their training
- Infants who have sustained blunt trauma to the eye(s)
- Studies in which the presence of vitreous hemorrhages obscures the fundal view

Ranking	Quality standards for retinal examination
1	Examined by ophthalmologist, dilated pupil examination, AND indirect ophthalmoscopy clearly documented
2	Examined by ophthalmologist, with use of RetCam (making the assumption that the baby's pupils were dilated)
3	Examined by ophthalmologist, EITHER dilated pupil examination documented without mention of examination method, OR indirect ophthalmoscopy documented without mention of pupil status
4	Examined by ophthalmologist, no details regarding pupil dilatation or use of indirect ophthalmoscopy, and only if detailed documentation of retinal hemorrhages is included
	Mixed ranking

Quality Standards

We restricted our search to 1970 onward, aiming to reflect current obstetric practice. We set stringent standards for the quality of the retinal examination to minimize the risk of including abused children. Only studies that provided details of the precise retinal findings in patients with RH were included (Table 1). Studies on retinopathy of prematurity (ROP) were excluded because of the well-recognized association with RH.[13]

Although all studies were conducted prospectively, the authors chose slightly different ways of describing and classifying the RH present. To synthesize the data, we adopted the following scheme to define the number, size, and location of RH, where all of the terms used in the primary studies were accounted for in a standardized manner (Table 2). The details of each author's specific grading systems (eg, Grade 1, 1+, etc) are given in Appendix 4 (e-Supplement 1). There also was variability in description of

Table 2. Definition of retinal hemorrhages

Severity	
Mild	Few, small, grade 1, grade 1+, grade 2+, 1-10 in number, <1 disk diameter
Moderate	Many, medium, grade 2, grade 3+, 11-30 in number
Severe	Too many to count, confluent, grade 3, grade 4, grade 4+, 31+ in number
Location	
Posterior pole	Zone 1, macula
Periphery	Outside zone 1, ie, zone 2 and Zone 3
Layers	
Preretinal, intraretinal, subretinal, multilayer	

layer of retinal involvement of RH between the studies; thus, we classified the layers as preretinal, intraretinal, subretinal, or multilayer. We used the international definition of ROP zone to group the extent of RH into the following: ROP posterior pole (zone 1, macula)/periphery (outside zone 1, ie, zone 2 and zone 3).[14]

Statistical Methods

Sufficient homogenous data were available with regard to mode of delivery to enable a meta-analysis of the included studies. The results are given as OR, with 95% CIs, calculated for each mode of delivery and each study. A random-effects model, using Mantel-Haenszel statistical methodology, was used for the meta-analysis. This allowed comparison of studies not estimating exactly the same intervention effect due to varying examination time across studies. RevMan 5 (Review Manager Version 5.1.2) was used to produce the forest plots.[15] To measure the consistency between studies within each meta-analysis the I^2 statistic was computed, which describes the percentage of total variation across studies that is due to heterogeneity rather than chance.[16] An I^2 value of 0% indicates no observed heterogeneity between the studies, with increasing values indicating increasing heterogeneity.[16] Unfortunately, there was insufficient homogenous data to enable a meta-analysis of specific retinal features, which are thus summarized in a narrative form.

Results

Of 45 fully reviewed studies, 13 were included, representing a total of 1,777 infants: 4 were prospective cohorts,[10,17-19] and 9 were case series.[20-28] Some oft-cited studies were excluded because they failed to meet our quality standards.[29-31] The commonest reasons for exclusion were "direct" retinal examinations,[29,30,32-42] insufficient retinal examination detail,[32,43-46] ocular trauma or other neonatal complications,[47-49] and examinations conducted by a nonophthalmologist.[41,50,51]

Obstetric Correlates: Mode of Delivery

It is clear that the most significant variable in relation to newborn RH is the mode of delivery (Table 3). With 25.6% of infants having RH after spontaneous vaginal deliveries (SVD) and 27.9% having RH with non-SVD, being

Table 3. Retinal hemorrhages and mode of delivery

Study	Study design: Prospective cohort	Study design: Case series	Sample size	Mode of delivery (Number of children with retinal hemorrhages/total number children): Vaginal	Instrumental: No details provided	Instrumental: Forceps	Instrumental: Vacuum	Instrumental: Double instrument	Caesarean delivery: No details provided	Caesarean delivery: Emergency first stage	Caesarean delivery: Emergency second stage after failed instrumental	Caesarean delivery: Elective	Timing of exam, hours
Bergen and Margolis[17]	X		100	13/38	-	20/51	-	-	2/11	-	-	-	<24
Berkus et al[20,21a]		X	326[b]	20/82	-	15/80	22/77	18/36	-	1/42	5/9	-	<24
Emerson et al[22]		X	149	40/120	-	0/2	9/12	-	1/15	-	-	-	<30
Gonzalez Viejo et al[18]	X		420	59/275	18/52	-	-	-	4/93	-	-	-	<72
Hughes et al[19]	X		53	7/23	-	1/7	7/9	2/2	-	1/8	-	0/4	<96
Kuit et al[23]		X	100	-	-	-	54/100	-	-	-	-	-	<30
Schoenfeld et al[10]	X		100	34/100	-	-	-	-	-	-	-	-	<48
Svenningsen and Eidal[24]		X	100	52/100	-	-	-	-	-	-	-	-	<24
Svenningsen et al[27]		X	51	-	-	-	27/49	-	-	-	1/2	-	<24
Svenningsen et al[25]		X	54	-	-	-	31/54	-	-	-	-	-	<24
Svenningsen et al[26]		X	46	27/46	-	-	-	-	-	-	-	-	<24
Williams et al[28]		X	278	30/122	-	12/54	42/90	6/12	-	-	-	-	<48
Total			1777	282/906	18/52	48/194	192/391	26/50	7/119	2/50	6/11	0/4	

[a]Study sample duplicated in Berkus et al 1985 and Berkus et al 1986. Data in this table were taken from the more detailed 1986 paper.[20]
[b]Thirteen children did not have their eyes examined.

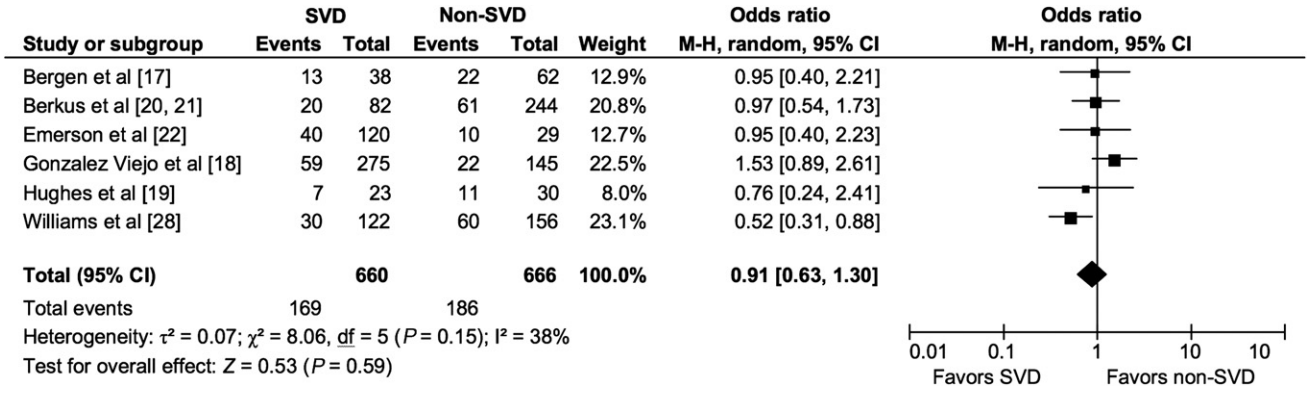

FIG 2. Forest plot of the odds ratio of retinal hemorrhages in spontaneous vaginal delivery (SVD) versus non-SVD.

born by SVD did not significantly affect the odds of RH (OR 0.91; 95% CI, 0.63-1.30; Figure 2). However, a delivery via the use of instruments significantly increases the odds of RH (OR 1.75; 95% CI, 1.30-2.34), with 35.5% of births via instrument having RH compared with 25.6% of SVD births having RH (Figure 3A). More specifically, the use of forceps did not increase the likelihood of RH (OR 0.85; 95% CI, 0.55-1.33), with 24.7% of births via instrument having RH and 28.6% of SVD having RH, but vacuum delivery (OR 2.75; 95% CI, 1.32-5.70), double-instrument (ie, forceps and vacuum; OR 3.27; 95% CI 1.68-6.36), and births via instrument where the details were unspecified (OR 1.94; 95% CI 1.02-3.67) all significantly increased the odds of RH (Figure 3B), with 42.8% of births via instrument in these subcategories having RH compared with 25.1% of SVD having RH.

Infants delivered by cesarean were less likely to develop RH, with 7.7% of cesarean births having RH compared with infants delivered by SVD in the 5 relevant studies, with 25.8% having RH (OR 0.26; 95% CI 0.14-0.48; Figure 4A). The only exception is second-stage emergency cesarean delivery after a failed delivery by instrument, which did not show a significant difference in odds (OR 3.88; 95% CI 0.95-15.84); many of these cases may have had a failed delivery by instrument. Likewise, an elective cesarean delivery (OR 0.24; 95% CI 0.01-5.14), first-stage emergency cesarean (OR 0.15; 95% CI 0.03-0.67), or those where the details were unspecified (OR 0.20; 95% CI 0.09-0.45), all *reduced* the odds of RH (Figure 4B), with 5.2% of cesarean births in these subcategories having RH compared with 26% of SVD with RH.

There was some statistical heterogeneity among studies when either all deliveries via instrument or all cesarean deliveries were combined. Subgroup analyses within mode of delivery also were reasonably homogenous, other than deliveries via vacuum ($P = 0.07$), where the I^2 is 57%. All studies in which the authors examined deliveries via vacuum have an effect in the same direction (births via vacuum increase the odds of RH), but the magnitudes of effect vary from an odds ratio of 1.24 to one of 8. The heterogeneity found in this meta-analysis suggests that studies can be compared by specific mode of delivery but not grouped into "instrumental" or "cesarean section." Caution is also required when combining studies in which births via vacuum were assessed, possibly because of differing time of examination among the 5 studies (2 examined within 24 hours of birth and the other 3 within 30, 48, and 96 hours, respectively).

Additional Obstetric Correlates

The second stage of labor is divided into2 phases, passive and active. In 4 studies[18,22,25,28] authors compared the duration of the second stage of labor to the incidence of RH, but only Emerson and colleagues,[22] who examined those delivered by SVD, vacuum, forceps, and cesarean, found no difference between the total duration of the second stage of labor in those with (45 ± 40) or without (49 ± 44) RH. Gonzalez Viejo and colleagues,[18] who also included all modes of delivery, identified that infants with RH spent longer in the "expulsive" phase of labor (11.04 ± 4.9 minutes with RH and 7.42 ± 3.51 minutes without RH; $P < 0.05$). However, Williams and colleagues,[28] who examined various modes of delivery, found a significant association between a short (<30 minutes) second stage of labor and the presence of moderate-to-severe RH ($P < 0.006$). Svenningsen and Eidal,[25] who examined infants after vacuum extraction alone, did not find an association between the active phase of second stage of labor and the presence of RH. No association was found between RH and maternal analgesia,[22,24,25] parity,[18,22,24,28] birth weight,[17,18,22,24] or Apgar score.[18,22,24,28]

Ophthalmologic Features

The authors of the included studies conducted and recorded their examinations in various ways (Appendix 5, e-Supplement 1), but all retinal details in the included studies are accounted for within our analysis. We extracted the retinal details from the text and tables within the relevant included studies (Table 4). Only 5 of 13 described the laterality of RH, and those authors concluded that RH is more commonly bilateral (58.7%) than unilateral

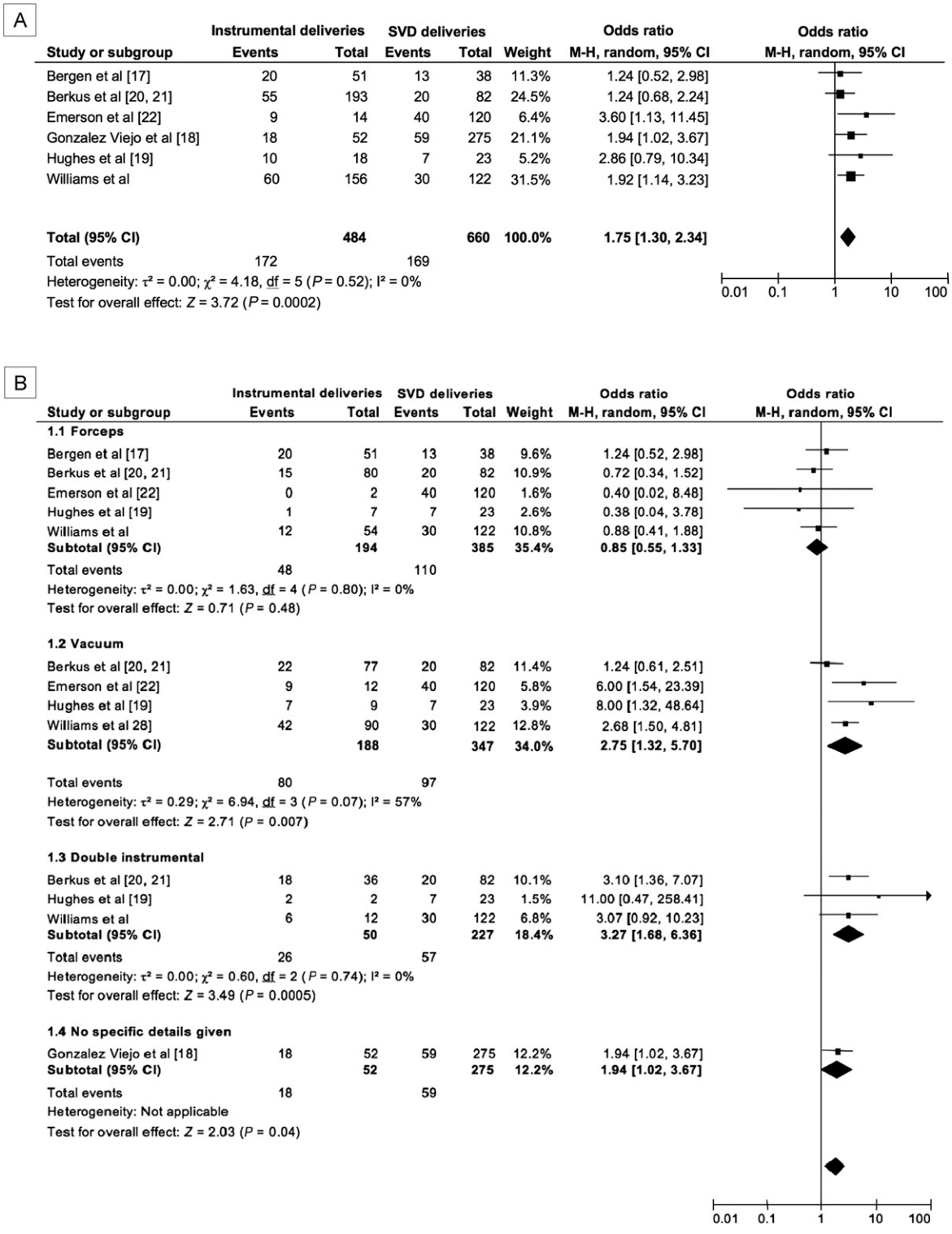

FIG 3. A, Forest plot of the odds ratios of retinal hemorrhages of all instrumental deliveries versus spontaneous vaginal deliveries SVDs. B, Forest plots of the odds ratios of retinal hemorrhages (by subgroup mode of delivery)of instrumental deliveries versus SVDs deliveries.

(41.3%), $P = 0.0331$.[10,17-19,22] Those investigators examining infants up to 48 hours or more after delivery,[10,18,19,28] found a lower prevalence of RH (223/851 [26%]) than those examining all infants within 30 hours (358/926 [39%]).[17,20-27]

The severity of RH was described in 10 of 13 studies (Table 4), indicating that RHs were more frequently "moderate" (26%-43%) or "mild" (22%-56%) than "severe" (18%-37%). In only 6 of 12 studies did the authors describe the sizes of RH, with the majority being small

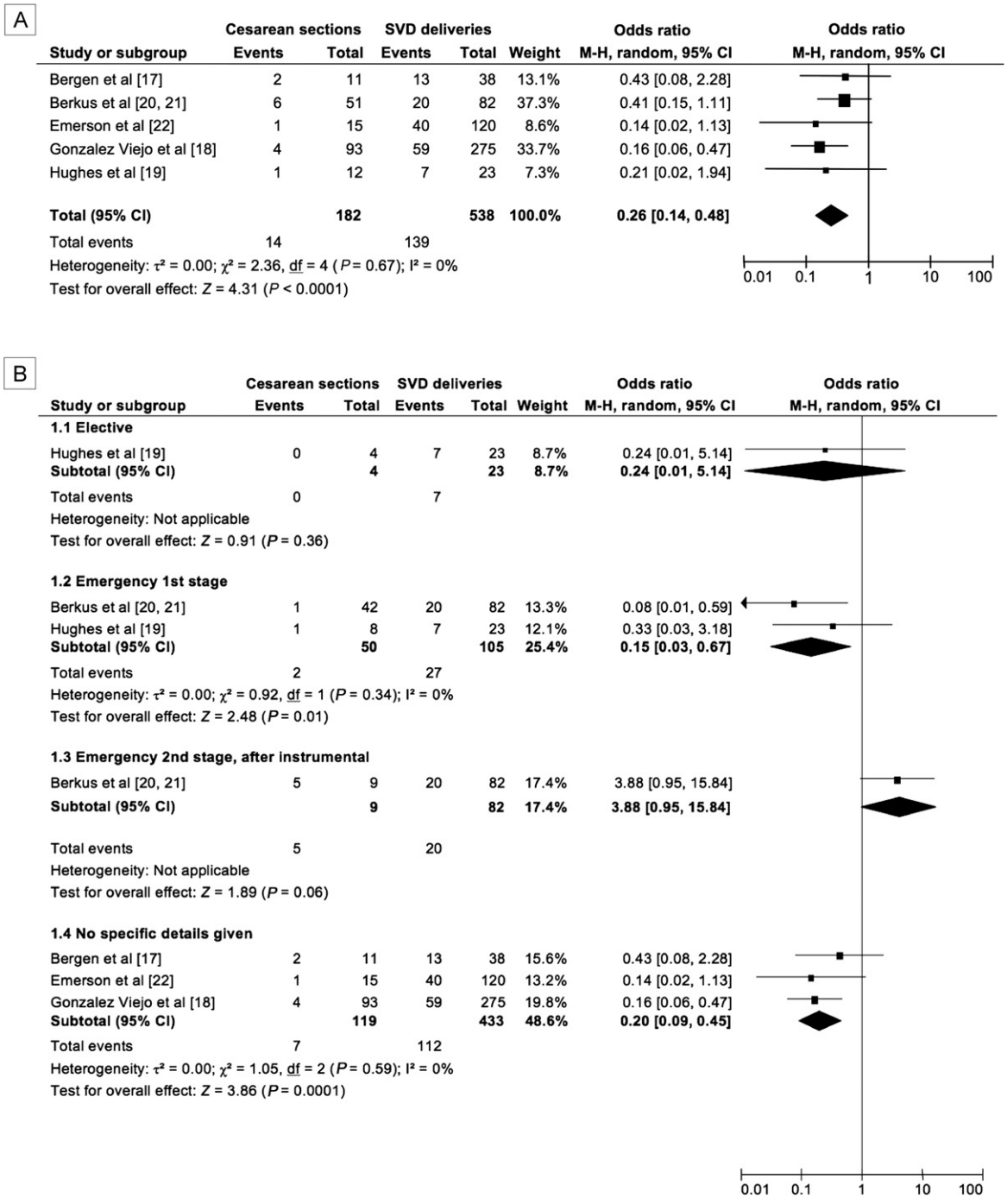

FIG 4. A, Forest plot of the odds ratios of retinal hemorrhages of all cesarean deliveries versus SVDs. B, Forest plots of the odds ratios of retinal hemorrhages (by subgroup mode of delivery) of cesarean deliveries versus SVDs.

(63%-82%), with medium or large RH less common (18%-37%).

Of the 5 studies recording the retinal layer involved,[10,17,19,22,28] intraretinal hemorrhages were the most common (superficial and deep retinal), with one case of subretinal hemorrhage, and up to 10 cases of preretinal hemorrhages.[10] It was impossible to determine whether there was any multilayer involvement in the infants because none of the studies provided this level of detail.

RHs were found in the posterior pole in 7 of 13 studies recording this information.[10,17,18,20,22,23,28] In only 2 studies[10,22] did investigators describe RH extending to the periphery. One detailed report[22] noted that 96% involve ROP zone 1 (including the posterior pole), although 32% also extended out to ROP zone 3 (periphery). More importantly, 4% of RH were not found in zone 1, but only in zones 2 and 3, underscoring the importance of using indirect

Table 4. Details of retinal hemorrhages found

Study	Laterality Number children in classification/total children with RHs, (percent; 95% CI)		Severity Number RHs in classification/total RHs (percent; 95% CI)		
	Bilateral	Unilateral	Mild	Moderate	Severe
Bergen and Margolis[17]	19/35 (54.3%; 38.2-69.5)	16/35 (45.7%; 30.5-61.8)			
Berkus et al[20,21b]			18/57 (31.6%; 21-44.5)	39/57 (68.4%; 55.5-79)	
Emerson et al[22]	26/50 (52%; 38.5-65.2)	24/50 (48%; 34.8-61.5)	35/76 (46%; 35.3-57.2)	41/76 (54%; 42.8-64.7)	
Gonzalez Viejo et al[18]	48/81 (59.3%; 48.4-69.3)	33/81 (40.7%; 30.7-51.6)			
Hughes et al[19]	14/18 (77.8%; 54.8-91)	4/18 (22.2%; 9-45.2)	5/23 (21.7%; 9.7-41.9)	10/23 (43.5%; 25.6-63.2)	8/23 (34.8%; 18.8-55.1)
Kuit et al[23]			23/5 (42.6%; 30.3-55.8)	19/54 (35.2%; 23.8-48.5)	12/54 (22.2%; 13.2-34.9)
Schoenfeld et al[10]	21/34 (61.8%; 45-76.1)	13/34 (38.2%; 23.9-55)	25/55 (45.5%; 33-58.5)	20/55 (36.4%; 24.9-49.6)	10/55 (18.2%; 10.2-30.3)
Svenningsen and Eidal[24]			23/52 (44.2%; 31.6-57.7)	14/52 (26.9%; 16.8-40.3)	15/52 (28.9%; 18.3-42.3)
Svenningsen et al[27]			7/27 (25.9%; 13.2-44.7)	10/27 (37%; 21.5-55.8)	10/27 (37%; 21.5-55.8)
Svenningsen et al[26]			15/27 (55.6%; 37.3-72.4)	7/27 (25.9%; 13.2-44.7)	5/27 (18.5%; 8.2-36.7)
Svenningsen et al[25]			8/31 (25.8%; 13.7-43.3)	13/31 (41.9%; 26.4-59.2)	10/31 (32.3%; 18.6-49.9)
Williams et al[28]			29/90 (32.2%; 23.5-42.4)	61/90 (67.8%; 57.6-76.5)	

RH, retinal hemorrhage.
[a]In Schoenfeld et al[10] the number reflects eyes rather than infants.
[b]Berkus et al 1986[20] did not provide details on retinal hemorrhages found.

ophthalmoscopy. Vitreous hemorrhages were not recorded in any case.

Resolution of RH

All 3 prospective studies[10,19,22] addressing the resolution of RH found that the majority of cases resolved within 2 weeks.[10,19,22] Two[10,22] noted that persistent hemorrhages were more severe; however, there was no precise description in the layer of retinal involvement. Emerson and colleagues[22] noted that 85% (28/33) of RH resolved within 2 weeks, a single subretinal hemorrhage persisted longer than 4 weeks, resolving by 42 days. Likewise, of the 10 of 50 eyes with persistent RH reported by Schoenfeld and colleagues,[10] 9 had disappeared by 23 days, with only one persisting to 42 days. In the study of Hughes and colleagues,[19] 9 of 14 resolved by 10 days, whereas dense foveal hemorrhages in 2 infants persisted to days 22 and 31 after delivery; the latter case had intraretinal hemorrhages (no further details available concerning precise layer) that persisted to day 58. Overall, 97% (79/81) of RH resolved completely within 42 days.

Discussion

While one is examining young infants with suspected abusive head trauma, birth-related RH may form part of the differential diagnosis. This rigorous review, in which we used strict quality standards, highlights that RH in the newborn are strongly correlated with the mode of delivery: whereas RH occur in 25.6% of SVD, they occur in 52% infants born of double instrumental delivery (OR 3.27) and 42.6% of vacuum extraction births (OR 2.75). When present, RHs are more commonly bilateral, predominantly in the posterior pole, "mild" or "moderate" in number, and usually intraretinal. In only 3 studies[10,19,22] did authors consider the clinical course of these hemorrhages, where 83% resolved within 10 days and all but one of the persisting RH resolved within 42 days.[19] Unfortunately, because of the limited longitudinal data,[10,19,22] there are too few cases to determine the predicted duration of RH.

The indications for the instrumental delivery must be considered in conjunction with the direct effect of a vacuum delivery.[20] It has been hypothesized that a constant suction force on the chignon can cause edematous changes in the brain tissue, with a resulting increase in intracranial pressure, stasis of blood flow in the central retinal vein, which combined with an increase in pressure in the ophthalmic artery may thus precipitate the retinal bleeding. A cesarean section appears protective for RH (OR 0.19; 95% CI, 0.01-3.72) although there were few elective cesarean deliveries to underpin this analysis. Vacuum extraction was more likely to be associated with a greater prevalence of moderate-to-severe RH. The relationship between the duration of the second stage of labor and the likelihood of RH is complex.

The 4 studies addressing this issue arrived at apparently differing conclusions.[18,22,25,28] This may be the result of varying study designs; 3 were cohort studies,[18,22,25] whereby a clinician decided when and how to deliver the infant. Only Williams and colleagues[28] had a subgroup of women randomized to a forceps or a vacuum delivery. In this study, a decreased rate of RH among the infants with a longer second stage of labor may suggest that the head compression per se is not a significant mechanism for RH. It may be that a rapid descent or a rapid compression and decompression of the head may affect the rate of RH. Smaller infants had a shorter second stage and more severe RH, suggesting that these infants may be more susceptible to injury. In comparing these 4 studies,[18,22,25,28] it is important to note that the duration of the *second stage* of

Table 4. (Continued)

Location of RH		Layer			Size of RH Number children[a] in classification/total with RHs (percent)	
Periphery	Posterior pole	Preretinal	Intraretinal	Subretinal	Small	Medium or large
			Flame-shaped, oval, round			
	Macular involvement					
3 zone 3 only; 24 zones 1, 2, 3	73: zone 1 involvement only		Blot, blot with white center, dot, flame-shaped	1 case		
	Posterior pole; macular involvement					
	Around disks and arcades; variable distribution		Round, white center			
	Macular involvement				42/54 (77.78%)	12/54 (22.22%)
Periphery	Around disks and arcades; posterior pole	Up to 10 cases	Flame-shaped, round		45/55 (81.82%)	10/55 (18.18%)
					37/52 (71.15%)	15/52 (28.85%)
					17/27 (62.96%)	10/27 (37.04%)
					22/27 (81.48%)	5/27 (18.52%)
					21/32 (67.75%)	10/31 (32.25%)
	Macular involvement		Blot, dot, flame-shaped			

labor is not synonymous with the *active phase* of the second stage of labor (when the mother is actively bearing down). Multiple factors influence the duration of the second stage of labor, for example, parity, the strength of uterine contractions, position of the fetus, presentation of the fetus, birth weight, and the need for delivery to be expedited because of fetal or maternal conditions. These factors were not analyzed separately; the association between a longer second stage of labor and RH found by Emerson and colleagues[22] and Gonzalez Viejo and colleagues[18] may thus be due to factors other than the *duration* of the second stage of labor. The studies meeting our strict quality standards did not confirm putative associations between incidence of RH and maternal parity,[9] head circumference,[19] birth weight,[32] and Apgar score.[10]

The limitations of this review, in common with all systematic reviews, were primarily related to the quality of the 13 included studies. In particular, the lack of consistent terminology across studies made classification of RH characteristics difficult and limited statistical analysis to correlations between the mode of delivery and presence or absence of RH. Although a meta-analysis was possible for obstetric correlates, it was not possible for precise retinal features, where only a summative analysis could be conducted. For example, the grading system used by Berkus and colleagues[20] merely subdivided RH into "mild" (1+ and 2+) or "marked" (3+ and 4+); their threshold for considering RH as marked is unclear, which may explain the greater proportion of eyes with marked RH in this study. Two large studies had to be excluded because of the lack of indirect ophthalmoscopy[29,30]: it is well recognized that direct ophthalmoscopy does not allow a full view of the periphery, and thus, these studies would have underestimated the extent of RH. As illustrated by Emerson and colleagues,[22] in 32% of cases RH involved the periphery (24/76), and in 4% RH were found solely in the periphery. An estimate of the likely duration of birth-related RH and which types of RH are likely to persist longest was limited by their being only 3 longitudinal studies with sufficient detail addressing this question.

Although subdural hemorrhages are reported commonly in abusive head trauma, they have also been recorded as a consequence of birth,[52,53] these studies did not record the presence or absence of RH in those infants with intracranial injury. Within our review, no infants underwent scanning for intracranial injury, and those that were examined for neurological sequelae of birth did not correlate neurological outcome and RH[23]; however, only 1 of 100 infants had any abnormal neurology. This is clearly a very different situation to the child with symptomatic intracranial injury and RH as found in abusive head trauma.

In conclusion, retinal hemorrhages do occur in newborn infants, particularly after vacuum delivery; however, the infants in whom these are found are otherwise well. The RH are predominantly bilateral, intraretinal, and posterior. Limited available data noted that the majority resolving within 10 days and over 97% within 42 days.

Acknowledgments

The authors thank Laura Wain for editorial assistance.

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