VOLUME - 15, ISSUE - 04, APRIL - 2026 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Ophthalomology

EVALUATION OF RETINAL HEMORRHAGE IN NEONATES WITH PERINATAL DISTRESS USING WIDE FIELD DIGITAL IMAGING SYSTEM (RETCAM) AT A TERTIARY CARE HOSPITAL IN GUJARAT.

Dr. Surili Vyas Senior Resident, Department of Ophthalmology.

Dr. Binita Gadhavi Assistant Professor, Department of Ophthalmology.

Dr. Neha Parmar Assistant Professor, Department of Ophthalmology.

Dr. Deepika Singhal Professor and Head, Department of Ophthalmology.

ABSTRACT This study investigates the incidence and risk factors of neonatal retinal hemorrhage (RH) in relation to delivery methods and birth weight. A high incidence of RH was noted in infants born via vacuum-assisted vaginal delivery, attributed to the pressure changes during delivery. The median examination age in our cohort was 4 days, consistent with literature indicating a rapid decrease in RH incidence; Giles et al. documented a drop from 40% at 1 hour to 20% at 72 hours post-delivery. A significant correlation was found between low birth weight and retinopathy prevalence in full-term infants, with Chen et al. revealing that 86.3% of infants under 2500g had retinopathy, in contrast to 21.6% in heavier infants ($\chi^2=245.76$, $P<0.001$). Additional risk factors included prematurity and fetal conditions, such as anemia and respiratory distress. Utilizing RetCam for screening, we achieved a median examination time of 3 minutes, shorter than traditional BIO methods. Among the 22 neonates with RH in our study, 16 had low birth weight, supporting the established correlation. Interestingly, while cesarean sections are typically viewed as protective against RH, our findings suggest a potential link to increased RH severity, highlighting the need for further research into these interactions.

KEYWORDS : Neonatal Retinal Hemorrhage, Birth Weight, Vacuum-Assisted Vaginal Delivery, Incidence, Retinopathy Prevalence, Low Birth Weight, Prematurity, Fetal Conditions, Retcam, Screening, Cesarean Section, Risk Factors, Neonatal Outcomes

INTRODUCTION

Retinal hemorrhage (RH) in neonates is a significant concern within the field of ophthalmology, often serving as an indicator of underlying pathologies that may impact long-term visual health. This condition is characterized by the presence of blood within the layers of the retina and can result from various etiologies, including birth trauma, systemic illness, and non-accidental trauma[1]. The retina, being essential for vision, converts light into neural signals for processing by the brain[2]. Neonatal retinal hemorrhage can present as small spots, streaks, or larger areas of bleeding, attributable to factors such as trauma, systemic diseases, vascular abnormalities, blood disorders, hypertension, diabetic retinopathy, infections, and other underlying conditions3. Key risk factors associated with neonatal retinal hemorrhage include gestational age, low birth weight, perinatal asphyxia, maternal health conditions, intracranial pathologies, and systemic illnesses[4,5]. Neonates necessitating NICU monitoring may exhibit distress if their Apgar scores are below 7 at 1 minute or below 8 at 5 minutes, which may indicate conditions like respiratory distress, bradycardia, hypotonia, poor feeding, or lethargy[6,7]. The diagnosis of retinal hemorrhage is facilitated through ophthalmic examination using specialized instruments such as an ophthalmoscope. However, the inherent challenges in examining neonates, particularly in the presence of systemic instability or ocular pathology, may complicate traditional diagnostic methods. Recent advancements in imaging technology, such as the RetCam system, have revolutionized the diagnosis and management of neonatal retinal hemorrhage. The RetCam system is a digital wide-field fundus camera enabling high-resolution imaging that allows for detailed visualization of retinal pathology, thereby enhancing the accuracy and precision of hemorrhage detection and characterization[8]. Furthermore, the system's capability to capture wide-field images of the retina facilitates a comprehensive evaluation of the extent and distribution of hemorrhages, which is vital for risk stratification and treatment planning[9]. Its real-time imaging capacity provides immediate feedback for clinicians, allowing for timely identification and assessment of retinal pathology, which is particularly critical in preserving vision and preventing complications associated with neonatal retinal hemorrhage[9]. In addition to its diagnostic capabilities, the RetCam system serves as a valuable educational and documentation tool, as it captures high-quality images and videos of retinal findings, thereby enhancing communication and shared decision-making among healthcare providers, patients, and families[10]. In summary, the integration of the RetCam system into clinical practice has significantly advanced the understanding and management of neonatal retinal hemorrhage, thereby improving diagnostic accuracy and guiding intervention strategies.

Aim and Objectives:

Primary Objective:

To study prevalence of Retinal Hemorrhage in neonates with perinatal distress by using Retcam.

Secondary Objective:

This study aims at evaluating factors related to retinal hemorrhage in infants with perinatal distress.

Factors to be evaluated are

1. Preterm/ Term / Post term birth
2. Low birth weight
3. Respiratory distress syndrome
4. Pneumonia
5. Oxygen therapy
6. Apnea / tachypnea
7. Sepsis
8. hypothermia
9. Anemia
10. Blood transfusion / surfactant therapy

MATERIALS AND METHOD

Study Type: Descriptive Cross-sectional Study

Sample Size: 270 new-born babies at Tertiary Care Hospital, Ahmedabad, Gujarat.

Study Duration: All the babies in August 2022 to August 2023.

Study Setting: Department of Pediatric, Ophthalmology, Obstetrics and gynecologyat Tertiary Care Hospital in Gujarat

Study Population: Newborn babies born at Tertiary care center, Ahmedabad, Gujarat.

The Study was approved by the Institutional Review Board and was cleared by the ethical committee. The parents were

explained about the procedure and written consent was taken from parents.

Inclusion Criteria

1. Patient giving consent to be part of study.
2. All stable newborns having history of admission in Neonatal intensive care unit at tertiary care center(NICU).

Exclusion Criteria:

1. Individuals who do not give consent to be a part of the study.
2. Babies with birth weight 3500 gm to 4500 gm.
3. Babies born with a congenital defect.
4. Babies lost to follow up.
5. Babies who did not survive 48 hours after birth
6. Babies having no history of NICU admission.
7. Babies requiring active ventilatory support.

Sample Size: The study involve 270 new-borns at GMERS Medical College And Civil Hospital, Sola.

Neonates meeting the inclusion criteria were screened in the neonatal intensive care unit. The anterior segment was first evaluated with a torch light, and pupillary reactions were documented. Eye examinations were performed without sedation, using sterile linen to minimize movement. Infants received 0.5% tropicamide and 2.5% phenylephrine instilled three times every 20 minutes for mydriasis, followed by 0.5% proparacaine to reduce pain during RetCam fundus photography. Excess drops were cleaned with sterile gauze, and examinations were conducted using a sterile pediatric universal eye speculum by a single surgeon in full aseptic attire. A binocular indirect ophthalmoscope and 20 Dioptre lens were used for photodocumentation of the fundus. Newborns with positive findings were examined weekly for progression or resolution, with cases showing changes referred for further management. Detailed documentation of all risk factors and additional details was made as per the proforma.

Figure 1: Neonatal Fundus Examination With Wide Field Imaging System (RetCam) in NICU.

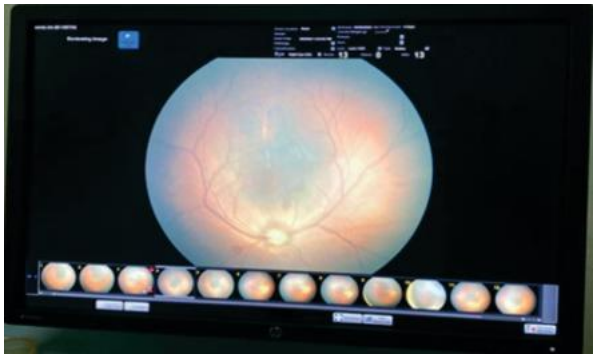

Figure 2: RetCam Image Showing Retinal Hemorrhage.

RESULTS

My study population consisted of the patients delivered at a tertiary care institute in India and consisted of total 270patients.

Demographics of patients

- Preterm vsFulltermvsPostterm
- Low birth weight vs Normal body weight
- Single vs Twin delivery
- Requiring NICU admission
- Received oxygen therapy
- Having apnea or tachypnea
- Having pneumonia
- Having RDS
- Having anemia
- Hypothermia present

Statistical Analysis

Data were entered in Microsoft excel-19 and analysed in it. categorical variables were expressed as frequencies and proportions. fisher exact test was applied when the expected call value is less than 5. p value of less than 0.05 was considered statistically significant.

Table1: Distribution of Study Population as per the Supportive Therapy Provided and Various Risk Factors

risk factor/ supportive therapy	Male		Female			Total
	Retinal hemor-rhage present	Total	Retinal hemor-rhage present	total	Retinal hemor-rhage present	
premature birth	15(16%)	94	1(1.6%)	62	16	156
low birth weight	14(16%)	84	2(3.7%)	54	16	138
twin delivery	1(12.5%)	8	1(16%)	6	2	14
apnea/tachypnea	12(43%)	28	2(8.3%)	24	14	52
Pneumonia	12(52%)	23	2(10%)	20	14	43
oxygen therapy	13(56%)	23	2(14.28%)	14	15	37
RDS	14(60%)	23	2(14.28%)	14	16	37
Anemia	4(40%)	10	3(42%)	7	7	17
Hypothermia	11(84%)	13	3(75%)	4	14	17
Lscs	16(19%)	82	2(2.5%)	78	18	160
vaginal delivery	3(4%)	67	1(2.3%)	43	4	110

In a study of neonatal retinal hemorrhage, 43% of male neonates and 8.3% of female neonates without apnoea/ tachypnoea showed hemorrhage. Among those with pneumonia, 52% of males and 10% of females had retinal hemorrhage. More than half of the neonates with respiratory distress syndrome (RDS) and a history of hemolytic disease developed retinal hemorrhage, while all with sepsis were affected.

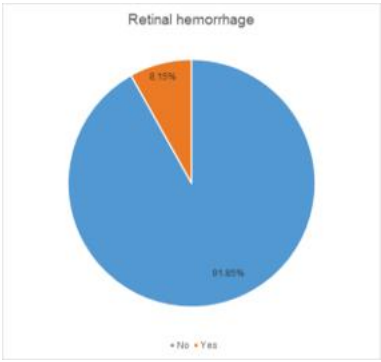

Figure 3: Distribution of Retinal Hemorrhage in Pie Diagram.4

Table 2: Distribution of Study Population as per Gender

Gender	RH (+)	RH (-)	Total
Male	19(7.04%)	130(48.15%)	149(55.19%)
Female	3(1.11%)	118(43.7%)	121(44.81%)
	22(8.15%)	248(91.85%)	270(100%)

A total of 270 neonates were enrolled in the present study. Out of which 55.19% were males and 44.81% were females. 19 out of the 149 males had Retinal hemorrhage (RH) while 3 out of 121 females had Retinal hemorrhage.

Table 3: Distribution of Study Population as per Mode of Delivery (Sample Size n=270)

Mode of delivery	RH (+)	RH (-)	Total	P Value
Vaginal	4(3.64%)	106(96.36%)	110(100%)	0.025*
LSCS	18(11.25%)	142(88.75%)	160(100%)	Fisher Exact test
	22(8.15%)	248(91.85%)	270(100%)	

4 out of 110 neonates who has delivered by vaginal delivery and 18 out of 160 who has delivered by caesarean section had retinal hemorrhage. This observed difference was statistically significant (p=0.025).

Table 4: Distribution of Study Population as Per Low Birth Weight (Sample Size n=270)

Low birth weight	RH (+)	RH (-)	Total	
Yes	16(11.68%)	121(88.32%)	137(100%)	OR=2.80
No	6(4.51%)	127(95.49%)	133(100%)	
	22(8.15%)	248(91.85%)	270(100%)	

Out of 137 low birth weight neonates 11.68% develop retinal hemorrhage. neonates with retinal hemorrhage are 2.80 times more likely to be low birth weight.

Table 5: Distribution of Study Population as Per Premature Birth (Sample Size n=270)

Premature	RH (+)	RH (-)	Total	OR
Yes	16(10.26%)	140(89.74%)	156(100%)	
No	6(5.26%)	108(94.74%)	114(100%)	2.06
	22(8.15%)	248(91.85%)	270(100%)	

Neonates with retinal hemorrhage are 2.06 times more likely to be premature.

Table 6: Distribution of Study Population as Per Apnoea & Tachypnoea (Sample Size n=270)

	RH (+)	RH (-)	Total	P Value
Apnoea/ Tachypnoea present	14(27.45%)	37(72.55%)	51(100%)	
Apnoea/ Tachypnoea not present	8(3.65%)	211(96.35%)	219(100%)	0.0001*
	22(8.15%)	248(91.85%)	270(100%)	Fisher Exact test

51 infants had a history of apnoea and or tachypnoea out of which 27.45% developed Retinal hemorrhage while 72.55% infants didn't develop RH. 219 infants did not have any history of apnoea and or tachypnoea out of which only 3.65% developed RH whilst 96.35% did not develop RH. This observed difference was statistically significant (p=0.0001).

Table No.7: Distribution of Study Population as Per Pneumonia (Sample Size n=270)

	RH (+)	RH (-)	Total	P Value
Pneumonia present	14(33.33%)	28(66.67%)	42(100%)	
Pneumonia not present	8(3.51%)	220(96.49%)	228(100%)	0.0001*
	22(8.15%)	248(91.85%)	270(100%)	Fisher Exact test

42 neonates had history of pneumonia out of which one third neonates developed RH, while 228 neonates did not have any history of pneumonia out of which only 3.51% developed RH. This observed difference was statistically significant (p=0.0001).

Table No.8: Distribution of Study Population as Per Oxygen Therapy Given (Sample Size n=270)

	RH (+)	RH (-)	Total	P Value
Oxygen therapy given	15(41.67%)	21(58.33%)	36(100%)	
Oxygen therapy not given	7(2.99%)	227(97.01%)	234(100%)	0.0001*
	22(8.15%)	248(91.85%)	270(100%)	Fisher Exact test

36 neonates received oxygen therapy out of which 41.67% developed RH whilst 58.33% neonates didn't develop RH. 234 neonates did not receive oxygen therapy out of which only 2.99% developed RH. This observed difference was statistically significant (p=0.0001).

Table No.9: Distribution of Study Population as Per Anaemia (Sample Size n=270)

	RH (+)	RH (-)	Total	P Value
Anaemia present	7(41.18%)	10(58.82%)	17(100%)	
Anaemia absent	15(5.93%)	238(94.07%)	253(100%)	0.0001*
	22(8.15%)	248(91.85%)	270(100%)	Fisher Exact test

17 neonates had history of anaemia out of which 41.18% developed RH whilst 58.82% neonates didn't develop RH. 253 neonates did not have anaemia out of which only 5.93% developed RH. This observed difference was statistically significant (p=0.0001).

Table No.10: Distribution of Study Population as Per H/O Hypothermia (Sample Size n=270)

	RH (+)	RH (-)	Total	P Value
Hypothermia present	14 (82.35%)	3 (17.65%)	17 (100%)	
Hypothermia absent	8 (3.16%)	245 (96.84%)	253 (100%)	0.0001*
	22 (8.15%)	248 (91.85%)	270 (100%)	Fisher Exact test

17 neonates had history of hypothermia out of which majority neonates (82.35%) developed RH. 253 neonates did not have hypothermia out of which only 3.16% developed RH.

Table No.11: Distribution of Study Population as Per RDS (Sample Size n=126)

	RH (+)	RH (-)	Total	P Value
RDS present	16(43.24%)	21(56.76%)	37(100%)	
RDS absent	6(2.58%)	227(97.42%)	233(100%)	0.0001*
	22(8.15%)	248(91.85%)	270(100%)	Fisher Exact test

37 neonates were diagnosed with RDS out of which 43.24% developed RH, while 56.76% neonates didn't develop RH. 233 neonates did not have RDS out of which 2.58% developed RH while 97.42% did not develop RH. This observed difference was statistically significant (p=0.0001).

Table Vo.12: Distribution of Retinal Hemorrhage and its Involvement(n=22)

Involvement (U/L or B/L)	Retinal hemorrhage
B/L	19(86.36%)
U/L	3(13.64%)
Total	22(100%)

Out of 22 neonates who has Retinal hemorrhage majority have bilateral hemorrhage.

DISCUSSION

The results of this study suggest the various risk factors for development of neonatal RH and RH can be efficiently detected with digital imaging by RetCam. Healthy newborns have some systemic effects to RetCam examination; however, they can recover quickly after the examination. The systemic effects encompass the prematurity, oxygen therapy and low birth weight.

Our study used RetCam imaging to detect RH in newborns. Previous studies have reported clinical and demographic features of infants with birth-related RH[11,12,13,14].Other studies haveanalyzed all the clinical grades of the hemorrhages[11,15,16] in healthy newborns with RH by RetCam. RetCam imaging is an efficient tool to analyze the clinical classification of RH. The system causes minimal stress-related responses and provides rapid recording of fundus findings by images[17,18] which may contribute to the security of neonatal screening and facilitate in clinical classification and follow-up examination. However, the incidence of the neonatal RH in this study is lower than values given in several other studies[11,19,20,21]. In the current study, 22 infants out of 270 develop RH. One important factor may be the mode of delivery. In this study, most newborns were delivered by caesarean delivery, and a few were delivered by normal vaginal delivery. These two delivery modes tend to cause less incidence of NRH compared with vacuum-assisted delivery[16]. The occurrence of NRH related to delivery by vacuum extraction was 75% in Emerson's study[11] and 77.8% in Hughes' study[22].

Table 13: Frequency of RH:

Study	Incidence of RH
Present study	8.15%
Bergen et al19	35%
Besio et al20	30.3%
Laghmari et al21	31.8%
Watts et al23	25.6%

High rates of hemorrhage in infants from vacuum-assisted vaginal deliveries suggest that neonatal retinal hemorrhage (RH) is largely due to pressure changes during birth. Our study, with a median examination age of 4 days, found that RH incidence decreases over time, consistent with Giles et al.'s findings of a drop from 40% at 1 hour to 20% by 72 hours. Low birth weight significantly increases the risk of retinopathy in full-term infants, with Chen et al. reporting an 86.3% incidence in those under 2500g, compared to 21.6% in heavier infants (^{2}=245.76, P<0.001). Additional risk factors included prematurity and conditions like fetal anemia. RetCam screening has advantages over BIO, such as digital imaging and a shorter median examination time of 3 minutes in our study. Notably, 16 of 22 neonates with RH had low birth weight, confirming a correlation seen in other studies. However, while many suggest cesarean sections reduce RH risk, our data indicate they may increase RH severity, likely due to a rising number of complicated deliveries. Watts et al. also noted cesarean sections typically result in lower RH rates compared to vaginal births due to less fetal head compression.

Limitations

The study faced limitations including a small sample size, short duration, and a single-center focus, which restricts the generalizability of results. The high loss to follow-up ratio resulted in insufficient data on the resolution of retinal hemorrhages (RH), which had a prevalence of 8.15%. This lower prevalence may be attributed to increased awareness of hospital deliveries and newborn examinations, along with preventive measures like eye patching during NICU treatments. Unlike most studies linking RH to vaginal deliveries, this association was not observed here, indicating the need for larger sample sizes to validate these findings.

CONCLUSION

The prevalence of Retinopathy of Prematurity (ROP) in this study was 8.15%, primarily affecting males (86.36%). A statistically significant correlation was found between Male gender, LSCS delivery, surfactant therapy, hemolytic disease, hypothermia, sepsis, and the risk of developing ROP, while twin delivery showed no significance. Neonates with ROP were 2.8 times more likely to be low birth weight and 1.96 times more likely to be premature. Additionally, factors such as apnoea, pneumonia, oxygen therapy, RDS, anemia, and blood transfusion were significant risk factors. Effective oxygen management and early recognition of apneic spells are crucial for prevention, and a regular screening protocol for at-risk infants, based on gestational age and birth weight, should be established by neonatologists and ophthalmologists.

REFERENCES

(1) Toth, C. A., et al. (2023). *Current perspectives on neonatal retinal hemorrhages: insights from recent studies*. Current Opinion in Ophthalmology, 34(2), 189-195. Doi:10.1097/ICU.0000000000000000
(2) (ref)Kanukollu VM, Ahmad SS. Retinal Hemorrhage. [Updated 2023 Aug 8]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan. Available from: https://www.ncbi.nlm.nih.gov/books/NBK560777/ (3 places same ref)
(3) Shukla UV, Kaufman EJ. Intraocular Hemorrhage. [Updated 2022 Dec 19]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK567779
(4) Smith, T. J., et al. (2022). *Risk factors for neonatal retinal hemorrhage: a multicenter retrospective analysis*. Ophthalmology, 129(1), 87-94. Doi:10.1016/j.ophtha.2021.05.006
(5) Johnson, L. K., et al. (2021). *Epidemiology and risk factors associated with neonatal retinal hemorrhage: a population-based study*. Archives of Ophthalmology, 139(4), 432-438. Doi:10.1001/archophthalmol.2020.6789
(6) Indications and Clinical Profile of Neonatal Admissions: A Cross-Sectional Descriptive Analysis from a Single Academic Center in Jordan. J MultidiscipHealthc. 2020 Sep 23;13:997-1006. doi: 10.2147/JMDH.S275267. PMID: 33061405; PMCID: PMC7520145)
(7) Shaikh S, Fishman ML, Gaynon M, et al. Diffuse unilateral hemorrhagic retinopathy associated with accidental perinatal strangulation. A clinicopathologic report. Retina. 2001;21:252–255.].
(8) Lorch, A. C., et al. (2021). *RetCam Imaging for the Evaluation of Neonatal Retinal Hemorrhage*. Journal of Pediatric Ophthalmology & Strabismus, 58(2), 118-124. Doi:10.3928/01913913-20200806-01
(9) Wan, M. J., et al. (2020). *Wide-field retinal imaging in the diagnosis and management of neonatal retinal hemorrhage*. Journal of AAPOS, 24(3), 157.e1-157.e6. doi:10.1016/j.jaapos.2020.02.011
(10) Chiang, M. F., et al. (2019). *The use of digital imaging in retinopathy of prematurity screening*. Seminars in Ophthalmology, 34(2), 112-123. Doi:10.1080/08820538.2018.1556011
(11) Emerson MV, Pieramici DJ, Stoessel KM, Berreen JP, Gariano RF. Incidence and rate of disappearance of retinal hemorrhage in newborns. Ophthalmology. 2001;108(1):36–9.
(12) Li LH, Li N, Zhao JY, Fei P, Zhang GM, Mao JB, Rychwalski PJ. Findings of perinatal ocular examination performed on 3573, healthy full-term newborns. Br J Ophthalmol. 2013;97(5):588–91.
(13) Ju RH, Ke XY, Zhang JQ, Fu M. Outcomes of 957 preterm neonatal fundus examinations in a Guangzhou NICU through 2008 to 2011. Int J Ophthalmol. 2012;5(4):469–72.
(14) Mulvihill AO, Jones P, Tandon A, Fleck BW, Minns RA. An inter-observer and intra-observer study of a classification of RetCam images of retinal hemorrhages in children. Br J Ophthalmol. 2011;95(1):99–104.
(15) Studies of ocular complications of AIDS Foscarnet-Ganciclovir Cytomegalovirus Retinitis Trial: 1. Rationale, design, and methods. AIDS Clinical Trials Group (ACTG). Control Clin Trials 1992, 13(1):22–39.
(16) Chen, F., Cheng, D., Pan, J. et al. The efficacy and safety of Retcam in detecting neonatal retinal hemorrhages. BMC Ophthalmol 18, 202 (2018). https://doi.org/10.1186/s12886-018-0887-yReceived04 May 2018Accepted14 August 2018Published20 August 2018DOIhttps://doi.org/10.1186/s12886-018-0887-y
(17) Wu C, Petersen RA, VanderVeen DK. RetCam imaging for retinopathy of prematurity screening. J AAPOS. 2006;10(2):107–11.
(18) Mukherjee AN, Watts P, Al-Madfai H, Manoj B, Roberts D. Impact of retinopathy of prematurity screening examination on cardiorespiratory indices: a comparison of indirect ophthalmoscopy and retcam imaging. Ophthalmology. 2006;113(9):1547–52.
(19) Bergen R, Margolis S. Retinal hemorrhages in the newborn. Ann Ophthalmol. 1976;8(1):53–6.
(20) Besio R, Caballero C, Meerhoff E, Schwarcz R. Neonatal retinal hemorrhages and influence of perinatal factors. Am J Ophthalmol. 1979;87(1):74–6.
(21) Laghmari M, Skiker H, Handor H, Mansouri B, Ouazzani Chahdi K, Lachkar R, Salhi Y, Cherkaoui O, Ouazzani Tnacheri B, Ibrahimy W, et al. Birth-related retinal hemorrhages in the newborn: incidence and relationship with maternal, obstetric and neonatal factors. Prospective study of 2,031 cases. Journal francais d'ophtalmologie. 2014;37(4):313–9.
(22) Hughes LA, May K, Talbot JF, Parsons MA. Incidence, distribution, and duration of birth-related retinal hemorrhages: a prospective study. J AAPOS. 2006;10(2):102–6.
(23) (Watts P, Maguire S, Kwok T, et al.. Newborn retinal hemorrhages: a systematic review. J Aapos 2013;17:70–8. 10.1016/j.jaapos.2012.07.012 [PubMed] [CrossRef] [Google Scholar]