Original Research Article

INCIDENCE AND RISK FACTORS OF RETINOPATHY OF PREMATURITY IN HIGH-RISK NEONATES

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ABSTRACT

Background: The aim is to determine the incidence, staging pattern, regression rates, and associated risk factors of retinopathy of prematurity (ROP) among high-risk neonates.

Materials and Methods: This prospective study included 223 high-risk neonates (181 preterm and 42 term). Screening was performed at 4–6 weeks using indirect ophthalmoscopy, with ROP classified per ICROP guidelines.[1-3] Demographic variables, birth weight, gestational age, and systemic risk factors were recorded.[4-6] Infants requiring treatment underwent laser photocoagulation or vitreoretinal surgery.[7-9] Data was analyzed using descriptive statistics.

Results: ROP was diagnosed in 42 infants (18.83%). Incidence was higher in preterm (22.65%) than term infants (2.38%), aligning with global trends.[10,11] Infants <1 kg and <28 weeks had the highest incidence. Stage II ROP was most common, and spontaneous regression occurred in 76.19% of cases.[3,12] Significant risk factors included low birth weight, prematurity, oxygen exposure, sepsis, anemia, phototherapy, and RDS.[2,4,9] Ten infants required treatment (7 laser, 3 vitreoretinal surgery).

Conclusion: Low birth weight and prematurity are the strongest predictors of ROP. Early screening and timely treatment are essential to prevent advanced disease and avoidable blindness.[13,14]

Keywords: Retinopathy of prematurity (ROP); prematurity; screening; incidence; risk factors.

INTRODUCTION

Retinopathy of prematurity (ROP) is a vasoproliferative retinal disorder affecting premature and low-birth-weight infants, and remains a major cause of avoidable childhood blindness worldwide.[1-15] Developing countries, including India, are experiencing a rising burden due to improving neonatal survival but inconsistent quality of neonatal care. [16] Studies demonstrate an inverse relationship between ROP incidence and both gestational age and birth weight.[17,18] Additional postnatal factors such as oxygen exposure, sepsis, anemia, and poor postnatal growth are also implicated. [19,20] As neonatal practices differ across regions, locally generated data are essential to refine screening strategies and improve outcomes. This study aims to determine the incidence, staging pattern, regression rates, and risk factors of ROP among high-risk neonates in Southern India.

MATERIALS AND METHODS

This prospective, hospital-based clinical study was conducted in the Neonatal Intensive Care Unit and Ophthalmology Department of a tertiary care centre in Southern India from July 2025 to September 2025. Ethical approval was obtained from the Institutional Ethics Committee and written informed consent was obtained from parents.

Inclusion Criteria

Infants were eligible if they met any of the following:

- Preterm infants with birth weight <1500 g or gestational age <34 weeks.[17-21]
- Term or heavier infants (>1500 g or >34 weeks) with high-risk features including prolonged oxygen exposure, sepsis, respiratory distress syndrome (RDS), anemia, intraventricular hemorrhage (IVH), intrauterine growth restriction

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(IUGR), phototherapy, blood transfusion, congenital heart disease, multiple gestation, neonatal hyperbilirubinemia, or birth asphyxia.[22,23]

Exclusion Criteria

- Infants without high-risk features
- Infants medically unfit for pupillary dilation or fundus examination

Methodology

Baseline demographic and clinical data were recorded. Pupillary dilation was achieved using tropicamide 1% and phenylephrine 2.5%. Fundus examination was performed using indirect ophthalmoscopy with a 20D lens at 4–6 weeks postnatal age or 31–33 weeks postmenstrual age, following the screening recommendations of the American Academy of Pediatrics(AAP),[24,25] and international classification of retinopathy of prematurity (ICROP) classification guidelines.[26]

Retinal findings including zone, stage, clock hours, and plus disease were documented. Infants were followed weekly or biweekly based on severity, as recommended in ETROP-based follow-up schedules.[27]

Treatment

Infants with Type 1 ROP or threshold disease underwent indirect laser photocoagulation, the current standard of care.[7,28] Advanced stages (stage 4/5) were referred for vitreoretinal surgery.[29]

Statistical Analysis

Data were analyzed using descriptive statistics. Incidence proportions were compared across gestational-age and birth-weight groups. Associations between systemic risk factors and ROP occurrence were assessed using proportional distribution analysis.

RESULTS

A total of 223 high-risk neonates were screened, of whom 42 (18.83%) developed retinopathy of prematurity (ROP).[9,15] The incidence was significantly higher among preterm infants (41/181; 22.65%) compared with term high-risk infants (1/42; 2.38%), consistent with previously reported trends.[3,8]

Among the ROP cases, 22/42 (52.38%) were male and 20/42 (47.62%) were female, indicating no significant sex-related difference, similar to earlier observations.[4]

Incidence by Birth Weight and Gestational Age: ROP incidence increased with decreasing birth weight. Among infants weighing <1 kg, 12/21 (57.14%) developed ROP, compared with 22/114 (19.29%) in the 1–1.5 kg group, 6/46 (13.04%) in the 1.5–2 kg group, and 0/16 in those >2.5 kg. Similarly, infants <28 weeks gestational age had the highest incidence (17/36; 50%), followed by those 28–34 weeks (25/187; 12.15%). These findings are consistent with established ROP epidemiology.[3,9]
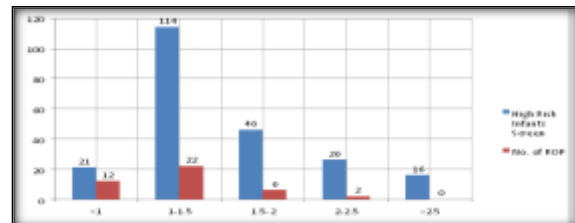
Figure 1: incidence of ROP by birth weight
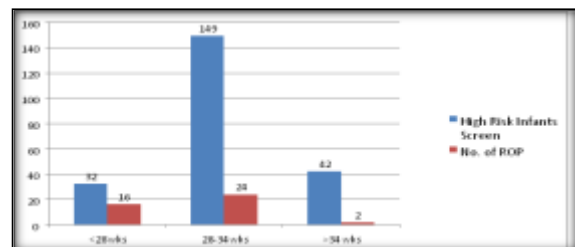
Figure 2: incidence of ROP by gestational age

Severity and Staging: Among the 42 ROP cases, Stage II was the most frequent (22 cases; 52.38%), followed by Stage I (13; 30.95%), Stage III (4; 7.14%), and Stage IV (2; 4.76%). Plus disease occurred in 1 infant (2.38%), and no Stage V ROP was observed. Most Stage I–II cases showed spontaneous regression.[3]

Figure 3: incidence of ROP by staging of disease.

Risk Factor Analysis: Key systemic and neonatal risk factors showed the following proportions of ROP among exposed infants:
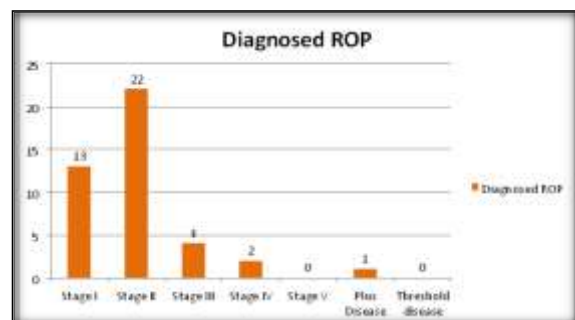
Table 1

Risk Factors	Number of infants with respective risk factor(N)	Number of infants with risk factor who develop ROP(n)	Percentage (n/N)
Oxygen Exposure	65	20	30.65%
IUGR	42	13	30.95%
Low Birth Weight	181	41	22.65%
RDS	45	10	22.22%
TWINS	10	3	30%

SEPSIS	80	24	30%
ANEMIA	34	10	29.41%
Blood transfusion	20	6	30%
Phototherapy	28	10	33.33%
ABO Incompatibility	6	3	50%

Low birth weight and prematurity remained the most prominent predictors, aligning with previous research.

Treatment and Outcomes

Of the 42 infants with ROP, 32 (76.19%) exhibited spontaneous regression. Seven infants (16.67%) underwent laser photocoagulation, and three (7.14%) required vitreoretinal surgery for advanced disease. No treatment-related complications were documented. Early treatment outcomes were favorable, consistent with ETROP trial recommendations.[9,28]

DISCUSSION

This prospective study found an ROP incidence of 18.83% among high-risk neonates, with a substantially greater burden in extremely preterm and very low birth-weight infants, consistent with the well-documented inverse relationship between ROP and maturity.[15,17] Stage II disease was most common, and more than three-quarters of affected infants exhibited spontaneous regression, in line with global evidence that early-stage ROP resolves in a majority of cases.[3] The strong associations observed between ROP and oxygen exposure, sepsis, anemia, phototherapy, and respiratory distress syndrome closely parallel findings from previous Indian and international studies,[4,19,23] supporting the prior hypothesis that ROP in developing settings is driven by immaturity compounded by postnatal systemic instability.[20]

Strengths of this study include its prospective design, comprehensive documentation of neonatal risk factors, and adherence to ICROP and AAP screening recommendations, enhancing reliability and comparability with existing literature. However, the single-centre design may limit generalizability, and the use of descriptive rather than multivariate analysis restricts identification of independent predictors. Despite these limitations, the study contributes meaningful region-specific epidemiological data, addressing the need for localized evidence in a country experiencing a "third epidemic" of ROP due to improved neonatal survival and variable oxygen practices.[16] The occasional occurrence of ROP in near-term or heavier infants, although infrequent, remains a subject of debate and may reflect inconsistent oxygen monitoring or unrecognized systemic instability, as noted in earlier reports.[8,29]

The favourable response to laser therapy observed in this cohort is consistent with the outcomes of the ETROP study, reinforcing its role as the standard of care for Type 1 disease.[9] These findings underscore the need for stringent oxygen regulation, strengthened neonatal care protocols, and universal screening of all high-risk infants irrespective of birth weight, particularly in resource-variable regions. Future research should include multicentre cohorts with advanced statistical modelling, evaluation of long-term visual outcomes, exploration of early biomarkers and postnatal growth trajectories, and assessment of tele-ROP and artificial intelligence-based screening systems to improve early detection and access to care.[11,14,20,21]

CONCLUSION

ROP incidence remains significant in high-risk neonates in Southern India. Low birth weight, prematurity, and systemic comorbidities are major predictors. Strengthening screening protocols, standardizing NICU practices, and ensuring timely treatment are essential to prevent blindness from advanced ROP.

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