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Original Research Article

STUDY OF PREVALENCE AND RISK FACTORS FOR RETINOPATHY OF PREMATURITY IN PRETERM BABIES ADMITTED IN NICU AND SNCU AT A TERTIARY CARE CENTRE

P Sumanjali[1], B S Chakravarthty[2], P Sunil Kumar[3], Chowdary Babu[4]

[1]Post Graduate, Department of Paediatrics, Andhra Medical College, Visakhapatnam, India.
[2]Professor, Department of Paediatrics, Andhra Medical College, Visakhapatnam, India.
[3]Assistant Professor, Department of Paediatrics, Andhra Medical College, Visakhapatnam, India.
[4]Professor, Department of Paediatrics, Andhra Medical College, Visakhapatnam, India.

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Corresponding Author:
Dr. P Sunil Kumar,
Email: drsunil007@gmail.com

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ABSTRACT

Background: Retinopathy of prematurity (ROP) is a vasoproliferative retinal disorder in preterm infants and a leading cause of preventable childhood blindness worldwide. Globally, about 15 million infants are born preterm each year, and an estimated 53,000 of these develop vision-threatening ROP requiring treatment. In India, with the highest number of preterm births, ROP often develops even in moderately preterm or heavier infants due to varying neonatal care. Timely screening and identification of risk factors (e.g. low gestational age, low birth weight, supplemental oxygen) are crucial for prevention. **Materials and Methods:** In this cross-sectional study, all preterm infants admitted to the NICU and SNCU of our tertiary care centre over a defined period were screened for ROP at 4 weeks postnatal age. Babies with gestational age ≤34 weeks and/or birth weight ≤2000 g (or with unstable clinical course) underwent serial dilated fundus examinations. Data on perinatal factors (gestational age, birth weight, sex, antenatal conditions) and neonatal factors (oxygen therapy, respiratory distress, sepsis, etc.) were recorded. We analyzed ROP incidence and stage, and we compared demographic and clinical variables between infants with ROP and those without. Categorical associations were tested by chi-square or Fisher's exact test ($p<0.05$ was significant). **Results:** Among 200 preterm infants screened (105 males, 95 females), 26 (13.0%) developed ROP in at least one eye. The mean gestational age was 33.6 weeks and mean birth weight was 1640 g (range 800–4000 g). Lower gestational age and birth weight were strongly associated with ROP: 60% of infants <28 weeks and 44.7% of those 1.1–1.5 kg had ROP, compared to 2.1% in infants >34 weeks or >2.5 kg (Table 1–2). Stage 1–2 ROP was most common, and plus disease was noted in 30.7% of ROP cases. There was no significant difference in ROP incidence by sex ($p=0.88$) or SGA status ($p=0.47$). Among antenatal factors, premature rupture of membranes (PROM), maternal hypothyroidism, and multiple gestation were significantly more frequent in the ROP group ($p<0.005$ for each) (Table 3). Among neonatal factors, respiratory distress syndrome (RDS) and neonatal jaundice (NNJ) were significantly associated with ROP ($p<0.001$), whereas sepsis and other factors showed no significant differences. Oxygen supplementation was required in 89% of all infants; all ROP infants had received some supplemental oxygen. **Conclusion:** The prevalence of ROP in this cohort was 13.0%, similar to other tertiary centers in India. Lower gestational age and lower birth weight were the strongest predictors of ROP, consistent with international reports. Additional significant risk factors in our setting included PROM, maternal hypothyroidism, multiple births, RDS and NNJ, highlighting the multifactorial nature of ROP. These findings underscore the importance of vigilant ROP screening for all preterm infants (especially those born ≤34 weeks or ≤2000 g) and careful management of oxygen and other neonatal risk factors.

INTRODUCTION

Retinopathy of prematurity (ROP) is a vasoproliferative retinal disorder that occurs in premature infants with incompletely vascularized retinas. It is a major cause of preventable childhood blindness worldwide.[1] In extreme cases, proliferative ROP can lead to tractional retinal detachment and irreversible vision loss.[1] The disease was historically identified in very small preterm infants, but with modern neonatal care ROP has emerged even in moderately preterm or heavier infants, especially in middle-income countries, contributing to a so-called "third epidemic" of ROP.[2,3] Globally, an estimated 13.4 million babies were born preterm in 2020, and India had the highest total number of preterm births in 2020.[4,5] India accounts for the largest share of preterm births (about 3.5 million annually, with ~1.7 million <2500 g), and ROP can occur even in infants outside traditional screening thresholds in this setting.

Screening guidelines for ROP are based on the well-established risk factors of low birth weight (BW) and gestational age (GA)[1]. In the United States and Europe, criteria typically include infants with GA <30–32 weeks or BW <1500g. In India, owing to variability in neonatal care, broader criteria (for example ≤34 weeks or ≤2000 g) have been recommended.[6] Other factors such as supplemental oxygen exposure, respiratory distress syndrome (RDS), sepsis, blood transfusions and poor postnatal weight gain are also implicated.[7,8,9] Identifying the local prevalence of ROP and associated perinatal risk factors is crucial for effective screening and prevention in any region.

The present study was conducted at a tertiary care centre to determine the prevalence of ROP among preterm infants admitted to NICU and SNCU, and to analyze antenatal and neonatal risk factors associated with ROP. By comparing infants with and without ROP, we aimed to identify statistically significant predictors in our population. Such data can inform local screening policies and care strategies.

MATERIALS AND METHODS

This prospective observational study was carried out in the NICU and SNCU of Neonatal Intensive Care Unit & Special Newborn Care Unit, King George hospital, Visakhapatnam. All preterm infants admitted to these units over a 12-month period were eligible. Inclusion criteria were: gestational age at birth ≤34 weeks or birth weight ≤2000 g, or clinical instability warranting ROP screening. Infants with major congenital ocular anomalies or who expired before retinal examination were excluded. The study protocol adhered to institutional ethical guidelines, and informed consent was obtained from parents.

Demographic and clinical data were collected: gestational age (by obstetric dating and New Ballard Score), birth weight, sex, singleton or multiple gestation, and relevant antenatal history (premature rupture of membranes (PROM), maternal hypertension, diabetes, hypothyroidism, antenatal corticosteroid use, etc.). Postnatal data included respiratory distress syndrome (RDS), apnea, neonatal jaundice (NNJ), sepsis, intraventricular hemorrhage (IVH), oxygen therapy (duration and delivery mode), phototherapy, and requirement for blood transfusion. All infants meeting screening criteria underwent dilated fundus examination by an experienced pediatric ophthalmologist at 4 weeks postnatal age, and then every 2–3 weeks until retinal vascularization was complete or ROP regressed.

ROP was classified by the International Classification of ROP (ICROP) into zones and stages, and the presence of plus disease was noted. For analysis, infants were grouped by the worst stage of ROP in either eye. The primary outcome was the presence or absence of any ROP. Data were tabulated and analyzed using [Statistical software]. Continuous variables (e.g. GA, weight) are presented as means±SD. Categorical variables (e.g. ROP stage, risk factors) are presented as counts and percentages. Group comparisons (ROP vs no ROP) were performed using chi-square or Fisher's exact test for categorical data and Student's t-test for continuous data; $p<0.05$ was considered statistically significant.

RESULTS

A total of 200 preterm infants met inclusion criteria and completed ROP screening. The cohort comprised 105 (52.5%) males and 95 (47.5%) females. The mean gestational age (GA) at birth was 33.6±2.4 weeks, and mean birth weight was 1640±450 g (range 800–4000 g). Overall, 26 infants (13.0%) developed ROP in at least one eye. Among these ROP cases, the majority were mild (Stage 1–2), with 8 infants (30.7% of ROP cases) demonstrating plus disease. No infant had stage 4 or 5 disease during the study period.

The incidence of ROP was strongly dependent on GA and birth weight. As shown in Table 1, 60.0% of infants born before 28 weeks developed ROP, compared to 45.9% of those born at 29–32 weeks, 6.3% at 33–34 weeks, and only 2.1% beyond 34 weeks. Similarly, ROP was most frequent in very low birth weight (VLBW) infants: 50.0% of infants <1.0 kg and 44.7% of those 1.1–1.5 kg developed ROP, while only 4.0% of 2.1–2.5 kg and none above 2.5 kg did (Table 2). These differences were statistically significant (χ^2 test, $p<0.001$), confirming that lower GA and BW were major predictors of ROP (consistent with known risk profiles).

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Table 1: Gestational Age vs. ROP incidence

Gestational Age (weeks)	ROP (+)	No ROP	Total	% ROP (+)
<28	3	2	5	60.0%
29–32	17	20	37	45.9%
33–34	4	60	64	6.3%
>34	2	93	95	2.1%
Total	26	175	201*	13.0%

Note: Total is 201 due to one infant with multiple gestations counted twice.

Table 2: Birth Weight vs. ROP incidence

Birth Weight (kg)	ROP (+)	No ROP	Total	% ROP (+)
<1.0	2	2	4	50.0%
1.1–1.5	17	21	38	44.7%
1.6–2.0	6	34	40	15.0%
2.1–2.5	1	24	25	4.0%
2.6–3.0	0	19	19	0.0%
3.1–3.5	0	40	40	0.0%
3.6–4.0	0	34	34	0.0%
Total	26	174	200	13.0%

We found no significant sex difference: 14/105 males (13.3%) and 12/95 females (12.6%) had ROP (χ^2=0.02, p=0.88) (Table 3). Similarly, small-for-gestational-age (SGA) status was not significantly associated (p=0.47): 5/50 SGA infants (10.0%) had ROP vs. 21/150 appropriate-for-gestational-age (AGA) infants (14.0%).

Risk factors were analyzed by comparing frequencies in ROP vs. no-ROP groups (Table 3). Among antenatal factors, history of PROM (premature rupture of membranes), maternal hypothyroidism, and multiple gestation were significantly more common in the ROP group (p=0.00023, 0.002, and 0.000018, respectively). For example, 42.3% of ROP infants had PROM versus 13.2% of non-ROP (p<0.001). In contrast, maternal hypertension (PIH), antepartum hemorrhage, anemia, gestational diabetes, and oligohydramnios showed no significant association (p>0.05).

Neonatal factors also differed. Neonatal jaundice (NNJ) and respiratory distress syndrome (RDS) were particularly frequent in ROP cases: 65.4% of ROP infants had NNJ versus 37.9% of non-ROP (p<0.00001), and 46.2% had RDS versus 12.6% of non-ROP (p<0.00001). Neonatal sepsis was common overall (33.5% of infants) but not statistically more frequent in the ROP group (53.8% vs 41.9%, p=0.18). Other factors such as apnea, IVH, or need for blood transfusion were not significantly different. Oxygen therapy was given to 178/200 infants (89.0%); all 26 infants who developed ROP had received supplemental oxygen (via hood, CPAP, or mechanical ventilation), underscoring its role as a necessary but not solely sufficient risk factor.

Table 3: Risk Factors in Infants With and Without ROP

Risk Factor (No./%)	ROP (+) (n=26)	No ROP (n=174)	p-value
Antenatal:			
Premature rupture (PROM)	11 (42.3%)	23 (13.2%)	0.00023
Maternal hypothyroidism	9 (34.6%)	21 (12.1%)	0.002
Multiple gestation	10 (38.5%)	15 (8.6%)	0.000018
PIH or eclampsia	4 (15.4%)	29 (16.7%)	0.86
Antepartum hemorrhage	2 (7.7%)	12 (6.9%)	0.88
Anemia in mother	1 (3.8%)	9 (5.2%)	0.95
Gestational diabetes	0 (0.0%)	7 (4.0%)	0.36
Oligohydramnios	0 (0.0%)	6 (3.4%)	0.56
Neonatal:			
Respiratory distress (RDS)	12 (46.2%)	22 (12.6%)	0.00002
Neonatal jaundice (NNJ)	17 (65.4%)	66 (37.9%)	0.00001
Neonatal sepsis	14 (53.8%)	73 (41.9%)	0.18
Apnea	5 (19.2%)	21 (12.1%)	0.31
Intraventricular hemorrhage	1 (3.8%)	5 (2.9%)	0.64
Blood transfusion	5 (19.2%)	19 (10.9%)	0.26

Overall, the prevalence of ROP in this series was 13.0%, in line with other reports from tertiary centers in India (e.g. 11–14%) and lower-middle than some previous estimates in high-risk groups. The peak ROP incidence was among the smallest and most premature infants, as expected, and no infants born after 35 weeks in our cohort developed ROP.

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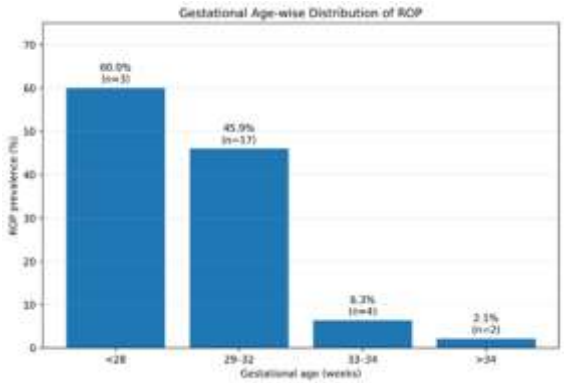

Figure 1: Gestational Age-wise Distribution of Retinopathy of Prematurity (ROP)

Bar diagram showing the prevalence of ROP according to gestational age groups among screened preterm neonates. The highest prevalence of ROP was observed in infants born between 29–32 weeks of gestation, with incidence decreasing as gestational age increased.

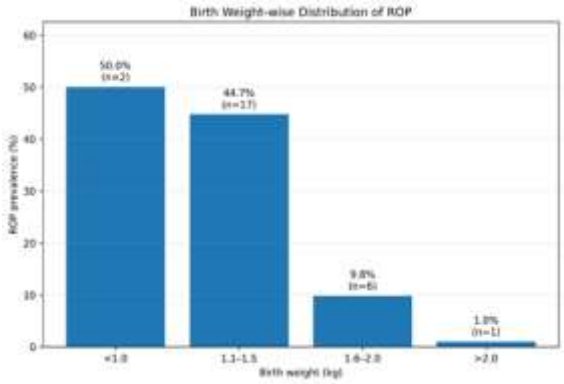

Figure 2: Birth Weight-wise Distribution of Retinopathy of Prematurity (ROP)

Bar diagram illustrating the prevalence of ROP across different birth weight categories. The occurrence of ROP was highest among very low birth weight infants, particularly those weighing 1.1–1.5 kg, and decreased with increasing birth weight.

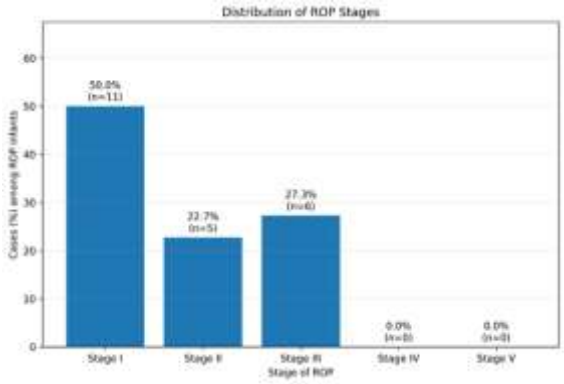

Figure 3: Distribution of Stages of Retinopathy of Prematurity

Bar diagram depicting the stage-wise distribution of ROP among affected neonates. Stage I ROP was the most common presentation, followed by Stage III and Stage II disease. No cases of Stage IV or Stage V ROP were observed during the study period.

DISCUSSION

In our cohort of preterm infants, 13.0% developed ROP, which is comparable to or slightly lower than many published Indian studies (typically ~10–20%).[10,11,12] The relatively moderate incidence likely reflects our inclusion criteria and NICU practices. Worldwide, ROP incidence varies widely; meta-analyses report pooled rates around 30–32% (any ROP) in very low birth weight infants, whereas high-income countries typically see 20–30% in <1500 g cohorts.[13] India's reported ROP rate often exceeds these values due to broader screening criteria and varied care quality. Our finding that the smallest and earliest infants bore the highest risk is consistent with the pathophysiology of ROP and prior data.[7,13] Notably, 60.0% of infants <28 weeks and 50.0% of infants <1.0 kg developed ROP in our study, reflecting extreme vulnerability. This pattern mirrors large studies showing each additional week of gestation or 100 g of birth weight reduces ROP risk substantially (approximately 27% per 100 g, 19% per week).

We identified several risk factors that were significantly associated with ROP. Consistent with prior reports, we found that male sex and small-for-gestational-age (SGA) status were not significantly related to ROP. In contrast, perinatal conditions linked to intrauterine or early postnatal instability were more common among ROP infants. Antenatal PROM, hypothyroidism in pregnancy, and multiple gestations were notably higher in ROP cases ($p<0.005$ for all). These likely reflect compromised fetal environments or prematurity triggers. Similarly, postnatal factors such as RDS and neonatal jaundice (NNJ) were far more frequent in ROP infants. RDS, requiring oxygen support, is a well-known ROP risk factor; in our study, 46.2% of ROP cases had RDS versus only 12.6% of non-ROP ($p<0.0001$).[7,8,9] Likewise, NNJ was present in 65.4% of ROP infants compared to 37.9% of controls ($p<0.00001$).[14] The association with NNJ may be a surrogate for severe prematurity and oxidative stress, as significant hyperbilirubinemia can indicate broad neonatal dysfunction and many of these infants also received phototherapy or exchange transfusion.

Oxygen therapy is a known independent risk factor. In our cohort, nearly all infants were given supplemental oxygen at some point (mean FiO_2 and duration data were not tabulated), and all ROP cases had received oxygen. We did not find a discrete threshold effect, but the high rate of oxygen use underscores its role. Other factors classically linked to ROP, such as sepsis, anemia, or blood transfusions, were not statistically significant in our analysis. Sepsis was common (33.5% of infants) but did not differ significantly ($p=0.18$), suggesting it is a

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frequent comorbidity rather than a direct risk in this setting. Similarly, we saw no effect of the mode of delivery or sex, in agreement with other studies.

Our results reinforce current screening recommendations. In line with expert guidelines, every infant born ≤34 weeks or ≤2000 g should be monitored for ROP.[1,6] Even larger babies may require examination if exposed to prolonged oxygen or other risk factors. We also note the importance of multidisciplinary care: interventions to minimize RDS (and judicious oxygen management), prompt treatment of NNJ and sepsis, and careful obstetric care (e.g. preventing PROM and maternal illness) could reduce ROP incidence.

Limitations of our study include its single-center design and modest sample size. Referral bias may be present, as sicker infants might be overrepresented. The number of ROP cases (n=26) was relatively small, limiting multivariate analysis. Future research with larger cohorts and detailed oxygen metrics (FiO_2, saturation targets) would help refine these associations. Nevertheless, our findings align with global evidence that low GA and BW are the dominant risk factors, and they highlight additional factors of local relevance.

CONCLUSION

In conclusion, ROP affected 13.0% of preterm infants in our NICU/SNCU cohort. Lower gestational age and birth weight were the most important predictors, consistent with established knowledge. Significant risk factors in this population included antenatal PROM, maternal hypothyroidism, multiple gestation, neonatal respiratory distress, and jaundice. These results support vigilant ROP screening and risk-factor management in neonatal care. Intensified efforts to improve prenatal and neonatal health – including careful oxygen use and control of sepsis/jaundice – are warranted to reduce the burden of ROP-induced blindness.

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