

Impact of COVID-19 Pandemic on Retinopathy of Prematurity Services in the Indian Public Healthcare System

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Purpose: To analyze the impact of the COVID-19 pandemic on the retinopathy of prematurity (ROP) services at Special Newborn Care Units (SNCUs), which provide care for sick neonates in the Indian public healthcare system.

Methods: A retrospective chart analysis of 508 babies screened for ROP at two SNCUs in West Bengal (India). We compared the data from the lockdown period (April, 2020-June, 2020; study arm) with the same period of the preceding year, 2019 (control arm).

Results: Out of the 508 babies, 187 were screened during the lockdown and 328 during 2019. The odds of developing ROP were 2.08 times (95% CI:1.25–3.48; P=0.002) higher during the lockdown period (35/187 babies; 18.72%) as compared to the previous year (34/328 babies; 10.37%). Also, the risk of sight-threatening ROP (ST-ROP) increased significantly during the lockdown (12/35 ROP babies; 34.29%) compared to the previous year (4/34 ROP babies; 11.76%) (odds ratio: 3.9; 95% CI:1.1–13.7; P=0.015). Notably, all babies with ROP during the lockdown presented more than 30 days after birth, compared to none in the previous year. All babies requiring laser therapy recovered completely in both groups.

Conclusion: An increased odds of developing ROP, including ST-ROP, was observed during the COVID-19 pandemic. Delayed ROP screening, which was noted in all study eyes, can have a detrimental effect on long-term visual prognosis. The findings of our research call for modifying the present healthy policy framework to make it more adaptable to disruptions in healthcare services, given the cyclical nature of the worldwide COVID-19 pandemic.

Keywords: retinopathy of prematurity, laser photocoagulation, COVID-19, pandemic

Introduction

The COVID-19 pandemic arrived in India on January 27, 2020, when an overseas passenger tested positive for the virus after visiting Wuhan, China.¹ Since then, the virus has spread rapidly across the country, with India becoming one of the worst-hit nations in the world. The government has implemented various measures to control the spread of the virus, including lockdowns and vaccination drives. Healthcare services were widely disrupted across the country during the nationwide lockdowns. Non-essential services were suspended as part of national health policy, with only emergency services made available. This led to delays in routine medical check-ups and screenings, which may have serious consequences for patients with serious medical conditions.²

Screening all preterm and low birth weight neonates is critical for detecting the potentially vision-threatening eye condition retinopathy of prematurity (ROP).² All newborns who weigh ≤ 2000 g or are ≤ 34 weeks' gestation must undergo ROP screening, according to Indian national guidelines.³ The standards also stipulate that at least one screening must be completed within the first 30 days of life.³ Nearly 2% of total live births in India are infants with birth weight ≤ 2000 grams and gestational age ≤ 34 weeks.⁴ Although the actual prevalence of ROP in India is unknown, it has been estimated that the incidence ranges from 22 to 52%.^{5,6} 20% of these infants have severe ROP, which can result in total blindness if it is not identified and treated in a timely manner.⁷ In to address this issue, the Government of India

established around 700 “Special Newborn Care Units (SNCUs)” where devoted staff members provide neonates with comprehensive care.⁸ However, in a country as large as India, with a population of over 1.3 billion, there are only 20,000 ophthalmologists, and less than 150 who actively practice ROP management.⁹ Consequently, although there is typically at least one SNCU in each district, most of these facilities do not offer a continual ROP screening program due to the shortage of medical personnel. Compounding the difficulty of ROP screening and treatment were the COVID lockdown restrictions on travel and public transportation, hospital admissions limit, the closure of regular outpatient services, and the apprehension about contracting the COVID-19 virus. As a result, many premature babies have missed out on critical ROP screening and treatment, which can lead to permanent vision impairment or blindness. Therefore, In this study, we set out to evaluate how the COVID-19 pandemic has affected ROP services at SNCUs in India’s public healthcare system serving the most vulnerable populations.

Subjects and Methods

Design

A retrospective chart analysis of consecutive infants who underwent ROP screening between April 2020 to June 2020 (The first lockdown period in India) at two SNCUs in the Indian state of West Bengal was conducted. Also, data on the infants who had ROP screenings in the year before the pandemic began (April 2019 to June 2019) was extracted. The study was conducted in accordance with the tenets of the Declaration of Helsinki and was approved by the Institutional Review Board of Retina Institute of Bengal in Siliguri, India. Written informed consent for treatment and data collection was obtained from the parent/guardian of each child.

ROP Screening

A detailed history, including birth weight, gestational age at birth, and any adverse events that occurred during the child’s stay in the SNCUs, was obtained. A senior Vitreoretinal surgeon (S.C.) with 15 years of experience examined all eligible neonates using a binocular indirect ophthalmoscope and +20 D lens under topical anesthesia with 2% proparacaine eye drops. The newborns’ eyelids were separated with an infant wire speculum, and a wire vectis was utilized as a scleral depressor. To fully dilate the pupils, 0.4% tropicamide + 2.5% phenylephrine eye drops were utilized three times. ROP was graded into stages and zones according to the International Classification of Retinopathy of Prematurity (ICROP).¹⁰ Repeated examinations were scheduled separately for babies with any stage of ROP until the ROP totally regressed or reached high-risk prethreshold or threshold ROP, at which point immediate laser treatment was performed under topical anesthesia, under anesthesiologist supervision, with a doubled-frequency Nd: YAG laser and a Laser Indirect ophthalmoscope.

Statistical Analysis

The Epi Info software (Version 7.2.5) was used to perform statistical analysis. The proportion of babies developing ROP and sight-threatening ROP (ST-ROP) was calculated and measured the association in terms of Odds Ratio (OR) for estimating the higher risk of ROP amongst those eligible babies who underwent screening during the COVID-19 pandemic (Group 1) as against those screened in the previous year (Group 2). Variables with *P* values of less than 0.05 were considered statistically significant.

Results

Study Cohort

A total of 187 babies were screened at the two SNCUs during the COVID-19 pandemic lockdown (April 2020 – June 2020). In the corresponding months of the previous year, 328 newborns were screened for ROP at the two SNCUs. Thus, 57.01% fewer babies were screened during the lockdown compared to the time before the pandemic.

Incidence of ROP

The incidence of ROP increased during the pandemic to 18.72% (35/187 babies), compared to a far lower incidence of 10.37% (34/328 babies) during the pre-pandemic period. During the lockdown period, the odds of developing ROP increased

2.08-fold (95% confidence interval [CI]: 1.25–3.48, $P = 0.002$) compared to the previous year. Importantly, all newborns with ROP during the lockdown presented beyond thirty days after delivery, compared to none the previous year.

Incidence of Sight-Threatening ROP

During the pandemic period, more than a third of the babies who had ROP (12/35 babies; 34.29%) developed ST-ROP, in contrast to the previous year, when only 11.76% (4/34 babies) of babies with ROP developed ST-ROP. When compared to the pre-pandemic period, the odds of developing ST-ROP were 3.9 times higher during the COVID-19 period (odds ratio: 3.9; 95% CI: 1.1–13.7; $P=0.015$).

Treatment and Follow-Up

Laser therapy was required in 12 babies (12/35; 34.29%) during the pandemic period compared 4 babies (4/34; 11.76%) in the pre-pandemic period. The risk of newborns with ROP requiring laser therapy increased 3.9 times during the COVID-19 period in comparison to the pre-pandemic era (odds ratio: 3.9; 95% CI: 1.1–13.7; $P=0.015$). In both groups, all of the newborns who received laser therapy recovered completely. No anti-vascular endothelial growth factor (anti-VEGF) injections were needed in any of the babies.

Table 1 depicts the comparative analysis between the volume of ROP during the COVID-19 pandemic lockdown and during the same period in the previous year. Table 2 shows the staging of ROP in both the treated and untreated eyes during both periods.

Table 1 Comparative Analysis of the Volume of Retinopathy of Prematurity During the COVID-19 Pandemic Lockdown and During the Same Period in the Previous Year

	Pre-COVID	COVID-19 Lockdown	Odds Ratio
Newborns Screened	328	187	
Incidence of ROP	10.37% (34/328 babies)	18.72% (35/187 babies)	2.08 [1.7–3.8]
Incidence of ST-ROP	11.76% (4/34 babies)	34.29% (12/35 babies)	3.9 [1.1–13.7]
Newborns with ROP requiring Laser Therapy	11.76% (4/34 babies)	34.29% (12/35 babies)	3.9 [1.1–13.7]

Abbreviations: ROP, Retinopathy of prematurity; ST-ROP, Sight-threatening retinopathy of prematurity.

Table 2 Staging of Retinopathy of Prematurity During the COVID-19 Pandemic Lockdown and During the Same Period in the Previous Year

	ROP Staging	Pre-COVID (Number of Eyes)	COVID-19 Lockdown (Number of Eyes)
Treated Eyes	Zone 1 Stage 2+	0	2
	Zone 1 Stage 3+	0	5
	Zone 2 Stage 2+	3	3
	Zone 2 Stage 3+	1	2
	APROP	0	0
Untreated Eyes	Zone 1 Stage 2 (No Plus)	4	7
	Zone 2 Stage 3 (No Plus)	0	0
	Zone 1 Stage 2 (No Plus)	26	16
	Zone 2 Stage 3 (No Plus)	0	0

Abbreviations: ROP, Retinopathy of prematurity; AP-ROP, Aggressive posterior retinopathy of prematurity.

Discussion

In the current study, the authors sought to evaluate the real effects of the COVID-19 lockdown on the ROP screening in the SNCUs of the Indian public healthcare system. Our real-world data indicate that the number of babies screened during the pandemic declined by more than half, with ROP developing at a rate that was 2.08 times greater during the pandemic period compared to the pre-pandemic era. In addition, ST-ROP was 3.9 times more frequent during the lockdown period than the preceding year. Furthermore, the delayed presentation was more typical during the COVID-19 era as well.

ROP is a disease of the retina that has the potential to cause blindness.³ It can afflict infants who were born at least four weeks prematurely and who received intense neonatal care.³ It develops over time and is not present at birth. Identification and management of ROP as early as possible are essential, as they can reduce the risk of permanent vision loss. The early detection of ROP and timely management to prevent visual loss necessitates routine screening of all preterm babies based on the recommended guidelines.^{2,3} ROP is progressively becoming one of the most important contributors to the preventable blindness of children in India and other low- and middle-income nations (LMIC).¹¹ As a part of the millennium development goals (MDG) and the sustainable development objectives (SDG), India's Health Ministry has prioritized reducing neonatal mortality over the past few decades.^{12,13} This has not only led to an increase in the number of preterm kids who are surviving, but it has also led to an increase in the number of preterm babies who are in danger of developing ROP, which can lead to blindness. In light of this, it is crucial to combine ROP and newborn healthcare services to provide adequate screening for premature babies. Given this context, the Government of India set up about 700 SNCUs at sub-district and district hospitals to care for newborns who are sick. These SNCUs have been instrumental in reducing neonatal mortality rates and improving access to healthcare for preterm babies.¹⁴ However, there is still a need for greater awareness and resources to address the issue of ROP in preterm infants. Because as many as 15% of preterm newborns referred to SNCUs are at risk for developing ST-ROP, it is ideal to test the retinas of all eligible preterm infants admitted to these facilities.¹³ For these babies, immediate treatment with a laser or an anti-VEGF injection is required to prevent irreversible vision loss. In our study, out of all the newborns with ROP, 34.29% underwent laser therapy during the lockdown and 11.76% needed it during the pre-pandemic period. All of the infants made a full recovery owing to early detection and management, which allowed for complete retinal vascularization.

The COVID-19 pandemic, which began towards the end of 2019 in China and quickly spread throughout the world, reached its peak in early 2020.¹⁵ With multiple waves spreading throughout numerous nations, this pandemic has grown to be the worst public health catastrophe in at least a century. Besides this, the pandemic is still active in the majority of the world's countries. As a result, governments have implemented various measures such as lockdowns, social distancing, and vaccination programs to control the spread of the virus and reduce its impact on society. Despite the development of vaccines and the implementation of various measures to curb its spread, new variants of the virus continue to emerge, posing a threat to global health and economies.¹⁵ The pandemic has also highlighted existing inequalities in healthcare systems around the world. In a Netherlands-based study, a decline in the incidence of preterm births was noted after COVID-19 mitigation measures were implemented.¹⁶ However, the decrease in preterm births was limited to individuals residing in neighbourhoods characterized by high socioeconomic status.¹⁶ Likewise, in another study from Japan, a developed nation, a reduction in the number of infants with ROP and fetal growth restriction (FGR) was seen.¹⁷ India currently has the third-highest number of COVID cases in the entire world as of the submission date.¹⁸ The Government of India has implemented many lockdowns, the first of which occurred at the beginning of the year 2020, as part of its response to the pandemic.¹⁹ However, the lockdowns have disproportionately affected marginalized communities, such as migrant workers and those living in poverty, who often lack access to basic healthcare services and have been left without work or income during the lockdowns. The author provides voluntary services to such marginalized populations by serving in two SNCUs located in the predominantly rural areas of the Indian state of West Bengal. As a subset of this, weekly ROP screening is carried out at each of the centers, and these operations were maintained even during the period of lockdown. However, there was a decline in the number of babies screened for ROP during the pandemic to the tune of more than half (57.01%) when compared to the pre-pandemic numbers of our study. Such a decline in newborn screening during the lockdown period could be attributed to reduced access to healthcare facilities, fear of contracting COVID-19, and transport restrictions. In the study by Katoch et al² from India, a similar decline in the

number of newborns screened during the lockdown period was observed in both the OPD (396 vs 87; $P=0.001$) and the NICU (241 vs 169; $P=0.001$). They compared data from the lockdown period (24 March 2020–31 May 2020) to data from the preceding months (1 January 2020–23 March 2020) rather than comparing the same timeframe from the previous year, as was done in the present study. In another study from the USA, Mantagos et al²⁰ compared the ROP clinic volume from the 3-month COVID-19 period in 2020 to the same 3-month period in 2019. They also observed a 19% and 53% decrease in the number of ROP evaluations performed for inpatient and outpatient newborns in 2020 compared to 2019.

There is a very small window of opportunity for optimal screening and management of ROP. During the COVID period, the Indian Retinopathy of Prematurity (iROP) Society, the All India Ophthalmological Society (AIOS), and the Vitreo-Retina Society of India (VRSI) collaborated and formulated the ROP screening guidelines.^{2,21} Of the ROP screening guidelines, performing at least one test within the first 30 days of life is extremely vital. Several studies have demonstrated that a delay in screening is linked to the development of ROP.^{22,23} In our study, too, all newborns who developed ROP during the lockdown presented after the 30-day threshold period, compared to none before the pandemic. In addition, the likelihood of developing ROP increased by more than twofold (OR: 2.08) during the lockdown compared to the prior year. These findings highlight the importance of timely ROP screening, especially during a pandemic when access to healthcare may be limited. It is crucial to prioritize the screening of high-risk infants to prevent the development of severe ROP and its associated complications. Indeed, in our study, the probability of developing ST-ROP was nearly four times (OD: 3.9) higher during the COVID period compared to the pre-pandemic era. Thus, parents and caregivers should also be educated on the importance of ROP screening and the potential consequences of a delayed screening. Furthermore, telemedicine may be a useful tool in providing timely ROP screening during a pandemic, as it allows for remote assessment of the newborns' eyes by trained professionals. This approach can help ensure that infants receive the necessary care and treatment for ROP, even in areas where access to healthcare is limited.

India has a burgeoning population of about 1.3 billion people, but only about 20,000 ophthalmologists, and less than 1% of those specialize in ROP care.⁹ However, despite the government's laudable effort to establish one SNCU in each district, most healthcare facilities lack the manpower to conduct regular ROP screening. This shortage of ophthalmologists and ROP specialists in India highlights the need for more investment in healthcare infrastructure and training programs to meet the growing demand for ROP care. Additionally, telemedicine and other innovative solutions can be leveraged to improve access to screening and treatment for infants at risk of ROP.²⁴ This shortage of ROP specialists and screening facilities poses a significant challenge to providing timely and effective care to premature infants, which can lead to irreversible vision loss if left untreated. Addressing this issue requires a concerted effort from the government, healthcare providers, and other stakeholders to increase awareness, training, and resources for ROP care. Additionally, India's healthcare system has struggled to keep up with the surge in COVID cases, highlighting the need for increased investment in healthcare infrastructure and resources. The current health policy framework must be revised so that a more resource-sensitive model for ROP screening and management may be established, making the system more resilient to disruptions in healthcare services. Investing in telemedicine and digital health technologies can also improve access to ROP care, especially in remote and underserved areas, and help mitigate the impact of pandemics or other healthcare crises on healthcare delivery. Moreover, partnerships between the public and private sectors can facilitate the development of sustainable ROP programs that address the needs of all infants at risk of blindness due to ROP.

Our study has a few limitations. Firstly, the study period was limited to the first three months of the COVID-19 pandemic and the associated lockdown in our country. As a result, it is possible that it may not provide a precise picture of the total impact the pandemic has had on ROP screening in India. Second, there could be a selection bias in the study since there is a possibility of infants dropping out from the screening and/or follow-up visits due to the COVID-19 related restrictions. Lastly, the study only included 2 of the 11 SNCUs in our state, and it excluded the privately run centers in the district as well. Hence, it might not accurately reflect the incidence of ROP or how the pandemic has affected ROP in the state. The study does, however, draw attention to the fact that ROP is a concern in the region and the substantial impact the pandemic has had on the screening program. Therefore, further research is needed to determine the full extent of the impact of the pandemic on ROP screening and treatment in the state, including a larger sample size that includes all SNCUs and private centers. This information could help inform policies and interventions to mitigate the

effects of the pandemic on ROP care. These programs can help bridge the gap in healthcare access during a pandemic and prevent long-term visual impairment in premature infants.

In conclusion, the number of newborns screened for ROP decreased considerably during the COVID-19 lockdown. During the COVID-19 pandemic, the chances of developing ROP were twice as likely, and the chances of developing ST-ROP were almost four times as likely as they were before the pandemic. Delayed ROP screening was observed in all study eyes developing ROP during the pandemic era, compared to none in the pre-pandemic period. The outcomes of our study provide new insights into potential and challenges in the real-world implementation of ROP screening programs within the Indian public healthcare system. The authors suggest making reforms to the current healthcare policy framework to improve its capability to sustainably and uninterruptedly deliver essential health services during such global humanitarian crises.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

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