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Retinopathy of prematurity screening and risk mitigation during the COVID-19 pandemic



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BACKGROUND

The coronavirus disease 2019 (COVID-19) pandemic has significantly disrupted the delivery of healthcare. Although most nonurgent ophthalmology visits at Boston Children's Hospital were canceled, premature infants at risk for retinopathy of prematurity (ROP) still required timely, in-person care during the initial 3-month period of the infection surge in Massachusetts. The purpose of the current study was to report our protocols for mitigating risk of exposure to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) between infants and eye care providers and to compare examination rates and results with the same 3-month period in 2019.

METHODS

During the infection surge, we added new infection control measures and strengthened existing ones. Additional personal protective equipment was used, and the number of ophthalmologists rotating in the three high-capacity NICUs we service was limited.

RESULTS

More infants required ROP examinations during the study period in 2020 than in the same period in 2019, but fewer examinations were performed. There were no cases of missed progression to severe ROP during this time and no known transmission of SARS-CoV-2 between ROP patients and ophthalmology staff.

CONCLUSIONS

Overall, effective ROP care was safely provided during the COVID-19 pandemic, and contact with this vulnerable population was minimized. (J AAPOS 2021;25:91.e1-5)

Retinopathy of prematurity (ROP) is a common and potentially blinding disease that affects the developing retinal vasculature of premature infants and can cause tractional retinal detachment. Detection and management of ROP warranting treatment requires timely and effective screening. In the United States, premature babies born at <30 weeks' gestational age (GA) or with birth weight (BW) of $\leq 1,500$ g, and those whose medical course has been deemed complex enough to be a risk factor for ROP by their attending pediatrician or neonatologist are screened for ROP.¹

The coronavirus disease 2019 (COVID-19) pandemic, caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has led to significant disruption in the delivery of healthcare.²⁻⁵ While most children with SARS-CoV-2 infection have mild COVID-19 symptoms, infants can still develop early-onset SARS-CoV-2 infection⁶ and

children can develop life-threatening disease, including a recently recognized multisystem inflammatory syndrome associated with COVID-19.^{7,8} Infection control in neonatal intensive care units (NICU) is a critical aspect of perinatal care; however, ROP screening examinations have unfortunately been associated with other viral outbreaks.⁹ Given the blinding potential of ROP, ophthalmologists had to adapt their practice patterns to ensure continued delivery of care without compromising the safety of patients, colleagues, and themselves. We describe the measures taken by the Department of Ophthalmology at Boston Children's Hospital to mitigate the risk of SARS-CoV-2 transmission during ROP screening.

Materials and Methods

This observational study, deemed exempt from approval by the Institutional Review Board of Boston Children's Hospital, complied with requirements of the US Health Insurance Portability and Accountability Act of 1996. We describe the measures undertaken for in-person ROP care by the Department of Ophthalmology to mitigate the risk of COVID-19 transmission during the 3 months of infection surge in Massachusetts, starting the week of March 16, 2020, the Monday after a state of emergency was declared by the governor.¹⁰ The measures described here are in addition to hospital-wide measures implemented by the three separate NICUs our service covers for in-person examinations. Although we also provide telemedicine ROP screening, our practice for screening these patients did not change, because

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images were captured by the neonatology service; we did not have to implement specific measures for the ophthalmology staff to follow. Infants discharged from NICUs where tele-screening was performed were then followed as outpatients, and at that point our updated departmental protocols were applied. Descriptive statistics were used to compare the number of examinations performed and patients treated for ROP during the same 3-month period during 2019.

The pediatric ophthalmology service at Boston Children's Hospital provides comprehensive in-person ROP coverage, including screening and treatment to the Boston Children's, Brigham and Women's Hospital, and Beth Israel Deaconess Medical Center NICUs in Boston and tele-screening to two additional NICUs (South Shore Hospital, Weymouth, MA, and Catholic Medical Center in Manchester, NH). The ROP service consists of 7 ophthalmologists and 2 ROP nurses. The ROP nurses monitor each NICU census, coordinate timing of the ROP examinations with each neonatology team, track babies after discharge, and accompany the ophthalmologist to the NICU to assist with the eye examination. All three NICUs covered by our department for in-person examinations are level-3 NICUs with a combined total capacity of 137 beds. In 2019 we screened 264 infants for ROP in-person for a total of 955 inpatient and 430 outpatient examinations.

Inpatient Infection Control Measures

Common infection control measures at all three hospitals included screening of all staff for COVID-19 symptoms at the start of each shift, universal use of ear-loop masks, and enhanced personal protective equipment (PPE) use (N95 respirators, face shields, gowns, and gloves) for care of patients with suspected or confirmed COVID-19, or for patients undergoing aerosol-generating procedures. Staff did not undergo routine SARS-CoV-2 testing unless symptomatic. It has been standard practice at our institutions to use a sterile ROP eye examination kit, that includes a scleral depressor and lid speculum, for each patient; this practice continued during the COVID-19 pandemic. All visitors to the hospitals were screened at entry points and mask wear was mandatory.

Ophthalmology Department-specific Measures

- A new rotation schedule was created: not all the ophthalmologists would round each week, and each ophthalmologist would round at only one NICU.
- ROP nurses no longer accompanied ophthalmologists on rounds; assistance for infant positioning was provided by the bedside nurse.
- Fellows and residents no longer participated in ROP rounds.
- Ophthalmologists started wearing hospital-issued scrubs that were provided at the start of each shift and would be disposed at the hospital at the end of the shift.
- Indirect ophthalmoscopes were disinfected with hydrogen peroxide wipes and 28 D lenses were cleaned with soap and water between patients.

- Retinal photography was limited to severe cases of ROP nearing treatment for evaluation of subtle changes between examinations.
- Family counseling was provided via teleconferencing applications or via telephone to minimize face-to-face interactions.
- Even prior to the COVID-19 pandemic, we were using the WINROP algorithm for risk-stratification of premature babies.¹¹ During the COVID-19 pandemic, we increased utilization of the WINROP risk-stratification algorithm to extend the length of follow-up when possible (eg, an older, WINROP negative premature infant who was found to be immature in zone II might be scheduled for a 3-week instead of a 2-week follow-up).
- Prior to the COVID-19 pandemic, it was not uncommon to follow patients until full retinal vascularization had occurred or they were at least 44 weeks postmenstrual age (PMA) with unequivocally regressing ROP in keeping with the current national screening criteria.¹ During the COVID-19 pandemic, we concluded examinations early whenever possible to avoid outpatient visits (eg, low-risk WINROP negative infants with no history of ROP, in zone III, who were at least 36 weeks PMA at the time of their last ROP examination).
- A protocol was developed with each NICU to allow for infants who required outpatient ROP follow-up to either have a prescription for dilating drops (cyclopentolate 1%) sent to their pharmacy, or have dilating drops for outpatient use given to the caregiver prior to hospital discharge. NICU bedside nurses educated caregivers about the use of dilating drops. One set of dilating drops were placed one hour prior to the scheduled outpatient eye appointment, so eyes were predilated for the visit to minimize time spent in clinic.

Outpatient Infection Control Measures

Hospital-directed measures included closing satellite clinics to maintain PPE supplies. The number of caregivers accompanying infants to appointments was limited to 2 adults, and other children, including siblings, were not permitted. Visitor screening for COVID-19 symptoms occurred at the hospital main entrance, and masks were required. Prearrival electronic check-in was encouraged to minimize check-in time, Plexiglas barriers were placed at check-in desks to minimize droplet dispersion, and verbal instead of written consent was obtained by administrative staff for billing authorization and acceptance of HIPAA/hospital privacy notices.

Ophthalmology Department-specific Measures

- ROP nurses would call families 2-3 days in advance of their appointment to perform a health screening, review instructions for use of dilating drops, and provide caregiver education. If families had not received a prescription for dilating drops at discharge one was called-in to their pharmacy.
- Appointment templates were changed to maximize physical distancing by having one patient arrive every 30 minutes.

Table 1. Number of births at our covering institutions and retinopathy of prematurity clinical volume during the 2020 COVID-19 surge in Massachusetts and during the same 3-month period in 2019

Study parameters	2019	2020
Number of births		
Total births	3032	2919
Births <31 weeks GA	52	64
Inpatient exams		
Infants screened	82	97
ROP exams performed	280	228
Infants requiring ROP treatment	2	4
Outpatient exams		
Infants screened	70	38
ROP exams performed	113	53

- On arrival and check-in patients were escorted directly to an exam room without having to wait in the waiting room.
- Patients arriving early were asked to call prior to entering and to wait outside or in the outside lobby until their scheduled appointment.
- A designated COVID-19 examination room was used for suspected or confirmed cases of COVID-19.
- PPE was used in accordance to CDC and hospital guidelines, including use of an ear-loop masks and goggles at all times by staff and enhanced PPE (face shield or goggles, isolation gown, gloves, N95 respirator) for patients with suspected or confirmed COVID-19.
- At the direction of the hospital, single use eyedrop bottles were used for each patient for dilation and topical anesthesia.
- Similar to the inpatient setting, efforts were taken to maximize the interval between follow-up visits, by utilizing the WIN-ROP algorithm.
- Between patients, high-touch areas (desks, chairs, knobs, door handles) in examination rooms were disinfected with hydrogen peroxide wipes, and equipment was cleaned according to manufacturer instructions.
- A sterile eyelid speculum and sterile depressor were used, if the attending physician deemed it necessary.
- Indirect ophthalmoscopes were disinfected with hydrogen peroxide wipes and 28 D lenses were cleaned with soap and water.
- The use of scribes was discontinued to minimize the number of persons in clinic.
- Trainees did not participate in outpatient ROP examinations to minimize the number of interactions with the infant.

Results

Details of the ROP clinical volume during the 3-month period starting March 16, 2020, until June 16, 2020, as well as the same 3-month period in 2019 are shown in Table 1. Compared with the same 3-month period in 2019, there was an 18% increase (97 from 82) in the number of premature infants screened for ROP as inpatients; however, there was a 19% decrease (228 from 280) in the number of examinations performed. Four patients were

treated in 2020 for type I ROP, compared with 2 in 2019; 3 patients were treated with laser retinal photocoagulation and 1 with bevacizumab intravitreal injections. The laser-treated patients were sedated and intubated by the NICU team for the procedure. Per hospital guidelines, admitted asymptomatic patients undergoing a procedure did not require SARS-CoV-2 testing. There was a 46% decrease (38 from 70) in the number of infants requiring an outpatient ROP examination in 2020, leading to a 53% reduction (53 from 113) in the number of outpatient ROP examinations performed compared with 2019. There were no cases of ROP progressing to stages 4 or 5 during the period of the enhanced safety measures or the following 6 weeks. There were no incidents of COVID-19 transmission between staff, caregivers, or patients during ROP care during this 3-month period.

Discussion

ROP is a potentially blinding disease that requires timely screening and treatment, and neither screening nor treatment could be postponed during the COVID-19 pandemic. The ophthalmology service at our institution sought to mitigate the risk of SARS-CoV-2 transmission during the COVID-19 surge in Massachusetts and adapted our screening protocols, while continuing to follow national ROP screening criteria.¹

We did not have any cases of transmission of SARS-CoV-2 during ROP examinations. Although we cared for 18% more inpatients during the 3-month period from March 16, 2020, to June 16, 2020, than during the same 3-month period in 2019, we performed 19% fewer inpatient examinations. In addition, 46% fewer infants required outpatient follow-up in 2020. Infants at higher risk (generally <28 weeks, birthweight <1250 g, WINROP positive) or with high-risk characteristics on examination (zone I or posterior zone II ROP, pre-plus disease, stage 2 or 3 ROP) were followed closely, according to pre-COVID practice, and eyes with type I ROP received timely treatment, with no progression to retinal detachment. Infants with older GA, higher BW, WINROP negative, and no concerning features on examination were followed at longer intervals. The reduction in examinations, therefore, was in effect the result of tighter implementation of screening guidelines, not requiring following patients to full maturity if they never had active ROP, as well as by better use of the WIN-ROP risk-stratification algorithm. The effect of risk-stratification algorithms to the number of required ROP screening examinations has been well documented in the literature.¹²

The main mode of SARS-Cov-2 infection is thought to be contact and droplet transmission, while fomite transmission is considered a likely mode of transmission, and airborne transmission is less likely to occur.¹³ Intrauterine vertical transmission of SARS-CoV-2 from infected mothers is unlikely,^{14,15} as well as transmission of SARS-CoV-2 to infants from SARS-CoV-2 positive mothers as

long as appropriate hygiene measures are followed.¹⁶ Of particular concern for ophthalmologists is that SARS-CoV-2 has been detected in tears and transmission of SARS-CoV-2 from tears to the respiratory tract by means of the nasolacrimal system is possible.^{17,18} SARS-CoV-2 transmission to healthcare workers can occur and is a particular occupational hazard to ophthalmologists, because hemorrhagic conjunctivitis is a manifestation of COVID-19 in newborns and because the ophthalmic examination requires close proximity to the face.¹⁹⁻²¹ We had concerns that ophthalmologists could be exposed in the clinics and be asymptomatic carriers to the NICU population. Rarely, other viral outbreaks have occurred in the NICU as a result of the ROP examination,⁹ and thus we determined an adjustment to how we approach ROP screening during the COVID-19 pandemic was required.

The measures undertaken by our department were aimed at minimizing the risk of transmission of SARS-CoV-2 during ROP screening. Key elements in controlling the viral spread have been social distancing (including limited numbers of physicians on the ROP rotation with each ophthalmologist covering only a single NICU each week), use of PPE, as well as deferral of elective and routine care when possible in order to limit exposure and preserve medical supplies.

Several challenges were encountered during the 3-month period of the COVID-19 pandemic surge, and potential limitations have been identified in maintaining some of these measures post-surge.

Although doable, it can be difficult to fit the indirect ophthalmoscope over face shields. It was easier to fit the ophthalmoscope over safety goggles, but the fit of goggles over spectacles should be assessed, as visualization can be limited, particularly if the fit is not tight, and condensation develops. We are not sure whether goggles provide the same level of protection compared to the face shields.

Out of an abundance of caution, during the 3-month surge, we were required by our institution to use a new bottle of mydriatic and topical anesthetic drops for each outpatient. This can be expensive, to the point of the cost of eye drops being greater than reimbursement for the examinations. With no evidence for disease transmission via eyedrops if appropriate measures are taken when handling them, this practice has since been discontinued.²²

There are concerns about the safety of mydriatic eye drop administration to premature infants at home and the risk of apnea and systemic side effects.²³ The decision to proceed with at-home dilation prior to the eye clinic appointment was made in conjunction with the neonatology service prior to discharge, and patients had to be stable and without an apneic spell for at least 7 days prior to discharge. We avoided phenylephrine-containing drops, which are known to affect heart rate and blood pressure in young children.

The detrimental educational effect of limiting trainee exposure to the ROP examinations during the 3-month

surge has to be considered. This would not be sustainable for longer periods of time, especially considering the shortage of ophthalmologists with expertise in performing ROP examinations.²⁴

We did experience significant resistance from many families about bringing their infants to clinic for outpatient ROP examinations; however, all of them had follow-ups within the recommended time frame. The ROP nursing team was instrumental in ensuring that infants were not lost to follow-up by communicating directly with families, addressing their concerns, and reassuring them by explaining the specific safety measures we had put in place. At times we connected families with our social worker to address social barriers and inform families about the possibility of having the Department of Children and Families involved if parents failed to bring infants for follow-up.

As clinic volume is expected to increase, the modified clinic templates, with outpatients staggered every 30 minutes, is not sustainable in the long term; the ability to provide outpatient ophthalmologic care has been reduced by 50% and has created a large back-log of visits for pediatric ophthalmic care.

It is possible that transitioning to remote screening, where NICU-based staff obtains retinal images would further decrease exposure from the ophthalmology team. In this scenario, increased number of imaging sessions would be required, but would be performed by NICU staff, and ophthalmologists would only perform bedside examinations for referral-warranted ROP or other concerns.²⁵

Because we are still in the COVID-19 pandemic, it is important to continue risk mitigation. Best practices entail using PPE, physical distancing, and prioritizing clinical care to life- and vision-threatening conditions. Predilation of select infants for outpatient screening can be considered to aid social distancing, by minimizing time spent in clinic. The use of risk-stratification algorithms should be considered to reduce examinations for low-risk infants.¹² Telemedicine ROP screening is effective²⁶ and can also be considered to minimize the need for ophthalmologists to physically enter the NICU.

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