Evolving Guidelines for Retinal Surgeries and Retinopathy of Prematurity (ROP) Treatment Procedures During the COVID-19 Pandemic

(May 27, 2020)

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As we emerge from the enhanced community quarantine and slowly begin returning to our operating rooms, we must always keep in mind a few things that we have learned about the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), the virus that caused the coronavirus disease 2019 (COVID-19) pandemic.[1]

First, SARS-CoV-2 is highly infective as evidenced by its high reproduction number (R0) of 3.3, with a median of 2.8.[2] The R0 is defined as the number of cases generated by one case in a population where all individuals are susceptible to infection.[3] This means a single case is capable of infecting three other people. The influenza virus that figured in the great 1918 pandemic has a median R0 of ~2.0[4] while that of seasonal flu is ~1.3.[5]

Second, transmission can occur from mildly symptomatic patients. But more disturbingly, some have reported transmission even from pre-symptomatic or asymptomatic carriers.[6,7] There has been a report of transmission from an asymptomatic 22 year-old patient to seven other youngsters even after only a single, few-hour-contact with the former.[8] Pending large, prospective, epidemiological studies on transmission, these anecdotal reports should warn us to be more prudent in our actions as health care providers.

Third, the virus is known to survive in aerosol form (defined as <5 μm) for three hours under controlled conditions. It is also known to be more stable on plastic and stainless steel surfaces compared to copper and cardboard. It has been found to be viable on these surfaces for 72 hours, but in greatly reduced titers.[9] Thus, it is important that (1) we reduce or minimize aerosol formation from health workers, patients, and procedures in the operating room and (2) minimize the travel or spread of aerosol away from aerosol-generating machines and procedures (AGP) such as endotracheal intubation, extubation, non-invasive ventilation, nebulization, use of drills, open suctioning, electrocautery.[10]

Although there have been reports of aerosol generation from high-speed drills in spinal surgery[11] and dental[12], there is no conclusive evidence yet on the AGP potential in eye surgery such as the phacoemulsification tip, vitrectomy cutter, and even during air-fluid exchange.[13] Similarly, as of this writing, there are also no published reports confirming the presence of the SARS-CoV-2 in the vitreous and aqueous fluid among confirmed COVID-19 patients.

Philipp J Ophthalmol 2021;46:38-50

However we should be aware that viral ribonucleic acid (RNA) has been detected in the conjunctiva via reverse time polymerase chain reaction (RT-PCR),[14] and it has been cultured from the preocular tear film in one case of conjunctivitis.[15]

Lastly, a recently published report showed that SARS-Cov-2 is much more efficient in infecting the ex-vivo human conjunctiva than SARS-CoV, with virus level about 80-100 times higher.[16] This implies that the eye might be an additional route of infection and care must be taken for the health care workers in the operating room and the patient whose eye is exposed during the entire procedure.

With these in mind, the Vitreo-Retina Society of the Philippines (VRSP) is issuing this general set of safety guidelines in the conduct of retinal surgery, intravitreal injections, and management of retinopathy of prematurity (ROP) for the duration of the COVID-19 pandemic.

Furthermore, the user is encouraged to read and follow related guidelines including:

1. Philippine Academy of Ophthalmology (PAO) Ophthalmological Risk Stratification for COVID-19;[17]

2. Department of Health (DOH) Memorandum No. 2020-0220 Return to Work Guidelines;[18]

3. COVID-19 Testing Recommendations Prior to Elective Ophthalmic Surgeries;[19]

4. Anesthesia Guidelines for Post Enhanced Community Quarantine (ECQ) Elective Surgeries;[20] and

5. Philippine College of Surgeons (PCS) Recommendations for the Rational and Effective Use of Personal Protective Equipment.[21]

According to the Department of Health (DOH) Memo No. 2020-0220, returning doctors and staff should be checked daily for temperature and influenza-like symptoms, observe hand hygiene, social distancing, and cough etiquette. Symptomatic health personnel should not be allowed entry into the health facility until given clearance by a primary care provider or the local health office. Health personnel who test IgM negative and IgG negative, or IgG positive regardless of IgM results may continue to work.

For definition purposes in this document, suspect is defined as persons under investigation (PUI) with no confirmed or awaiting COVID-19 test results; probable as PUI with inconclusive test results; while confirmed refer to those with positive COVID-19 test results.

Retinal Surgery under Local/Regional Anesthesia

A. Before the Day of the Surgery

   i. Consider the vulnerability and increased risk of the patient for developing severe symptoms from COVID-19 infection[22] versus risk of vision loss from deferral of surgery.

   ii. Prescreen and call the patients before the scheduled day of vitreoretinal surgery

      1. Identify risk factors such as history of travel to hot zone areas, history of exposure to suspect, probable or confirmed COVID-19 patients in the last 2-14 days, presence of symptoms such as cough, fever, chills, sore throat, difficulty of breathing, muscle pain, loss of taste or smell, diarrhea, headache, conjunctivitis.[23]

      2. Remind patients about hand hygiene, wearing masks, and maintaining physical distancing of at least 6 feet.[24]

   iii. Consider COVID-19 testing, preferably RT-PCR, in all patients scheduled for retinal surgery under local/regional anesthesia. All COVID-19 testing results should always be correlated with the patients history, risk factors, and presence or absence of symptoms. It is important to remind the patient to quarantine himself/herself in the interim period between the test and the day of surgery. If patient is unable to undergo COVID-19 testing, appropriate precautions and evidence-based infection prevention techniques should be considered.[20] Please check the operating room guidelines for procedures in your respective institutions, surgical protocols may vary.[20]

   iv. Medical or cardiopulmonary clearance may be needed based on the presence of co-

morbidities and according to the respective hospital guidelines.

v. Deferment of the surgery among suspect, probable or confirmed COVID-19 patients is recommended, except in cases with a high risk of irreversible vision loss within a short period of time (e.g. retinal detachment, endophthalmitis). If deferment is not possible, instruct the patient to proceed according to the respective hospital guidelines regarding confirmed COVID-19 cases. Co-management with an infectious disease specialist may be considered.

B. On the Day of the Surgery

i. Screen patient for COVID-19-related signs and symptoms.

ii. All patients must wear surgical masks at the waiting area.

iii. Maintain physical distancing of at least 6 feet in the waiting room.

iv. Adequate ventilation at the waiting area (at least 6 to 12 air changes per hour) is suggested. Consider using high-efficiency particulate air (HEPA) filters to improve air quality.[25]

v. Prevent overcrowding in the waiting room.

vi. Provide alcohol-based hand sanitizers at the waiting area.

vii. Minimize the waiting time of the patient.

viii. Meticulous disinfection of the waiting area is recommended.

C. Intraoperative Considerations

i. At this time, there is little evidence to prove whether pars plana vitrectomy (PPV) is an AGP or not. As a precautionary principle, we will consider PPV as an AGP since it falls in the category of "surgery in which high speed devices are used".[26] Scleral buckling and pneumatic retinopexy are not considered AGPs.

In a video demonstration by the London Eye Consultants, non-valved cannulas/trocars seem to produce less droplets than valved cannulas. No aerosol generation was noted with either valved or non-valved cannulas on the video.[27]

ii. Povidone-iodine is known to deactivate SARS-CoV.[28,29] Although there is no specific evidence regarding its effectivity against SARS-CoV-2, it is recommended that topical povidone-iodine drops be applied to the conjunctival fornices for two minutes prior to the procedure.

iii. In local anesthesia cases, the presumed aerosol generating segment of PPV will either be during vitrectomy or air-fluid exchange, thus the risk of aerosol exposure prior to starting the procedure is low to non-existent. Thus, full body personal protective equipment (PPE) or hazmat suits are optional for local anesthesia cases.

iv. While performing a retrobulbar block, please ensure that the patient is wearing a mask (surgical or N95 mask).[30] The use of disposable gloves is recommended when touching the patient's eye. Oxygen supplementation may be given via a nasal cannula under the mask. Alternatively, an oxygen mask may be used and a surgical mask placed over it. Taping the edges of the mask is suggested.

v. The surgeon has the option of using extra microscope draping as necessary. A sterile plastic draping technique proposed by Dr. Rodrigo Anguita can be found in the May 2020 issue of *Eye*.[31] Another double draping technique using cloth this time was demonstrated by Dr. Aman Chandra on the *Euro Times* website also in May 2020.[32]

vi. For non-COVID-19 patients undergoing a non-aerosol generating procedure (scleral buckling, pneumatic retinopexy), the following guidelines may be observed:

1. The ophthalmologists and operating room staff should be wearing a surgical mask, disposable gloves, a surgical cap, and a disposable fluid resistant surgical gown during the surgery. Wearing of a face shield or goggles is optional.[33,34]

2. Supplemental oxygen under low flow

can be delivered under a surgical mask via nasal cannula or an oxygen mask.[35] Taping the edges of the surgical mask or oxygen mask is suggested.

3. Use sterile fluid-resistant disposable drapes with adhesives to ensure that the edges of the opening are sealed.

vii. For non-COVID-19 patients undergoing an aerosol generating procedure (PPV), the recommendations are:

1. The ophthalmologist and operating room staff should be wearing eye protection (face shield or goggles), an N95 mask or an equivalent filtered respirator, disposable gloves, a surgical cap, shoe covers, and a disposable fluid resistant surgical gown during the surgery.[33,34]

2. The rationale for wearing an N95 mask or its equivalent is purely precautionary. As the COVID-19 RT-PCR tests do not provide a 100% specificity rate, we recommend wearing an N95 mask in the unlikely event that the patient may be a false negative case.

3. Supplemental oxygen can be delivered under a surgical mask via nasal cannula or an oxygen mask.[35] Taping the edges of the surgical mask or oxygen mask is suggested.

4. Use sterile fluid-resistant disposable drapes with adhesives to ensure that the edges of the opening is sealed

viii. For suspect, probable and confirmed COVID-19 patients undergoing either an AGP or non-AGP, the recommendations are:

1. Defer the surgery if possible.

2. The operating room must be informed in advance of a patient transfer of a confirmed or possible COVID-19 positive case.

3. The case must preferably be performed in an operating room designated for suspect, probable or confirmed COVID-19.

4. Suspect, probable or confirmed cases of COVID-19 should be placed at the end of the list where feasible.

5. For patients with probable or confirmed COVID-19, any of these potentially infectious AGPs should only be carried out when essential. Where possible, these procedures should be carried out in a single room with the doors shut. Only those healthcare staff who are needed to undertake the procedure should be present. Once vacated by staff following an AGP, leave the room for 5 minutes before cleaning.[36]

6. The ophthalmologist and operating room staff should be wearing eye protection (face shield or goggles), an N95 mask or an equivalent filtered respirator, disposable gloves, a surgical cap, shoe covers, and a disposable fluid resistant surgical gown during the surgery.[33] Full body PPEs may be used, and these must be donned prior to first encounter with the patient.[37] It is important to note that when full body PPEs are worn, it will no longer be possible to scrub prior to donning the surgical gown. Therefore, it is best for the surgeon to consider the risks and benefits of wearing full PPE in the operating room set-up.[38]

7. Patients must wear an N95 mask or equivalent filtered respirator at all times.[35,39] Care must be taken when supplemental oxygen through a nasal cannula is inserted under the N95 mask. Alternatively, an oxygen mask may be used and a surgical mask placed over it.[35] Taping the edges of the mask is recommended.

8. Use sterile fluid-resistant disposable drapes with adhesives to ensure that the edges of the opening is sealed.

ix. PPE should be put on and removed in an order that minimizes the potential for self-contamination. The order for PPE removal

is (i) gloves, (ii) hand hygiene, (iii) gown, (iv) goggles, (v) surgical mask and N95 mask and (vi) hand hygiene.[40]

x. It has been shown that the risk of transmission is highest during the doffing of PPE. Extra time should be allowed for donning and doffing. The presence of an observer during the donning and doffing procedure is highly recommended. Simulation sessions should be conducted for training staff in donning and doffing of PPE.[35]

xi. Proper and thorough disinfection of the operating room theater as prescribed by the infection control committee of the health facility should be done after every case

D. Postoperative Considerations

i. Provide patients with postoperative instructions including the next follow-up visit. Try to minimize the number of follow up visits postoperatively, unless a complication is noted.

ii. Remind the patient about the safety measures to lessen the risk of contracting COVID-19 infection.

iii. Provide a contact number just in case he or she develops changes in vision and signs and symptoms of COVID-19 infection.

Retinal Surgery under General Anesthesia

A. Before the Day of the Surgery

i. Consider the vulnerability and increased risk of the patient for developing severe symptoms due to COVID-19 infection[22] versus the risk of vision loss from deferral of surgery.

ii. Prescreen and call the patients before the scheduled day of vitreoretinal surgery.

1. Identify risk factors such as history of travel to hot zone areas, history of exposure to suspect, probable or confirmed COVID-19 patients in the last 2-14 days, presence of symptoms such as cough, fever, chills, sore throat, difficulty of breathing, muscle pain, loss of taste or smell, diarrhea, headache, conjunctivitis.[23]
2. Remind patients about hand hygiene, wearing masks, and maintaining physical distancing of at least 6 feet.[24]

iii. Consider COVID-19 testing, preferably RT-PCR, in all patients scheduled for retinal surgery under general anesthesia. All COVID-19 testing results should always be correlated with the patient's history, risk factors, and presence or absence of symptoms. It is important to remind the patient to quarantine himself/herself in the interim period between the test and the day of surgery. If a patient is unable to undergo COVID-19 testing, appropriate precautions and evidence-based infection prevention techniques should be considered.[20] Please check the operating room guidelines for procedures in your respective institutions, surgical protocols may vary.

iv. Medical clearance should be a multidisciplinary approach. Cardiopulmonary clearance and anesthesiology clearance may be obtained in accordance with health facility guidelines.

v. Suspect, probable or confirmed COVID-19 patients who need emergency surgery under general anesthesia should at least be co-managed with an infectious disease specialist or an internist with knowledge in managing COVID-19 cases.

vi. For confirmed COVID-19 patients, elective surgical procedures under general anesthesia should be delayed until the patient is no longer infectious and has recovered from COVID-19 infection.

B. On the Day of the Surgery

i. Screen patient for COVID-19-related signs and symptoms.

ii. All patients must wear surgical masks at the waiting area.

iii. Maintain physical distancing while in the waiting room for out-patient cases.

iv. Adequate ventilation at the waiting area (at least 6 to 12 air changes per hour) is

suggested. Consider using high-efficiency particulate air (HEPA) filters to improve air quality.[25]

v. For in-patient cases, the patient should only be transferred to the operating room when the surgeon and staff have fully prepared the machine, instruments, and materials necessary for the surgery. Vitrectomy and laser machines should be checked to minimize the movement of the staff in and out of the room while the operation is ongoing.

vi. Strict staff safety protocol should be observed at all times (frequent hand washing, alcohol sanitizers, and disinfection of waiting rooms are recommended).

vii. Operating room attire/PPE:

1. The patient should be in a hospital gown, surgical cap and surgical mask.

2. All surgeries under general anesthesia are considered as AGP.[41] Whether the patient is suspect, probable, or confirmed COVID-19 or negative, the use of level 4 PPE is recommended.[21] This includes a N95 mask, goggles or face shield, double gloves, surgical cap, full body PPE, dedicated shoes and shoe covers. However, the surgeon is advised to consider the risks and benefits of using full PPE in the operating room set-up.[38]

vii. Surgeon should go through the patient checklist which may include: (1) COVID-19 test results; (2) COVID-19 questionnaire with patient's signature; (3) cardio-pulmonary clearance; (4) infectious disease clearance (if applicable); and (5) Signed consent form for the procedure.

C. Intra-operative Considerations

i. During General Anesthesia Induction

1. During induction of general anesthesia, Philippine Society of Anesthesiologists (PSA) guidelines must be followed.[20]

2. Minimize personnel during the aerosolizing procedure. The surgeon and the members of the surgical team not involved in the intubation, an AGP, should stay out of the operating room while intubation is ongoing.

3. Allow 18-28 minutes until the air turnover is adequate to clear potential viral particles before entering the operating room presuming that the operating room has 15 air changes/hour. Identify the room size and air exchange rate in your specific facility.[42]

ii. During Actual Operation

1. Team dynamics should be strictly followed. There should be a clear delineation of roles.

2. Povidone-iodine is known to deactivate SARS-CoV.[28,29] Although there is no specific evidence regarding its effectiveness against SARS-CoV-2, it is recommended that topical povidone-iodine drops be applied to the conjunctival fornices for two minutes prior to the procedure.

3. Monitoring by all team members during the procedure must be observed to check for potential contamination.

4. In a YouTube video created by London Eye Consultants, non-valved trocars seem to produce less droplets than valved ones. No visible aerosol generation was observed with either valved or non-valved cannulas on the video.[27]

5. The surgeon has the option of using extra microscope draping as necessary. A sterile plastic draping technique proposed by Dr. Rodrigo Anguita can be found in the May 2020 issue of *Eye*.[31] Another double draping technique using cloth this time was demonstrated by Dr. Aman Chandra on the *Euro Times* website in May 2020.[32]

iii. During General Anesthesia Extubation

1. During extubation of general anesthesia, PSA guidelines must be followed.

2. Minimize personnel during the AGP. Surgeons and other members of the surgical team not involved in the extubation procedure should stay out of the operating room while extubation is ongoing.

D. Post-Operative Considerations

i. Strict adherence to proper doffing procedure. The presence of an observer during donning and doffing procedure is highly recommended.

ii. Provide patients with postoperative instructions including the next follow-up visit.

iii. Remind the patient about the safety measures to lessen the risk of contracting COVID-19 infection.

iv. Provide a contact number just in case he or she develops changes in vision and signs and symptoms of COVID-19.

Intravitreal Injections

A. Before the Day of the Injection

i. Consider the vulnerability and increased risk of the patient for developing severe symptoms due to COVID-19 infection[22] versus the risk of vision loss from deferral of injection.

ii. Prescreen and call the patients before the scheduled day of intravitreal injection.

1. Identify risk factors for COVID-19 such as history of travel to hot zone areas, history of exposure to suspect, probable or confirmed COVID-19 patients in the last 2-14 days, presence of symptoms such as cough, fever, chills, sore throat, difficulty of breathing, muscle pain, loss of taste or smell, diarrhea, headache, conjunctivitis.[23]

2. Remind patients about hand hygiene, wearing masks, and maintaining physical distancing of at least 6 feet.[24]

3. During the call, discuss the following: (1) the procedure, (2) what to expect, and (3)the post-injection instructions to shorten face-to-face conversation and minimize the time spent in the clinic.

iii. Since intravitreal injection is a 5-10 minute procedure with low risk of generating aerosol[41,43] and done under topical anesthesia, routine COVID-19 testing is not mandatory. COVID- 19 testing is recommended in patients with risk factors of having the infection. As stated above (A.ii.1).

iv. If indicated, consider bilateral injection on the same day to minimize hospital visits.[44]

v. Deferment of the intravitreal injection for suspect, probable or confirmed COVID-19 patients is recommended except in cases with high risk of vision loss and when time element is essential (e.g., endophthalmitis). If postponement of the injection is not possible, instruct the patient to proceed to the area designated for suspect, probable and confirmed COVID-19 patients.

B. On the Day of the Injection

i. Screen patient for COVID-19-related signs and symptoms.

ii. All patients must wear surgical masks at the waiting area.

iii. Maintain physical distancing of at least 1 to 2 meters at the waiting room.

iv. Prevent overcrowding at the waiting area.

1. Space out appointments between patients.

2. Limit companion to one per patient.

3. Adequate ventilation at the waiting area (at least 6 to 12 air changes per hour) is suggested. Consider using HEPA filters to improve air quality.[25]

v. Provide alcohol-based hand sanitizers at the waiting area.

vi. Minimize the waiting time of the patient.

vii. Meticulous disinfection of the waiting area is recommended.

C. Intraoperative Considerations

i. Perform the intravitreal injection technique as recommended by the VRSP.[45]

ii. Povidone-iodine is known to deactivate SARS-CoV.[28,29] Although there is no specific evidence regarding its effectivity against SARS-CoV-2, it is recommended that topical povidone-iodine drops be applied to the conjunctival fornices for two minutes prior to the procedure.

iii. Adequate ventilation in the operating room or designated room for intravitreal injections (at least 6 to 12 air changes per hour). Consider using HEPA filters to improve air quality.[25]

iv. For bilateral same-day injections, each eye should be prepared with povidone-iodine separately. Two separate sets of sterile eye sheet, lid speculum, instruments, 30-gauge needle and syringe should be utilized. Whenever feasible, separate vials of medication with different lot numbers should be used for each eye.[45]

1. Non-COVID-19 or Low-Risk Patients

a. The ophthalmologist should be wearing goggles or face shield, surgical mask or N95 mask, and gloves during the injection.[46,47] Wearing of disposable water-resistant gown is optional.

b. The patient should be wearing a surgical mask during the procedure. An adhesive tape may be used to hold the mask across the cheeks and the bridge of the patient's nose. Consider using sterile fluid-resistant disposable drapes with adhesive or washable fabric drapes.

2. Suspect, Probable or Confirmed COVID-19 Patient

a. Defer the procedure if possible until the patient is non-infectious or fully recovered from COVID- 19 infection.

b. If the injection cannot be deferred (e.g., endophthalmitis), perform the intravitreal injection in the operating room theater designated for suspect, probable or confirmed COVID-19 patients.

c. The ophthalmologist should be wearing a surgical cap, goggles, face shield, N95 mask, disposable water-resistant gown, shoe covers, and gloves during the injection.[46] Level 3 or 4 PPE is recommended.

d. Patient should be wearing a N95 mask during the injection.

e. Use sterile fluid-resistant disposable drapes with adhesives to ensure that the edges of the opening are sealed.

3. PPE should be put on and removed in an order that minimizes the potential for self-contamination. The order for PPE removal is (i) gloves, (ii) hand hygiene, (iii) gown, (iv) goggles, (v) surgical mask and N95 mask, and (vi) hand hygiene.[40]

4. It has been shown that the risk of transmission is highest during the doffing of PPE. Extra time should be allowed for donning and doffing. The presence of an observer during the donning and doffing procedure is highly recommended. Simulation sessions should be conducted for training staff in donning and doffing of PPE.[35]

5. Proper and thorough disinfection of the operating room theater or room designated for injections as prescribed by the infection control of the health facility.

D. Post-Operative Considerations

i. Provide patients with post-injection instructions including the dates of next follow-up visit and next injection.

ii. Remind the patient about the safety measures to lessen the risk of contracting COVID-19 infection.

iii. Provide a contact number just in case he or she develops changes in vision and signs and symptoms of COVID-19.

Retinopathy of Prematurity Treatment Procedures

Retinopathy of prematurity (ROP) is an important cause of avoidable childhood blindness in the world and treatment, if warranted, is time-sensitive. For some low-risk neonates, the interval of screening may be lengthened to minimize patient visits. However, delaying treatment for infants meeting the criteria can be detrimental. The Philippine Academy of Ophthalmology-ROP Working Group (PAO- ROPWG) recommends treatment of infants with Type 1 ROP within 72 hours of diagnosis. Type 1 ROP is defined as follows: Zone I, any stage ROP with plus disease; Zone I, stage 3 without plus disease; and Zone II, stage 2 or 3 with plus disease. Aggressive posterior ROP (APROP) should be treated as soon as possible within 48 hours of diagnosis.[48]

The PAO-ROPWG recommends ablation of peripheral avascular retina using laser indirect ophthalmoscope (LIO) or intravitreal anti-vascular endothelial growth factor (anti-VEGF) injection as an adjunct to LIO or as primary treatment for very aggressive ROP.[48]

The decision to treat and choose which treatment modality is best for the infant rests upon the clinician. However, in the course of ROP treatment, the following points should be considered during the pandemic:[49] (1) infants and toddlers can be asymptomatic carriers or in pre-symptomatic period of transmission; (2) implementing source control measures like face mask and social distancing in this age group is difficult; (3) crying increases the risk of aerosol generation and transmission; and (4) proximity of these patients to caregivers, along with sustained crying, might further increase the risk and load of aerosol.

A. Before the Procedure[50]

i. Ensure that eye center or operating room staff are oriented about standard precautions, regardless of infection status and these include the following:

1. Hand hygiene

2. Use of PPE (e.g., gloves, gown, mask, goggles/face shield)

3. Safe handling of potentially contaminated equipment and surfaces

4. Respiratory hygiene/ cough etiquette

ii. Screening Prior to Scheduling of Procedure

1. Infants requiring treatment for ROP are usually already known to the treating ophthalmologist. Therefore, infection status of the neonate might have already been taken into consideration, especially if still in the neonatal intensive care unit setting. Inform attending pediatrician of plan for treatment, and if necessary, secure clearance.

2. For outpatient treatment, prescreen and triage patients through digital/telehealth methods prior to actual visit.

3. Ask for the following symptoms of acute respiratory infection within the past 14 days: fever (axillary temperature >38°C), cough, difficulty of breathing.

   a. Other symptoms for preterm infants may include poor feeding or 'milk refusal', lethargy, vomiting, diarrhea, and abdominal distention.[51]

   b. If positive for any of the above symptoms, refer to attending pediatrician for evaluation and clearance. However, emphasize the urgency of the treatment to both the parents and pediatrician. Treatment schedule must adhere to recommendations.

4. Ask for exposure history. Evaluate if the infant has been in close contact with sick individuals, whether from home or during travel, who are proven COVID-19 patients or highly suspected of COVID-19. Refer to attending pediatrician accordingly.

5. Prescreen caregivers for risk factors. Ask for the presence of the following within the past two weeks: cough, shortness of breath, colds, throat pain, headache, muscle and joint pain, diarrhea, lack of smell or taste; fever more than 38°C; history of COVID-19 infection; household member diagnosed with COVID-19; travel or residence in an area reporting local transmission of COVID-19; and contact or exposure to

someone with recent travel to an area with local transmission of COVID-19 . If any of the risk factors are present, refer to emergency room triage for COVID-19 testing.[25]

6. Please note that whatever the infection or exposure status of the infant, parents, or caregivers, all efforts to facilitate treatment scheduling must be done as treatment cannot be delayed so much.

7. Perform additional pre-procedure screening on the day of the Procedure

    a. Infants with COVID-19-related symptoms and history of exposure during pre-appointment screening should be referred back to pediatrics for appropriate management. However, emphasize the urgency of the treatment to both the parents and pediatrician. Treatment schedule must adhere to recommendations.

    b. Upon arrival, check the temperature of the infant and the caregiver.

    c. Require all personnel and visitors to wear surgical masks that cover mouth and nose, except the neonate/infant (<2 years of age).

    d. Limit non-patient visitors, companions, and caregivers. In the case of ROP management, limit to one caregiver only.

B. During the Procedure

    i. Intravitreal injection for non-COVID-19 or low-risk infants

        1. Procedure may be done under topical or general anesthesia. If under general anesthesia, consider appropriate PPE for AGPs. Please note that the discussion of the risks of general anesthesia to preterm infants is beyond the scope of these recommendations.

        2. Perform the injection according to the guidelines of the VRSP,[45] with special anatomic considerations. For infants,[52] half of the adult dose for intravitreal injection is injected into the eye 0.5 to 1 mm posterior to the limbus in a vertical direction to avoid hitting the lens. If the other eye is to be treated, a new set of instruments is used.

        3. Drapes and masks are not recommended because of risk of suffocation to the infant.[53]

        4. Despite the short duration of the procedure, the proximity of the surgeon and staff to the infant is less than two meters. Therefore, the following level 3 PPEs[21,25] are recommended for the surgeon and staff holding the infant: N95 mask or its equivalent, goggles or face shield, gloves, surgical cap, scrub suits, gowns (or coveralls), shoe covers; plus sterile gloves for the surgeon.

    ii. Intravitreal injection for suspect, probable or confirmed COVID-19 infants

        1. After clearance and coordination with Pediatrics, the treatment must be carried out despite infection status since delay in treatment can be potentially blinding.

        2. Procedure may be done under topical or general anesthesia. If under general anesthesia, consider appropriate PPE for AGPs. Please note that the discussion of the risks of general anesthesia to preterm infants is beyond the scope of these recommendations.

        3. Perform the injection according to the guidelines of the VRSP[45] with special anatomic considerations.

        4. Drapes and masks are not recommended because of risk of suffocation to the infant.[53]

        5. Despite the short duration of the procedure, the proximity of the surgeon and staff to the infant is less than two meters. Level 4 PPEs[21,25] are recommended for the surgeon and staff holding the infant: N95 mask or its equivalent, goggles or face shield, double gloves, surgical cap, scrub suits, dedicated

shoes, shoe covers; plus sterile gloves for the surgeon. Coveralls are optional because of concerns for infection during doffing, and danger of suffocation.[38]

iii. Laser indirect ophthalmoscopy (LIO) for non-COVID-19 or low-risk infants

1. Procedure may be done under topical or general anesthesia. If under general anesthesia, consider appropriate PPE for AGPs. Please note that the discussion of the risks of general anesthesia to preterm infants is beyond the scope of these recommendations. Efforts to ensure adequacy of treatment must be done to minimize possibility of re-treatment.

2. Minimize number of people inside the operating room or facility where you normally perform LIO.

3. Although vertical transmission has not been documented, the infant's exposure after discharge cannot be ascertained. Therefore, the surgeon and the assistants who are in close proximity to the infant must wear the following level 3 PPE:[21,25] N95 mask or its equivalent, goggles or face shield, gloves, surgical cap, scrub suits, gowns (or coveralls), and shoe covers. Since the procedure requires excellent view for the surgeon, the face shield may be omitted and replaced with an acrylic shield barrier attached to the indirect ophthalmoscope. The PPE goggles for the assistant should be replaced with recommended laser protection goggles during the procedure.

4. There is no evidence on the benefit and safety of acrylic aerosol boxes for use in the treatment of ROP. These acrylic boxes were initially made for use by anesthesiologists during intubation. However, there were concerns on the ease of use[54] and risks to healthcare workers when the PPE gets damaged.[55] In the context of ROP management, the use of acrylic boxes may preclude the surgeon's view of the retina and may lengthen the procedure time. The team should therefore focus on the appropriate PPEs recommended for this particular procedure.

5. During the procedure, minimize conversations among the staff.

6. After the procedure disinfect all equipment, lenses, speculum, and scleral depressor.

iv. LIO for suspect, probable or confirmed COVID-19 infants

1. For ROP, treatment cannot be delayed despite infection status.

2. The above recommendations apply.

3. Monitoring by the attending pediatrician is encouraged.

4. As regards PPE, the surgeon and assistants should wear a level 4 PPE:[21,25] N95 mask or its equivalent, goggles or face shield, double gloves, surgical cap, scrub suits, dedicated shoes, and shoe covers. Coveralls are optional because of concerns for infection during doffing, and danger of suffocation.[38]

C. After the Procedure

Follow up for ROP infants post-treatment should not be modified on account of COVID-19 since ROP warranting treatment is potentially blinding. Monitoring the status of the retinopathy is paramount. Adjustments to surgeon's set-up must be done to work around the urgency of monitoring and this includes standard precautions, wearing of masks for parents and caregivers, social distancing, and, as much as possible, allowing only one caregiver in the clinic.

D. ROP Treatment in the Neonatal Intensive Care Unit (NICU)

Neonates admitted at the NICU usually have known infection classification: suspect, probable, or confirmed.[51] Adhere to the NICU guidelines on standard precautions. The same recommendations as above apply for intravitreal injection and LIO for infants still admitted at the NICU.

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