Original Article

Incidence of SARS-CoV-2 Infection among Healthcare Personnel after Restarting an Elective Cataract Surgery during the First COVID-19 Wave

Ploysai Rujkorakarn MD[1], Samadhi Patamatamkul MD[1], Parinya Srihatrai MD[1], Suttida Wijitpan MD[1], Kes Srisawangwong MD[1], Watanyu Chinpakdee MD[1]

[1] Suddhavej Hospital, Faculty of Medicine, Mahasarakham University, Mahasarakham, Thailand

Background: During the COVID-19 pandemic, most elective surgeries were postponed, including cataract surgery. However, patients with severe and disabling visual impairment may have required urgent correction.

Objective: To report the incidence of SARS-CoV-2 infection among healthcare personnel working with the patients requiring cataract surgery, under a pre-operative screening protocol.

Materials and Methods: A retrospective observational study was conducted in the Suddhavej Hospital, Mahasarakham University, Mahasarakham, Thailand during the early unlocked phase in May 2020. The local pre-operative screening protocol used during the period included questionnaires and pre-operative nucleic acid testing to screen for COVID-19 infection among patients. A combination of serial single nucleic acid test and SARS-CoV-2 IgG antibody testing were used to screen SARS-CoV-2 infection among healthcare personnel. Mask wearing and physical distancing were required during hospitalization.

Results: One hundred fifty-eight patients underwent cataract surgery under local anesthesia. Thirty-three healthcare personnel were included. All tests for SARS-CoV-2 were negative for both patients and healthcare personnel. The incidence rate of COVID-19 infection among healthcare personnel was 0 (95% CI 0.000 to 0.003) per 100 person-hours. There were no reported symptoms compatible with COVID-19 during the observed period and follow-up.

Conclusion: Due to a very low incidence rate of hospital-acquired SARS-CoV-2 infection among healthcare personnel, elective cataract surgery under local anesthesia could be continued during COVID-19 pandemic with strict adherence to screening protocol and other preventive measures. SARS-CoV-2 screening method by questionnaire alone may be feasible in a low COVID-19 incidence rate.

Keywords: Cataract surgery; COVID-19; Pre-operative SARS-CoV-2 screening; Pool PCR testing; In-hospital transmission

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Cataract is one of the leading causes of reversible blindness in developing countries, including Thailand[1]. During the coronavirus disease 2019 (COVID-19) pandemic, elective surgeries were typically postponed to prevent the transmission of the virus. Eye surgeries in Europe and the USA decreased by 90%[2,3], whereas patients with cataracts in Thailand were placed on a waiting list for eye surgery. While cataract surgery is elective in most cases, patients with severe and disabling visual impairment may require urgent correction. Delay in performing cataract surgery can result in negative impacts on many health aspects including falls, fractures, accidents, and other neuropsychiatric problems[4-6].

Post-operative severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infections and in-hospital transmissions associated with eye surgery have been suggested as theoretical risks. Detection of SARS-CoV-2 nucleic acid in the aqueous humour and conjunctival swabs from COVID-19 patients has been reported[7,8]. At the time of the first COVID-19 wave, there was no definitive evidence-based protocol in Thailand on how to safely perform elective cataract surgery during the pandemic. Although, the COVID-19 case counts was gradually decreasing after the initial unlocked phase in Thailand in early May

Correspondence to:

Rujkorakarn P.

Suddhavej Hospital, Faculty of Medicine, Mahasarakham University, Mahasarakham 44000, Thailand.

Phone: +66-43-021021, **Fax**: +66-43-722991

Email: ploysai.r@msu.ac.th

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2020, there was still a concern among the surgeons over the risk of acquiring SARS-CoV-2 infection peri-operatively. With the early healthcare-associated COVID-19 death among ophthalmologists in Wuhan, ophthalmologists around the world were reported of acquiring COVID-19[9]. These data raised fear among healthcare personnel owing to the limited data regarding the peri-operative transmissibility of COVID-19 during that period[10].

In Mahasarakham Province, there were only two ophthalmology referral centers able to operate the cataract surgery, Suddhavej Hospital and Mahasarakham Hospital. Moreover, cataract surgery was ranked the highest performed surgery in Suddhavej Hospital prior to the pandemic, and therefore, the service was completely disrupted during the first COVID-19 wave. Until May 2020, Suddhavej Hospital, Mahasarakham University, was the only center in the province with approval to perform nucleic acid tests for SARS-CoV-2. The local infection committee in Suddhavej Hospital, therefore, implemented a pre-operative SARS-CoV-2 screening protocol involving multiple aspects including universal pre-operative nucleic acid testing prior to all surgeries including cataract surgery. The infection control committee also approved a SARS-CoV-2 screening protocol for healthcare personnel involved with the surgery during the first COVID-19 wave to ensure maximal safety. With the availability of laboratory center in the authors' hospital and the local infection control protocol, cataract surgery was able to resume right after the initial unlocked phase in early May 2020.

In the present study, the authors demonstrated the real-life incidence of SARS-CoV-2 infection among healthcare personnel working with patients requiring cataract surgery under a pre-operative screening protocol implemented by the local infection control committee in the authors' center.

Materials and Methods

Study design and setting

The authors conducted a retrospective study to demonstrate the incidence of SARS-CoV-2 infection among healthcare personnel involved in an elective cataract surgery. All cataract surgeries were performed under a pre-operative protocol to screen for SARS-CoV-2 and to prevent in-hospital SARS-CoV-2 transmission. The infection control committee of the present study hospital implemented the pre-operative protocol. The study was conducted at Suddhavej Hospital at Mahasarakham University in Mahasarakham, Thailand, between May 1 and May 31, 2020. At the start of the observed period, there were 2,960 confirmed cases of COVID-19 in Thailand, with one confirmed case in the Mahasarakham Province. No additional confirmed cases during the observed period were reported in the province. The Mahasarakham University's Ethics Committee for Research Involving Human Subjects approved the present study (No. 377-375/2564). Consents were waived.

Study participants

The purposive sample included 33 healthcare personnel worked in the ophthalmology outpatient clinic, in-patient ophthalmology ward, and operating room. They were three ophthalmologists, 22 registered nurses, and eight nurse assistants. One hundred fifty-eight patients underwent cataract surgery for severe visual impairment.

Pre-operative protocol for patients during each phase

There were three phases implemented during the study period. The first phase lasted two weeks, the second phase lasted one week, and the third phase also lasted one week. All patients gave their consents to attend surgery and were willing to comply with the local infection protocol in each phase to ensure the safety for both patients and healthcare personnel.

In the first phase, which was the first two weeks, the authors tested for SARS-CoV-2 twice on 67 patients, three days and one day before surgery, by nasopharyngeal-throat swabs. They also had a chest x-ray, body temperature measured, and questionnaire screening. The authors used the time points of day 3 and day 1 to ensure the highest sensitivity of SARS-CoV-2 detection. The nasopharyngeal-throat swabs for SARS-CoV-2 were analyzed by real-time reverse transcriptase polymerase chain reaction (rRT-PCR), by pooled specimens from five patients for a single pooled PCR test.

Once the results from the first phase were verified negative, the authors proceeded to the second phase, which was week 3, testing 48 new patients, first by phone interview three days before surgery, then performing a nasopharyngeal-throat swab only on day 1 before surgery. The day before surgery, they had a chest X-ray, took body temperature, and questionnaire screening. After confirming all swabs from the second phase were negative, the authors proceeded to phase three, which was week 4. On the 43 new patients, the authors omitted testing by the swab.

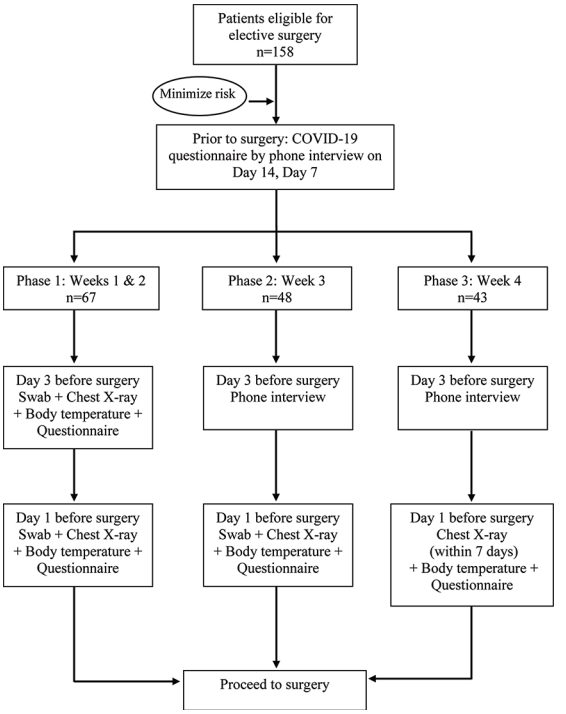

Figure 1. Pre-operative protocol during each phase of the study.

In all three phases, fourteen days prior to their respective surgery, the authors asked all patients and their relatives to remain in their hometowns. During this period, the authors interviewed patients by phone three times, such as 14, 7, and 3 days prior to surgery, and inquired about typical COVID-19 symptoms using a questionnaire. If any deviation from this protocol or any abnormal symptom consistent of COVID-19 was reported, the surgery was postponed. The questionnaire was used to collect demographics, possible COVID-19 symptoms, travel history, contacts, and co-morbidities. Figure 1 displayed the screening strategies taken across three phases over the four weeks.

The one relative per patient allowed in the in-patient ward during hospitalization was required to wear a surgical or cloth face mask. In the patient ward, beds were separated by two meters. Healthcare personnel were restricted to working in the study ward and out-patient clinic. Surgical masks were worn by healthcare personnel in the outpatient and in-patient treatment areas, gowns and gloves were worn only in the operating room.

Surgical procedure protocol

On the day of the surgery, few patients were allowed in the waiting room. All patients were required to maintain a physical distance of at least two meters and to wear face masks. During the operation, 10% povidone-iodine was used for periorbital skin preparation and 5% povidone-iodine was used to instill in the operated-upon eye as a standard of care. The patient's face was covered with a sterile drape to prevent the flow of exhaled breath. Techniques of cataract surgery depended on the surgeons' decisions.

Study outcome and measures

The primary outcome was the incidence rate of COVID-19 infection among healthcare personnel and defined as either positive rRT-PCR from nasopharyngeal-throat swabs or SARS-CoV-2 IgG seroconversion. Exposure was based on 1) the retrospective self-report of the number of patients each healthcare personnel took care of during hospitalization and 2) hours of contact with each patient. Exposure time was counted as eight hours per shift for the in-patient unit. Estimated time of contact with patients included time during an interview, history taking, physical examination, surgical procedure in the operating room, and pre- and post-operative care. The exposure time record was required according to the infection control protocol during the observed period.

Healthcare personnel were screened for SARS-CoV-2 from nasopharyngeal-throat swabs every week during the observed period using the rRT-PCR method. Single PCR testing was conducted for healthcare personnel. Universal mask wearing was required at all times, and they were expected to remain in the province during the study. They were also tested for SARS-CoV-2 IgG at baseline before implementing the protocol, two weeks after the start of the protocol, and six weeks after the start of the protocol, which was two weeks after the observed period.

Laboratory tests

Prior to RNA extraction, the authors pooled the samples with at least 40 µL of viral transport media from each patient and 200 µL of viral transport media for a single PCR testing. All specimens were manually extracted according to the manufacturer's instruction, and the elution underwent rRT-PCR using Gene aid Viral Nucleic Acid Extraction Kit II (Seoul, Republic of Korea), and primers targeting E gene, RNA-dependent RNA polymerase (RdRp) gene and N gene using Allplex™ 2019-nCoV assay approved by Korea Centers for Disease Control and Prevention and U.S. Food and Drug Administration (FDA). The

Table 1. Number of patients (n=158) and exposure time to patients for each group of healthcare personnel (n=33)

	Healthcare personnel (HCP)			
	Ophthalmologist	Outpatient clinic	Operating room	Ward
No. of patients/week/HCP; median (IQR)	68.75 (50.38, 72.25)	56.13 (10.13, 189.63)	16.5 (16, 19)	32.75 (28, 36)
Exposure to patients in hours/week/HCP; median (IQR)	8.725 (6.27, 12.08)	8.146 (1.02, 15.84)	10.75 (9.13, 10.89)	52.00 (50, 54)

IQR=interquartile range

Table 2. Baseline characteristics of patients in each phase of the study (n=158)

Patient characteristics	Total	Phase 1 (n=67)	Phase 2 (n=48)	Phase 3 (n=43)
Age (years); mean±SD	65.2±8.9	64.6±8.4	64.9±9.57	66.4±8.9
Male; n (%)	66 (41.8)	28 (41.8)	15 (31.3)	23 (53.5)
Comorbidity; n (%)				
Type II diabetes mellitus	58 (36.7)	27 (40.3)	13 (27.1)	18 (41.9)
Hypertension	70 (44.3)	35 (52.2)	17 (35.4)	18 (41.9)
Chronic kidney diseases or end stage renal disease	11 (7.0)	6 (9.0)	3 (6.2)	2 (4.7)
Heart diseases	2 (1.3)	1 (1.5)	0 (0.0)	1 (2.3)
Malignancy	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Others	49 (31.0)	24 (36.4)	12 (25.0)	13 (31.2)

SD=standard deviation

authors performed rRT-PCR using Bio-Rad CFX 96. SARS-CoV-2 IgG antibody was measured using FDA-approved MAGLUMI 2019-nCoV IgG/IgM indirect chemiluminescent immunoassay kit (SNIBE - Shenzhen New Industries Biomedical Engineering Co., Ltd., Shenzhen, China).

Statistical analysis

The authors reported categorical data as frequencies and percentages, and continuous variables as means, standard deviations, medians, and ranges based on distribution patterns. The alpha level was set at 0.05 for statistical significance. Data were analyzed using IBM SPSS Statistics for Windows, version 23.0 (IBM Corp., Armonk, NY, USA).

Results

The median age of healthcare personnel was 28 years (IQR 25, 32). Most were female (88%), and none had any underlying diseases. Median exposure time between ophthalmologists and patients was 8.7 hours/week/ophthalmologist (IQR 6.3, 12.1). Median number of patients was 68.8 patients/week/ophthalmologist (IQR 50.4, 72.3). Table 1 presents the median exposure and number of patients per week per healthcare personnel.

At 14 days before admission, none of the 158 patients had symptoms compatible with COVID-19. The authors did not detect any pattern of COVID-19 from pre-operative chest radiography. All patients had similar baseline characteristics (Table 2). Common comorbidities included Type II diabetes mellitus and hypertension. Among the surgical procedures, phacoemulsification was the most common procedure (n=144, 91%), followed by micro-incision cataract surgery (n=7, 4.5%) and extracapsular cataract extraction (n=7, 4.5%).

The 38 pooled PCR tests from 115 patients during the first and second phases were negative. PCR tests were omitted in the third phase. Healthcare personnel tested negative in each of the four consecutive weekly rRT-PCR nasopharyngeal-throat swabs for SARS-CoV-2. Their two SARS-CoV-2 IgG tests were also negative. The estimated incidence rate of COVID-19 infection among healthcare personnel was 0 (95% CI 0.000 to 0.003) per 100 person-hours. Therefore, there were no differences in infection rates between patients screened by nasopharyngeal-throat swabs plus questionnaire (phase 1 and 2) and those screened by questionnaire only (phase 3). All patients had at least one postoperative clinic visit, and there were no reported complications nor COVID-19 symptoms.

Discussion

The present study is the first study in Thailand that demonstrated the real-life incidence of hospital-acquired SARS-CoV-2 infection among healthcare personnel involved with the patients undergoing

elective cataract surgery during the first COVID-19 wave. There were no differences in infection rates among healthcare personnel whether patients were screened by universal nucleic acid test plus questionnaire or by questionnaire only during the observed period. Due to a very low incidence rate of COVID-19 infection in the present study community, the effectiveness between each SARS-CoV-2 screening strategy could not be compared. However, the authors were able to demonstrate that the protocol implemented by the local infection control committee in the authors' hospital, assisted in the resumption of cataract surgery in authors' center and their province. The volume of cases in the observed period exceeded the pre-pandemic volume of 50 to 100 cataract surgery performed per month by the same number of ophthalmologists. This continued to be higher throughout 2020 compared with the pre-pandemic 2019 period.

The present study results also added to the evidence that a universal nucleic acid testing among patients that underwent cataract surgery, may be omitted in the setting of a low COVID-19 incidence rate, when all other infectious control measures and symptoms screening were done as usual. King Chulalongkorn Memorial Hospital, the tertiary care center in Bangkok with the highest COVID-19 incidence rate in Thailand during the first COVID-19 wave, reported no SARS-CoV-2 nucleic acid test positivity prior to 1,200 surgeries during April 13 to May 31, 2020[11]. Even 20% of cases in the study reported having SARS-CoV-2 exposure risks, none had a detectable pre-procedural nucleic acid test and could proceed to the planned surgery[11]. Patients with symptoms of respiratory tract infection were postponed to surgery and sent for evaluation of possible SARS-CoV-2 infection, similar with the present study protocol[11]. In Japan, the universal pre-operative SARS-CoV-2 nucleic acid test prior to 1,376 patients planned for an elective cardiovascular-thoracic surgery, revealed only one positive test between May 21, and August 1, 2020[12]. During that period, Tokyo had a community SARS-CoV-2 positivity rate of 0.6% to 6.7%[12]. Their protocol postponed all symptomatic patients suspicious of having COVID-19 and patients with any possible SARS-CoV-2 exposure risk, similar with the present study protocol. All these data supported the Department of Medical Services of Thailand guideline during the first COVID-19 wave. The recommendations included questionnaire screening of COVID-19 symptoms and exposure risk without nucleic acid testing prior to an elective non-aerosol generating surgery in the low COVID-19 prevalence or incidence rate area.

Nevertheless, the Infectious Diseases Society of America recommends considering nucleic acid testing in asymptomatic individuals from hot-spot areas with a prevalence greater than 1%[13]. With regards to the recent Delta wave in Thailand, the national data on pre-operative SARS-CoV-2 nucleic acid tests positivity rate ranged from 1% to 5% during the peak in August 2021[14]. The pre-operative nucleic acid tests positivity rate was even higher during the current Omicron wave, reaching as high as 14.38% in February 27, 2022[14]. Hence, a pre-operative universal nucleic acid test should be considered in all elective non-aerosol generating surgery during the widespread of COVID-19 infection. However, cost-effectiveness remains an issue in resource-limited area or countries. A study in Korea reported that pre-operative pool PCR testing compared to single testing resulted in less burden and might be more cost-effective[15]. Based on the present study results and Korea's study, pool PCR testing may be acceptable in areas with limited resources and low COVID-19 incidence rate[15]. Pool PCR tests of up to five samples have been shown to yield a comparable sensitivity to an individual test[16,17]. By using the pool PCR tests in 1,000,000 individuals, it has been estimated that more than US$20 million would be saved given a COVID-19 prevalence of 1%[16]. To date, pre-operative pool PCR testing was reported from the study from Korea and the authors' current study, according to the review of literature[18]. With the approval of pool PCR testing by the Department of Medical Sciences of Thailand, there may be more evidence providing the clearer insight in the utility of this strategy in the pre-operative setting.

The present study results have limitations. First, a yield of universal rRT-PCR screening for SARS-CoV-2 depended on the COVID-19 prevalence and incidence rate in the community. The seroprevalence in the present study province was 1.6% according to unpublished data, and COVID-19 cases were 0.1 per 100,000 individuals during the study period. In addition, the proportion of asymptomatic COVID-19 cases during the initial outbreak in Thailand with GH clades was 13.9%, in healthy adults[19]. The present study population attending the surgery consisted of mostly older adults with comorbid conditions, in which SARS-CoV-2 infection often resulted in symptomatic COVID-19 cases. Therefore, the probability of detecting asymptomatic COVID-19 cases during the present study period may be very low.

According to the Thai national data of pre-operative screening among patients that underwent surgical procedures between April 1, 2020 and May 31, 2020, there were 15,318 rRT-PCR tests and they resulted in only two positive tests (0.01%)[20].

Therefore, the low prevalence of asymptomatic COVID-19 cases in the authors' province contributed to the effectiveness of the screening strategies. For example, universal PCR testing prior to elective orthopedics surgery in USA with more than 10% prevalence rate of infection demonstrated that 12.1% were positive for SARS-CoV-2, and more than half consisted of asymptomatic COVID-19 cases[21]. Additionally, circulating GR clades during the second wave in Thailand was associated with a two-fold increase in asymptomatic cases of up to 26.7%[19]. This might be even more during the current Omicron wave[22]. Therefore, a universal single or pool PCR testing protocol may be a favorable strategy during the current Omicron COVID-19 wave.

Second, the effectiveness of a pre-operative screening protocol depended on other factors, including compliance to infection control strategies, universal mask wearing, gown-gloves use, social distancing, and community preventive measures during the study outside of hospital. The authors could only evaluate in-hospital infection control compliance among healthcare personnel, patients, and their relatives during hospitalization. Trusting out-of-hospital preventive measures may be unreliable, such as restricting travel to endemic areas, universal mask wearing, hand hygiene, and social distancing. Additionally, studies demonstrated that most COVID-19 infection among healthcare personnel occurred in the community and very less likely to occur from a nosocomial transmission[23-25].

Third, sample size and duration of the present study observed period were small. Additionally, the present study was not designed to observe in-hospital transmission of COVID-19 from patients to patients. However, the results from post-operation follow-up visits at the out-patient clinic demonstrated that all patients had no COVID-19 symptoms and were doing well at the follow-up visit. This is reassuring for cataract patients that decide to attend the surgery during the pandemic.

Finally, post-operative SARS-CoV-2 infections and in-hospital transmissions associated with eye surgery were not reported. Most in-hospital transmission of COVID-19 from patients to healthcare personnel occurred in close and unprotected exposure or involved in the aerosol-generating procedure with positive cases. Even with a high-risk exposure, the reported rate of infection ranged from 2.4% to 2.5%[26]. Overall, the rate of infection among healthcare personnel linked to in-hospital transmission from COVID-19 patients was only 1.2%[25]. Detection of SARS-CoV-2 nucleic acid have been reported in aqueous humour and conjunctival swabs from symptomatic COVID-19 patients, but viability and infectivity have yet to be assessed[4,5]. Additionally, these COVID-19 cases would be screened out before surgery if universal nucleic acid test were done[5]. Lastly, the Public Health of England, the World Health Organization, and the Royal College of Ophthalmologists suggest that cataract surgery or phacoemulsification do not generate aerosols, consistent with the modelling study[27,28].

Conclusion

In conclusion, there was no SARS-CoV-2 infection among healthcare personnel working with the patients requiring an elective cataract surgery during the first COVID-19 wave. Under strict compliance to a pre-operative SARS-CoV-2 screening protocol and other infection control measures, an elective cataract surgery under local anesthesia can be done during the ongoing COVID-19 pandemic. Pre-operative screening protocol with a questionnaire alone may be feasible in a low COVID-19 incidence rate area.

What is already known on this topic?

Cataract surgery is one of the most common non-aerosol-generating, elective surgeries performed in the ophthalmology department. However, there were reports worldwide that ophthalmologists acquired SARS-CoV-2 from patients, in which some resulted in a subsequent death. However, in-hospital transmission of SARS-CoV-2 infection from a patient who underwent cataract surgery to healthcare personnel, has yet been reported.

What this study adds?

There was no hospital-acquired SARS-CoV-2 infection among healthcare personnel working with patients that underwent an elective cataract surgery during an unlocked phase of the first COVID-19 wave. Due to a very low incidence of hospital-acquired SARS-CoV-2 infection, selective cataract surgery can be done under a pre-operative SARS-CoV-2 screening protocol when all other infection control measures are done as usual. These include universal mask wearing, physical distancing, avoidance of

SARS-CoV-2 exposure in crowded place prior to a surgery, compliance to good hand hygiene, and an appropriate use of personal protective equipment in the operation room.

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Conflicts of interest

The authors declare that there is no conflict of interest.

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