

Safe return to elective surgery following a COVID-19 outbreak: an observational study

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Research

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Abstract

Background

It is a challenging task to resume suspended surgical services following coronavirus disease 2019 (COVID-19) outbreaks. We aimed to investigate the results of the pre-admission screening for patients awaiting surgery during the COVID-19 pandemic.

Methods

This retrospective study enrolled consecutive 100 patients who underwent surgical procedures under general anesthesia at a single institution in May 2020. For 2 weeks prior to admission, patients were required to avoid nonessential outings and record symptoms and temperatures every day. On the day before admission, real-time polymerase chain reaction (PCR) and chest computed tomography (CT) were performed.

Results

Pre-admission PCRs were all negative, and no CT imaging suggested COVID-19 infection, combined with clinical information. As a result, all surgeries were performed as scheduled. No virus was detected from the extubated tracheal tubes in operating rooms. No patients developed COVID-19 infection postoperatively. No nosocomial infection was reported through the study period and for 1 month thereafter.

Conclusions

With 2-week avoidance of nonessential outings before admission for surgery, combined with reverse transcriptase PCR and chest CT shortly before admission, we successfully resumed elective surgeries, confirmed by PCR of extubated tracheal tube swabs, at a hospital that experienced a COVID-19 outbreak.

Introduction

Coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has resulted in a worldwide pandemic and affected surgical care to an unprecedented extent as well as other medical services.

Our hospital is assigned to provide tertiary care and was also designated for treatment of specified infectious diseases in Kobe City, Hyogo Prefecture, Japan. We have been accepting COVID-19 patients since early March 2020, and presuming that nosocomial transmission occurred among health-care workers and patients. Totally 35 individuals were confirmed as COVID-19 positive, and 242, amounting to

more than 10% of all health-care workers had to be isolated at home due to close contact with those infected with COVID-19. This resulted in deferring elected surgeries and closing the emergency department. Nosocomial transmission was well controlled at the end of April, despite continuing to accept new severe COVID-19 patients. We decided to resume elective surgeries on May 11, after a 3-week suspension. However, as there are no recommendations or guidelines on how to reopen surgical delivery, we proposed a screening method to safely resume elective surgeries. We aimed to minimize the patient's risk of developing COVID-19 pneumonia postoperatively, which would result in high mortality, and prevent nosocomial infection, especially that associated with general anesthesia through aerosols during intubation and extubation [1–3]. Herein, we report the outcome of our screening strategy at a hospital that experienced a COVID-19 outbreak.

Patients And Methods

We retrospectively reviewed consecutive patients who underwent an elective surgical procedure under general anesthesia at Kobe City Medical Center General Hospital from May 11 through June 2. A summary of screening performed before hospital admission is shown in Fig. 1.

Briefly, two weeks prior to admission, patients were asked to avoid all nonessential outings and were required to record symptoms and temperatures daily. With the onset of any symptom including fever (37.5°C or higher), cough, throat pain, anosmia, or dysgeusia, patients were instructed to contact a physician by phone to determine whether they would be admitted as scheduled. Contact with an individual confirmed or suspected of COVID-19 was also considered important information. On the day before admission, SARS-CoV-2 real-time reverse transcriptase polymerase chain reaction (RT-PCR) testing was performed using nasopharyngeal swabs, and patients were subjected to plain chest computed tomography (CT). Furthermore, interviews were conducted regarding lifestyle and symptoms in the previous 2 weeks.

Nasopharyngeal swabs for RT-PCR testing were collected by otolaryngologists at a booth prepared outside the hospital (Fig. 2). RT-PCR tests were performed in accordance with the protocol established by the National Institute of Infectious Diseases in Japan [4]. On thin-slice CT imaging, we screened for ground glass opacity, or consolidation, which has occasionally been associated with COVID-19 [5, 6], by radiologists, and images were also reviewed by pulmonologists for a comprehensive evaluation. CT was not performed for some pediatric patients who needed sedation.

In addition, we performed RT-PCR using samples obtained by swabbing around the cuffs and tips of tracheal tubes shortly after extubation (Fig. 2), which appears to be more specific than nasopharyngeal samples. Patients who were not extubated in the operating rooms were excluded from this review. Hypothetically, this double-check screening minimizes contamination during postoperative management and allows clinicians to closely observe asymptomatic COVID-19 patients if the virus is detected. Postoperative pulmonary complications including COVID-19 pneumonia and mortality within 30 days

were assessed, and nosocomial infection was also reviewed throughout the study period and for 1 month thereafter.

The study was approved by the Hospital Ethical Board (No. 20022). Written informed consent was waived in accordance with the Council for International Organizations of Medical Sciences guidelines.

Results

During the study period, 132 patients underwent surgery under general anesthesia, and of these, 100 were reviewed for this analysis. We excluded 23 emergent or urgent cases, 6 cases not undergoing extubation in the operating room, and 3 for other reasons (Fig. 3). The characteristics of the patients and specialty of the surgeries are shown in Table 1. Regarding comorbidities associated with increased risk of mortality due to COVID-19 infection [7], hypertension was reported in 39% of the patients, diabetes in 17 %, chronic renal failure requiring dialysis in 5%, cerebrovascular disease in 5%, and cardiovascular disease in 4%. Two or more of these 5 diseases were observed in 22% of the patients.

All patients avoided nonessential outings 2 weeks prior to admission, as requested. Regarding symptoms, one patient developed fever over 38 °C for 3 days within a week of admission, which was explained by urinary tract infection and was relieved by oral antibiotics, with normal chest CT images confirmed. Two patients reported nonsignificant symptoms (Table 2).

CT was not performed for four pediatric patients. Completely normal CT findings were observed in approximately half of the patients (44 of 96). Most of the findings reported were nonspecific or COVID-irrelevant, such as linear opacity, small calcified nodules, endoluminal secretions, emphysema, fibrosis, and bronchiectasis. Ground glass opacity and infiltration were observed in four patients; these were further reviewed by pulmonologists and were considered to be aspiration pneumonia, bacterial pneumonia, or atypical adenomatous hyperplasia (Table 2). SARS-CoV-2 positivity was not detected in 100 nasopharyngeal swabs by RT-PCR.

After screening, all surgeries were performed as scheduled. SARS-CoV-2 was not detected in any of the samples from the extubated tracheal tubes for any of the 100 cases. Ninety-six patients were discharged alive, and four were still hospitalized at 30 days. Two patients developed aspiration pneumonia, not COVID-19 pneumonia, and were treated with antibiotics. No cases of 30-day mortality were observed. No incidence of nosocomial infection was reported throughout this period or for 1 month thereafter.

Discussion

One month after the World Health Organization announced that the COVID-19 outbreak was a global pandemic on March 11, 2020, a state of emergency was declared on April 7 by the Prime Minister in Japan. We admitted all severe COVID-19 patients as the only designated institution for COVID-19 patients in Kobe. The number of patients in the hospital rapidly increased early in April 2020, and presumed nosocomial infection subsequently occurred, resulting in seven patients and 28 health-care workers being

infected with SARS-CoV-2. We decided to suspend elective surgeries on April 20, closed the emergency department, arranged specific hospital zones, organized COVID-specific teams, set screening stations at all the entrances, and reduced staff–staff contact. Some of these practices had previously been introduced in a Taiwanese hospital and were successful in controlling the situation [8]. These measures also appeared to be effective at our institution, and the number of transmissions to health-care workers decreased in the middle of April.

Once a hospital has an outbreak, it is a great challenge to resume medical practice. However, we decided to resume elective surgeries as a tertiary care medical center as of May 11 after a 3-week suspension. Presymptomatic COVID-19 patients can develop COVID-19 pneumonia postoperatively, leading to high mortality. An international, multicenter, cohort study reported a mortality rate of approximately 20% (53 deaths among 280 cases) in elective cases with perioperative SARS-CoV-2 infection [9], which is consistent with an early report from Wuhan, China [10].

There was also a concern about nosocomial infection from presymptomatic or asymptomatic COVID-19 patients following admission to hospital [11-13]. A preliminary study investigating seroprevalence demonstrated that IgG for SARS-CoV-2 was detected in 3.3% of the preserved sera of randomly selected outpatients who visited our hospital for reasons other than COVID-19 from March 31 to April 17, indicating that Kobe had significant transmissions of SARS-CoV-2 infections despite the limited number of cases confirmed by RT-PCR [14]. Although the reliability of the kit used in the study still has to be determined, this finding also justified a strict screening of patients awaiting surgeries at that time. Thus, we proposed a seemingly strict screening system before hospital admission for elective surgeries.

First, we implemented RT-PCR testing, which has been widely recommended to confirm COVID-19-positive cases [15, 16], despite its sensitivity being 70% at the highest [17]. The low sensitivity could be due to the timing of testing [18] or inadequate sampling methods. The timing of sampling was determined to be the day before admission as the most recent test results were considered to be the most reliable.

Nasopharyngeal swab samples were obtained by otolaryngologists to ensure the quality of the samples. We also added chest CT imaging, which strengthens the screening results [19]. While imaging studies are not routinely indicated as a screening test in asymptomatic individuals [20], in asymptomatic COVID-19-positive patients, pneumonic changes were frequently observed on CT images in patients quarantined on the “Diamond Princess” cruise ship [21].

What remains is the concern that some asymptomatic or presymptomatic patients could be admitted even after negative RT-PCR testing and CT as false negatives. An interview interrogating history of travel to or residence in areas where COVID-19 was prevalent or following contact with COVID-19 confirmed or suspected individuals was also conducted, although infection routes were unknown in approximately half of COVID-19 patients in Kobe at that time. Symptoms during 2 weeks prior to admission were recorded and checked, including fever, cough, throat pain, anosmia, and dysgeusia. However, we also considered that in the cohort from the “Diamond Princess” cruise ship and Japanese citizens evacuated from Wuhan, the estimated asymptomatic proportion was 17.9% and 33.3%, respectively [22, 23]. Considering

that the incubation period is usually 4–7 days [24, 25] and that some patients never suffer from any symptoms [13, 22, 23], the absence of symptoms shortly before admission does not always imply that they are free from SARS-CoV-2 infection. Cheng et al. reported that all the second cases experienced their first exposure within 5 days of symptom onset in the index case [26]. Next, we required patients to strictly avoid nonessential outings for 2 weeks prior to admission. RT-PCR testing, CT imaging, and a patient interview on lifestyle and symptoms are to be considered suitable approaches to identify ineligible patients, while staying at home is an appropriate method to a greater likelihood of safely “passing” the screening protocol. A “2-week stay” at home would allow asymptomatic patients to develop symptoms or remain asymptomatic or even cured with no, if any, transmissibility sequelae [13].

As a consequence, no surgeries were postponed due to suspected COVID-19 case, based on the RT-PCR, CT, and interview before admission approach, and no COVID-19-associated respiratory complications developed postoperatively or associated transmission was reported. In addition, we confirmed that there was no detection of the virus in samples obtained from tracheal tubes shortly after extubation in all patients. A sample from a tracheal tube reflects the lower airway as well as the upper airway because the tube comes in contact with the pharynx at removal. Therefore, tracheal samples are theoretically as reliable or more reliable than nasopharyngeal samples [17] and can be taken in a noninvasive manner. If the virus was detected, we could isolate and closely observe the patient on the day of surgery or on the next day, minimizing the risk of nosocomial infection or mortality after surgery.

Kobe has had no new COVID-19 patients in the middle of May, and the state of emergency was lifted on May 21 for Hyogo Prefecture. Considering the results of this study, our screening protocol can be simplified by omitting RT-PCR testing and CT imaging before hospital admission, depending on the institution and COVID-19 prevalence. COVID-19 vaccines have yielded promising results [27, 28]. If global herd immunity is successfully accomplished, preoperative screening might be unnecessary. However, when another COVID-19 wave may occur if a new virus variant is resistant to the vaccines or the efficacy does not last for a long term, avoidance of nonessential outings for 2 weeks prior to admission would be still an effective policy, which is thought to be the most powerful factor in our screening system.

The limitations of this study are as follows. The study was retrospectively conducted. Furthermore, the interviews relative to nonessential outings, contact with others, and patient symptoms were quite subjective and were based on self-assessment. The swab samples of tracheal tubes have never been tested, and we have never tested swab samples in active COVID-19 patients. Our successful resumption of elective surgeries may mainly be attributed to successful control of COVID-19 transmission at Kobe, Hyogo Prefecture.

Conclusions

With the requirement of 2-week avoidance of nonessential outings before hospital admission, RT-PCR testing, and chest CT imaging studies shortly before admission, our institution was able to successfully

resume elective surgeries, as confirmed by the absence of SARS-CoV-2-positive cases by RT-PCR in extubated tracheal tube swabs, at a hospital affected by a COVID-19 outbreak.

Abbreviations

COVID-19: Coronavirus disease 2019; CT: chest computed tomography; RT-PCR, real-time reverse transcriptase polymerase chain reaction; SARS-CoV-2: severe acute respiratory syndrome coronavirus 2

Declarations

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Author's contributions

AA and YK: study design, data collection, manuscript preparation; HY and SS: establishment of the preoperative PCR sample collection system; AY and RI: interpretation of CT images; HM, SN, YS, and ME: management of clinical laboratory for RT-PCR; TI and NO: management of the radiology services including CT; KY, NH, and HM: preoperative evaluation of patients under general anesthesia and collection of PCR samples from extubated tracheal tubes; HK, TH, AD, surveillance through the hospital in view of infection control; RT and KT, comprehensive evaluation of patients with significant findings on CT images; YT and SK: comprehensive management of surgical services; YN and NS: optimization of the study protocol and review of the manuscript. The author(s) read and approved the final manuscript.

Availability of data and materials

The data of this survey are available from the corresponding author upon request.

Ethics approval and consent to participate

The study was approved by the Hospital Ethical Board (No. 20022). Written informed consent was waived in accordance with the Council for International Organizations of Medical Sciences guidelines.

Consent for publication

All the authors provide consent for publication.

Disclosure

This study is not supported by any funding. No authors report any conflicts of interest.

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Tables

Table 1. Patient characteristics and surgical specialties associated with surgical interventions

Age (median)	63	(1–90)	
Male/female	52/48		
Current smoker	8		
Number of comorbidities associated with increased risk of mortality in COVID-19 cases ^a			
	None	57	
	One	21	
	Two or more	22	
Specialty			
Gastrointestinal and hepatobiliary	20	Neurosurgery	6
Urology	19	Orthopedics	4
Obstetrics and gynecology	13	Breast	4
Head and neck	12	Cardiac	1
Thoracic	10	Dermatologic	1
Oral and dental	9	Plastic	1

a, Hypertension, diabetes, cardiovascular disease, cerebrovascular disease, chronic renal disease requiring dialysis.

Table 2. Summary of patient interviews on lifestyle and symptoms and computed tomography findings before admission

Interview			
Nothing to report	97		
Transient symptoms	3		
- Sore throat for 1 day			
- 37.7 °C for 1 day			
- Over 38 °C for 3 days	(Treated as UTI and resolved)		
Chest computed tomography			
Not performed	4 pediatric patients		
Nothing to report	44 (among 96)		
Findings (overlapping)			
Emphysema	9	Suspected tumor	2
Fibrosis	6	Ground glass opacity	4
Benign nodule or mucus plug	27	Infiltration	1
Linear opacity or scar	18		

Figures

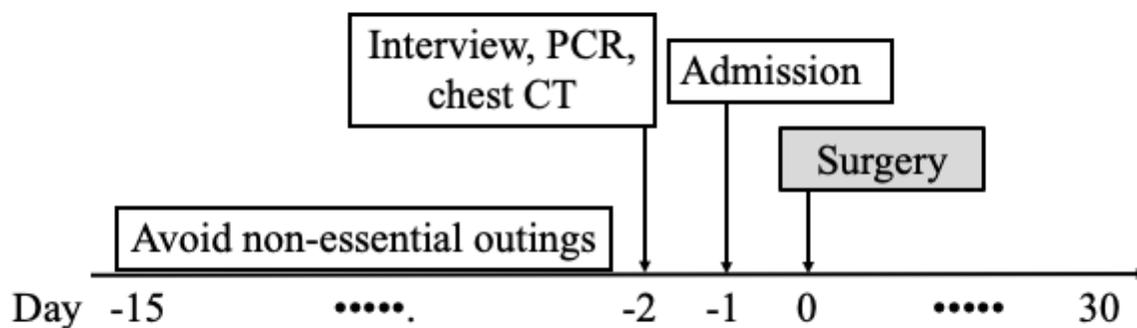


Figure 1

A schema of the screening protocol adopted for patients awaiting elective surgery.



Figure 2

Collection of two types of patient samples for polymerase chain reaction (PCR) testing. (Right) Otolaryngologists in personal protective equipment obtain nasopharyngeal samples. (Left) Extubated tubes are swabbed for reverse transcriptase PCR samples to confirm infection status of the patients.

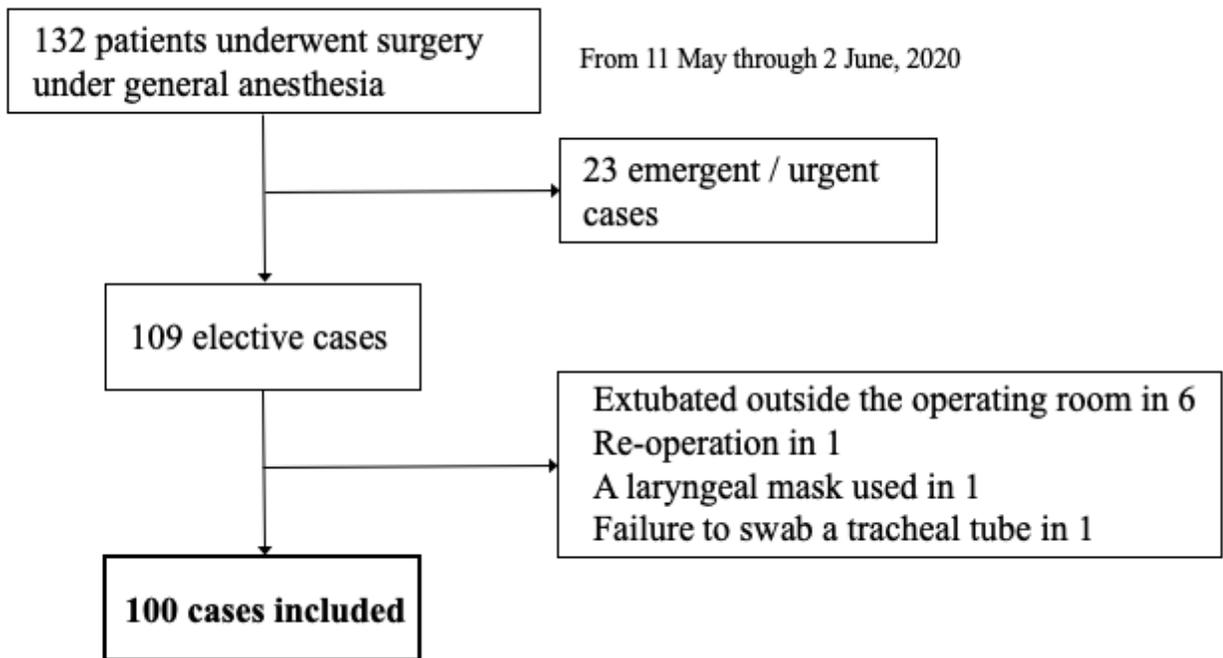


Figure 3

Flowchart of patient selection.