

The Feasibility and Safety of Routine Thoracic Surgeries in the Low-Risk Areas During the Coronavirus Disease 2019 Pandemic



Yiyang Wang, MD, Yonghui Zhang, MD, Feichao Bao, MD, Xiuxiu Hao, MD, Fenghao Yu, MD, Boyu Lin, MD, Zhitao Gu, MD, Wentao Fang, MD*

Department of Thoracic Surgery, Shanghai Chest Hospital, Shanghai Jiao Tong University, Shanghai, People's Republic of China

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ABSTRACT

Coronavirus disease 2019 (COVID-19) has been under good control, and work resumption has been gradually carried out in most parts of the People's Republic of China including Shanghai after March 2020. However, intense focus and resources have been diverted to patients with COVID-19, leaving patients with diseases other than COVID-19 somehow neglected owing to limited access to routine health care. Furthermore, whether routine thoracic surgery service is safe in low-risk areas of COVID-19 infection is still unknown. We hereby retrospectively analyzed the quantity and quality of thoracic surgeries performed by a single team from the Shanghai Chest Hospital between January and May 2020, compared with the corresponding period in the past year. Results suggested that comparable qualities of diagnosis, surgical treatment, and perioperative outcomes were safely and successfully achieved. The total number of surgical procedures gradually increased and surpassed with that of the corresponding period in the past year when the situation of COVID-19 has been in good control in Shanghai by April. Importantly, neither medical staffs nor patients were diagnosed of having COVID-19 infection. In conclusion, although COVID-19 has made considerable impact on elective surgery for thoracic diseases, it is safe and feasible to carry out routine thoracic surgery services in low-risk areas, provided that careful screening of COVID-19 and thorough protection of medical staffs and patients are taken. It is hoped that these findings would serve as a useful reference for thoracic departments all over the world during the COVID-19 pandemic, especially after work resumption.

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Keywords: Coronavirus disease 2019; Thoracic surgery; Shanghai Chest Hospital; Feasibility; Safety

Introduction

The outbreak of coronavirus disease 2019 (COVID-19), caused by the severe acute respiratory syndrome coronavirus 2, has infected more than 7 million people and caused more than 40,000 confirmed deaths worldwide by June 12, 2020.¹ This unprecedented pandemic has imposed huge social and healthcare burdens and exacerbated the relative shortage of medical resources around the world. More importantly, patients with chronic diseases including various cancers are more susceptible to the severe acute respiratory syndrome coronavirus 2 infection for their systemic immunosuppressive state and have much worse prognosis.^{2,3} Therefore, treatments for patients with cancer, especially those needing elective surgery, have become a

*Corresponding author.

Drs. Wang and Zhang contributed equally to this work.

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Address for correspondence: Wentao Fang, MD, Department of Thoracic Surgery, Shanghai Chest Hospital, Shanghai Jiao Tong University, No. 241 West Huaihai Rd., Shanghai 200030, People's Republic of China. E-mail: vwtfang@hotmail.com

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The COVID-19 situation in Shanghai

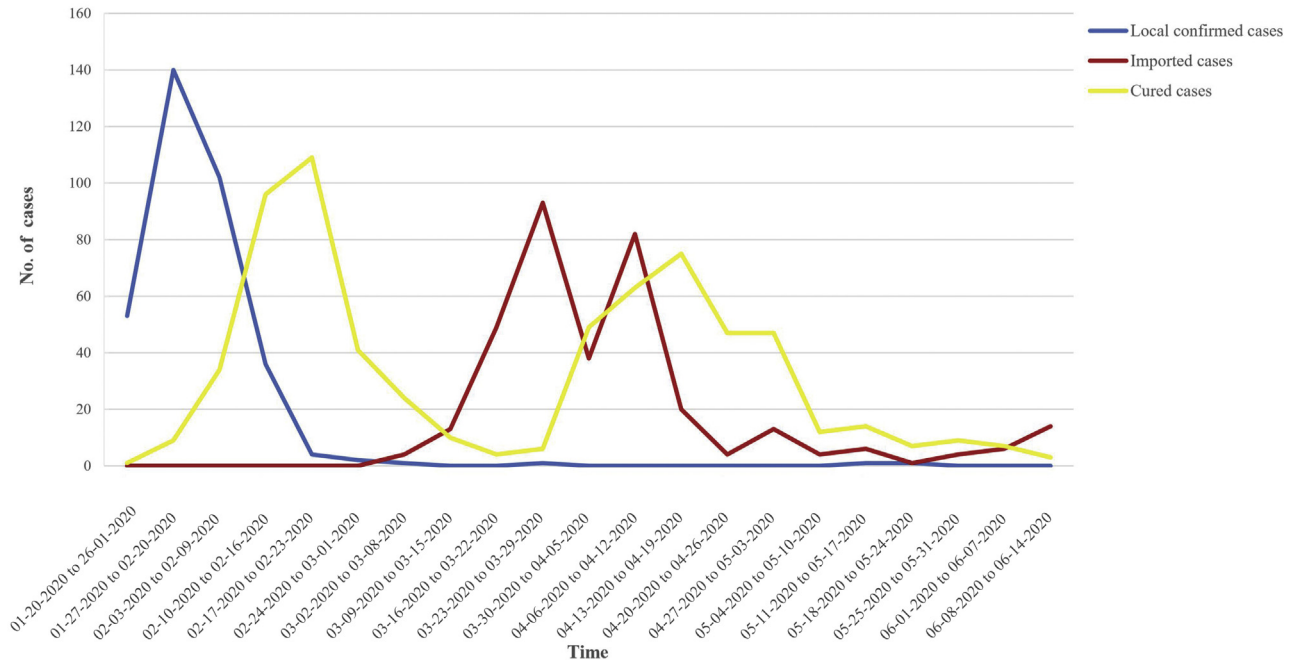


Figure 1. Situation of COVID-19 pandemic in Shanghai during the study period. COVID-19, coronavirus disease 2019.

dilemma and call for guidance during the COVID-19 pandemic.

After stringent and effective measures including city lockdown, personal quarantine, social distancing, and the general practice of using face masks, the situation of COVID-19 has been gradually under control in the People's Republic of China.⁴ However, since the beginning of work resumption in April, hospitals have been facing new challenges from a long waiting list of patients with cancer plus the existing burdens of COVID-19 prevention and control.

In this report, we compared the quantity and quality of thoracic surgical procedures by a single team of thoracic surgeons at the Shanghai Chest Hospital from January to May 2020 with the corresponding period in the past year. We tried to elucidate the safety for routine thoracic service at the time of COVID-19 outbreak and during work resumption in a low-risk area.

Materials and Methods

Patients

Patients treated by a single team of surgeons at the Department of Thoracic Surgery, Shanghai Chest Hospital, during January 1, 2020, to May 31, 2020, and those treated during January 1, 2019, to May 31, 2019, whose

data were retrieved from our database, were included in this analysis.

The primary objective was to analyze the number of elective procedures between these two time periods. The secondary objective was to compare the clinicopathologic characteristics, surgical procedures, and perioperative results of this year with the corresponding period in the past year.

Patient Screening and Medical Staff Protection

To prevent potential COVID-19 infection, multiple measures were undertaken and adjusted according to the situation of COVID-19 in Shanghai (Fig. 1).

1. After February 2020, when the COVID-19 pandemic was raging all around the P. R. China, chest computed tomography (CT), routine blood examination (white blood cell count), and a 14-day quarantine were required for every patient before the thoracic operation to rule out COVID-19 infection. Importantly, patients from epidemic areas and those with suspected symptoms including fever and aspiration difficulty were not permitted in the hospital. After admission, each patient was required to put on a face mask and keep social distance. Each room only allowed two patients in maximum. Surgeries for patients with small subcentimeter lesions or pure ground-glass

opacity (GGO) who were considered at low risk were postponed. As for protection for the medical staffs, face masks were a must for medical staff inside the hospital. Isolation gowns and eye protections were encouraged during invasive examinations and surgical procedures.

2. In late March and early April, when facing an increasing number of imported cases and potential secondary outbreak during work resumption, viral nucleic acid detection was added to the requirement lists for both patients and visiting family members apart from the procedures mentioned previously. However, personal quarantine was no longer required for patients from out of Shanghai with negative viral nucleic acid results.
3. After May 2020, chest CT scan, routine blood examinations, and viral nucleic acid detection were still definitely required, but there was no more any limitation on surgical indications. Furthermore, a 14-day personal quarantine was no longer required for those patients not from epidemic areas. Necessary protection for medical staffs was still considered of great importance for the prevention of COVID-19 hospital infection.

Statistical Analysis

Categorical and continuous variables were presented as frequencies (percentages, %) and mean values \pm SD, respectively. Differences of categorical variables were testified by Pearson chi-square or Fisher's exact test, when appropriate. Differences of continuous variables were tested by the Student's *t* test, using SPSS (version 22.0). Statistical differences were set as two-sided *p* value less than 0.05. Numbers of operations in each month this year and in the corresponding month in the past year were plotted by the broken line graph using GraphPad Prism version 5.0 (GraphPad Inc., San Diego, CA).

Results

After the first case of COVID-19 was reported in December 2019 in Wuhan, P. R. China, the confirmed local cases in Shanghai reached its peak level between late January and early February 2020 and then rapidly decreased after late February on account of the efficient and stringent policies and measures taken by the Shanghai municipal government. Nevertheless, imported cases were gradually increasing soon after early March owing to the worldwide outbreak of COVID-19 pandemic and have maintained at a certain level to late April (Fig. 1).

In terms of surgical volume, the sum of thoracic surgeries of our single surgical team was up to 226

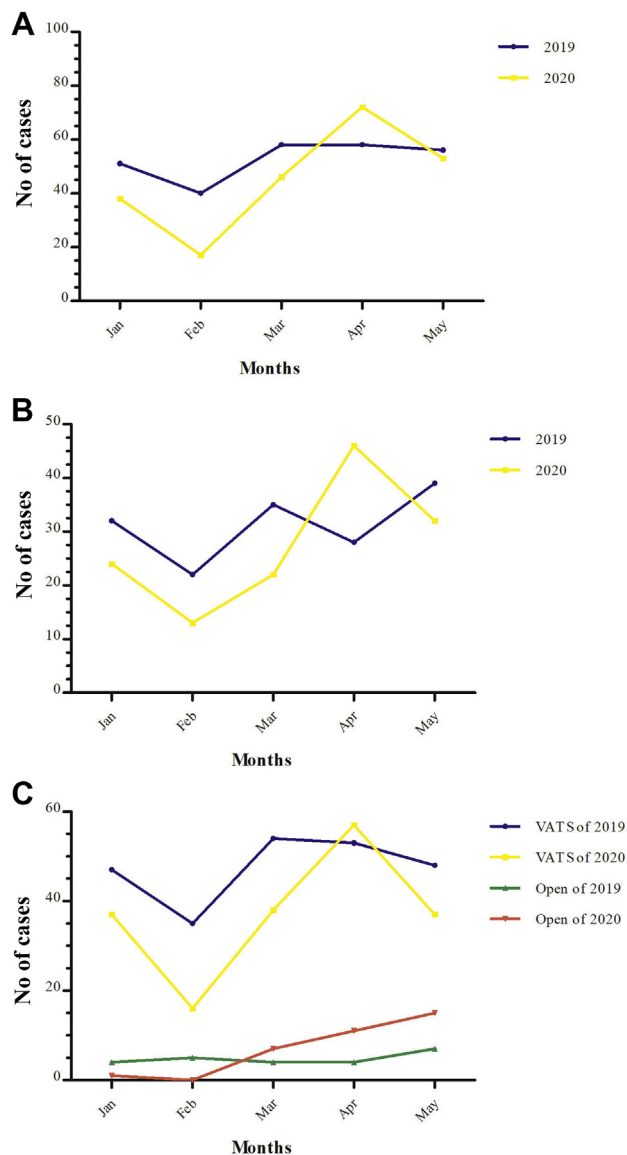


Figure 2. Comparison of numbers of surgical operations in each month between 2019 and 2020. (A) The total number of surgical operations; (B) number of pulmonary resections; (C) number of VATS and open procedures. Apr, April; Feb, February; Jan, January; Mar, March; VATS, video-assisted thoracic surgery.

cases, which was 14.1% lower than that of the same period in the past year ($n = 263$). Specifically, we experienced temporal decrease of surgeries amid the COVID-19 pandemic around February, owing to the influence of COVID-19 pandemic, in which traffic restriction from outside Shanghai and local personal quarantine in Shanghai were undertaken, causing a decline of both nonlocal and local patients seeking medical care at the Shanghai Chest Hospital. In addition, the surgical indications were reconsidered with small subcentimeter lesions or pure GGO temporarily withhold and postponed. This was another reason for the rapid

Table 1. Baseline Characteristics of Patients Receiving Thoracic Surgeries Between 2019 and 2020

Variables	No. of Patients		p
	Year of 2019 (n = 263)	Year of 2020 (n = 226)	
Gender, n (%)			
Male	124 (47.1)	114 (50.4)	0.467
Female	139 (52.9)	112 (49.6)	
Age (y), mean ± SD	53.9 (13.1)	56.6 (13.4)	0.022
Smoking history, n (%)			
No	198 (75.3)	167 (73.9)	0.724
Yes	65 (24.7)	59 (26.1)	
Comorbidity, n (%)			
No	157 (59.7)	136 (60.2)	0.914
Yes	106 (40.3)	90 (39.8)	
Induction therapy, n (%)			
No	229 (87.1)	200 (88.5)	0.632
Yes	34 (12.9)	26 (11.5)	
Surgical procedure, n (%)			
VATS	237 (90.1)	185 (81.9)	0.017
Open	24 (9.1)	34 (15.0)	
Endo	2 (0.8)	7 (3.1)	
Disease, n (%)			
Lung	156 (59.3)	137 (60.6)	0.286
Med	96 (36.5)	73 (32.3)	
Eso	11 (4.2)	16 (7.1)	
LOHS (d), mean ± SD	6.18 (11.2)	6.04 (7.4)	0.870
Postoperative complications, n (%)	17 (6.5)	7 (3.1)	0.086
In-hospital mortality, n (%)	1 (0.4)	3 (1.3)	0.246

Endo, endoscopic surgery; Eso, esophagus; LOHS, length of hospital stay; Med, mediastinum; VATS, video-assisted thoracic surgery.

decrease of surgeries amid the COVID-19 pandemic around February 2020. Nevertheless, the number of surgical procedures began to bounce back from its lowest point in February as the local situation of COVID-19 revealed signs of improvement and then surpassed the sum of the same period in the past year in April when full work resumption was upcoming (Fig. 2A). In detail, the amount of pulmonary operations was increasing since February and reached the peak in April 2020, which was 1.6 times than that in April 2019 (Fig. 2B). Furthermore, both video-assisted thoracoscopic surgery and open operations were increasing from the bottom of February 2020 which paralleled the shift of pandemic in Shanghai (Fig. 2C). Importantly, there were 26 patients (11.5%) who received surgical operations after neoadjuvant therapy in 2020, which was similar to those in 2019 (34 patients, 12.9%).

As for the surgical quality and safety, the COVID-19 situation did not compromise the selection of patients or the quality of surgery. Patients' clinical and pathologic characteristics in 2020 revealed no statistical difference against those in the same months in the past year (Table 1). More importantly, surgery-related characteristics and perioperative outcomes were consistent with or even better than those of the corresponding period in the past year (Table 2). Specifically, there were three

cases (75.0%) suffering from pulmonary complications and one case (25.0%) suffering from air leakage in 2020, in comparison with 10 cases (76.9%) with pulmonary complications and three cases (23.1%) with other complications in 2019 ($p = 0.937$). Therefore, the incidence of pulmonary complications did not increase during the COVID-19 pandemic according to our own experience. In other words, it was safe and feasible to conduct routine thoracic surgeries during this tough period. All the 226 patients received spirometry examinations, seven patients received esophagoscopy, and 16 patients received bronchoscopy before the operations. All the surgical procedures were safely performed under general anesthesia with double-lumen tube intubations. Specifically, neither patients nor health care professionals were identified with COVID-19, and no COVID-19-related mortality was confirmed.

Discussion

Thoracic surgeons have been facing unprecedented challenges since mid-December 2019 when COVID-19 was firstly confirmed in Wuhan, P. R. China.⁵ Although the COVID-19 situation in Shanghai was largely under control by March 2020 with the quick and efficient emergency responses and strategies by the local government,⁶ it is still in suspense whether routine thoracic

Table 2. Baseline Characteristics of Patients Receiving Pulmonary Surgeries Between 2019 and 2020

Variables	No. of Patients		p	
	Year of 2019 (n = 156)	Year of 2020 (n = 137)		
Gender, n (%)				
Male	70 (44.9)	65 (47.4)	0.659	
Female	86 (55.1)	72 (52.6)		
Age (y), mean ± SD	57.2 (11.0)	60.4 (10.8)	0.012	
Smoking history, n (%)				
No	115 (73.7)	94 (68.6)	0.335	
Yes	41 (26.3)	43 (31.4)		
Comorbidity, n (%)				
No	87 (55.8)	73 (53.3)	0.670	
Yes	69 (44.2)	64 (46.7)		
Induction therapy, n (%)				
No	143 (91.7)	120 (87.6)	0.251	
Yes	13 (8.3)	17 (12.4)		
Surgical procedure, n (%)				
VATS	153 (98.1)	127 (92.7)	0.026	
Open	3 (1.9)	10 (7.3)		
Surgery, n (%)				
WR	19 (12.2)	22 (16.1)	0.356	
Seg	46 (29.5)	38 (27.7)		
Lob	79 (50.6)	65 (47.5)		
Extended lob	9 (5.9)	4 (2.9)		
Sleeve resection	1 (0.6)	6 (4.4)		
Pneum	1 (0.6)	1 (0.7)		
Others	1 (0.6)	1 (0.7)		
Pathology, n (%)				
Benign	4 (2.6)	3 (2.2)	0.664	
ADC	137 (87.8)	115 (83.9)		
SCC	10 (6.4)	11 (8.0)		
Others	5 (3.2)	8 (5.9)		
Pathologic stage, n (%)				
Ia	118 (75.6)	89 (65.0)	0.046	
Ib	9 (5.8)	19 (13.9)		
IIa	5 (3.2)	3 (2.2)		
IIb	9 (5.8)	4 (2.9)		
IIIa	5 (3.2)	7 (5.1)		
IIIb	2 (1.3)	7 (5.1)		
IVa	2 (1.3)	5 (3.6)		
Undefined	6 (3.8)	3 (2.2)		
LOHS (d), mean ± SD	5.8 (7.0)	5.9 (7.4)		0.937
Postoperative complications, n (%)	13 (8.3)	4 (2.9)		0.048
In-hospital mortality, n (%)	1 (0.6)	2 (1.4)	0.487	

ADC, adenocarcinoma; Lob, lobectomy; LOHS, length of hospital stay; Pneum, pneumonectomy; SCC, squamous cell carcinoma; Seg, segmentectomy; VATS, video-assisted thoracic surgery; WR, wedge resection.

surgeries are feasible and safe in low-risk areas such as Shanghai during the COVID-19 pandemic, especially when facing the upcoming full work resumption.

The COVID-19 pandemic has made huge influence on our routine oncological diagnosis and therapy. Large amount of elective thoracic surgeries was postponed and delayed. As one of the largest tertiary referral centers for chest diseases in the P. R. China, the Shanghai Chest Hospital did not stop its service of either emergency surgeries or elective surgeries since the outbreak of COVID-19.⁶ To minimize the influence of COVID-19

among thoracic patients and to prevent potential hospital infection, strict surgical indications were formulated such as surgery for patients with small subcentimeter lesions or pure GGO was postponed during the outbreak of COVID-19 pandemic. Nevertheless, it did not mean that our routine surgical treatment was changed. In contrary, just as what we mentioned before, we did not change our treatment strategy during this study period. Only surgery for those patients with small subcentimeter lesions or pure GGO considered at low risk was postponed, with careful follow-up at the

outpatient department recommended. Those patients with severe or advanced disease needing surgical treatment were not delayed, and all of them received timely and radical surgical treatment. However, it still took almost 2 months for our surgical group to reach the similar or an increased level of thoracic operations compared with the past year when the COVID-19 situation was under good control in Shanghai. With the continuing decrease in confirmed local and imported cases, we truly believe that large amount of delayed thoracic patients should be treated in time during the full work resumption. In other words, thoracic surgeries are of appropriate feasibility during the COVID-19 pandemic. As for the safety of conducting routine thoracic operations during the COVID-19 pandemic, the Shanghai Chest Hospital has made great efforts and had zero infection after February 2020. According to our initial experience, chest CT scan, routine blood examinations, and viral nucleic acid detection were all of great importance for the screening of potential COVID-19-infected persons and carriers before admissions. Wearing face masks and keeping social distances were also of significance for inpatients. Furthermore, it was safe for our medical staffs to perform surgical operations and invasive examinations including bronchoscopy and esophagoscopy as long as necessary personal protection and prescreening were done. Regarding surgical safety, rescheduling elective surgeries, especially those involving early-stage lung cancers, may have helped prevent the risk of COVID-19 infection during the pandemic.^{7,8} Usually more than 90% of thoracic surgeries in the Shanghai Chest Hospital were conducted by means of minimally invasive surgery, large amount of which were for early-stage lesions. During the peak of the COVID-19 pandemic, the indication for thoracic surgery, especially pulmonary surgery, was carefully reconsidered. Therefore, when surgery for those patients with small subcentimeter lesions or pure GGO were reconsidered and temporarily withhold, the proportion of patients with locally advanced diseases needing complex open procedures increased accordingly. However, from our own experience and statistics, it is safe to perform thoracic procedures especially open surgeries under corresponding regulation and protection which could achieve comparable perioperative outcomes compared with those in the past year and the COVID-19 pandemic had limited impact on our treatment strategy, especially for locally advanced thoracic diseases. We are glad to find out that careful screening and examination and quarantine for COVID-19 did not compromise the quality of thoracic surgeries. Furthermore, sustainable growth has been witnessed since February 2020 and especially since the full work resumption after April in Shanghai, P. R. China.

In the aspect of postoperative complications, when comparing between these two years, we noticed that postoperative complication rate was decreased in the first two months of 2020 during the peak of the COVID-19 pandemic, when surgical indication was strictly reconsidered and surgical volume was largely decreased. Furthermore, complication rates in each month of 2020 were all lower than those in the same month of the past year (Appendix Fig. 1). When referring to the pulmonary surgeries, there was no any serious postoperative complication in the first two months in 2020. As the situation of COVID-19 became well controlled since March 2020, postoperative complication rate was slightly elevated as the surgical volume gradually increased, becoming similar to that of the corresponding period in the past year (Appendix Fig. 2). Therefore, it indicated that strict surgical indication and limited surgical volume during COVID-19 pandemic would at least not compromise the quality of surgical operation. In the meantime, less surgical burden may help surgeon to focus more on surgical perfection and perioperative care and reduce the postoperative complications. In contrast, postoperative complication rate was still comparable with that in the corresponding period of 2019 when the pandemic was under control and full work resumption was started. That is to say, it is safe and feasible to perform routine thoracic surgeries when a pandemic is controlled and during full work resumption.

It is our honor to share our own experience of handling the thoracic surgery service in a low-risk area during the COVID-19 pandemic. In our experience, a well-planned national epidemic prevention strategy is an essential precondition for the feasibility and safety of routine thoracic surgeries in low-risk areas during the COVID-19 pandemic. First, the powerful social surveillance systems and the effective medical interventions and treatment measures make both the local and the imported confirmed cases at extremely lower level. Second, the protocols of patient screening and medical staff protection formulated by the Shanghai Chest Hospital are carried out through to the end and both medical staffs and patients are willing to observe those protocols conscientiously. Third, taking safety first as our prime responsibility helped reduce the risk of hospital infection and make the routine thoracic surgeries safe and feasible.

There is one major limitation in this report. It is a retrospective study that only enrolled cases from a single surgical team of the Department of Thoracic Surgery at the Shanghai Chest Hospital. It would be a whole different story to perform thoracic procedures on confirmed or latent patients because our precautions of screening have prevented any suspicious patients from admission. More importantly, our experience is not able to answer for thoracic departments in the middle of the corona "red zone." It would be wrong and unethical to

encourage the rest of the world to copy our method without discriminating. However, we are confident to say that we did set a successful example for hospitals that are on the similar scale of COVID-19 crisis.

In conclusion, COVID-19 has a significant impact on the elective operations for thoracic disease for a delay of almost 2 months. However, routine thoracic surgery and invasive examinations could be performed safely as long as careful screening and examinations of patients and effective protection of medical staffs are well completed during the full work resumption in low-risk areas of COVID-19.

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Supplementary Data

Note: To access the supplementary material accompanying this article, visit the online version of the *JTO Clinical and Research Reports* at www.jtocrr.org and at <https://doi.org/10.1016/j.jtocrr.2021.100144>.

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