




Bronchoscopic procedures during COVID-19 pandemic: Experiences in Turkey

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Abstract

Background: Globally, coronavirus disease-2019 (COVID-19) is a new, highly contagious, and life-threatening virus. We aimed to demonstrate how we proceeded with bronchoscopic procedures without published guidelines at the inception of the pandemic period.

Materials and Methods: All bronchoscopic procedures applied from the first case seen in Turkey (11 March-15 May) were evaluated retrospectively. Patient data on indications, diagnosis, types of procedures, and the results of COVID-19 tests were recorded.

Results: This study included 126 patients; 36 required interventional bronchoscopic techniques (28.6%), 74 required endobronchial ultrasonography (EBUS; 58.7%), and 16 required flexible fiberoptic bronchoscopy (12.7%). All interventional rigid bronchoscopic techniques were performed for emergent indications: malignant airway obstruction (66.7%), tracheal stenosis (25%), and bronchopleural fistula (8.3%). Malignancy was diagnosed in 59 (79.7%), 12 (50%), and 4 (25%) patients who underwent EBUS, interventional procedures, and fiberoptic bronchoscopy, respectively. All personnel wore personal protective equipment and patients wore a surgical mask, cap, and disposable gown. Of the patients, 31 (24.6%) were tested for COVID-19 and all the results were negative. COVID-19 was not detected in any of the patients after a 14-day follow-up period.

Conclusion: This study was based on our experiences and demonstrated that EBUS and/or bronchoscopy should not be postponed in patients with known or suspected lung cancer.

KEYWORDS

bronchoscopy, COVID-19, endobronchial ultrasonography, interventional bronchoscopy, lung cancer

1 | INTRODUCTION

Coronavirus disease-2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), is a life-threatening and highly contagious virus that has resulted in more

than (as of 18 May) 300 000 deaths worldwide.¹ COVID-19 is a member of the coronavirus family and was first reported in Wuhan, China in December 2019. It was declared a global pandemic by the WHO on 11 March 2020.^{2,3} Since December 2019, COVID-19 has spread rapidly and, today, there are over four

Abbreviations: APC, argon plasma coagulation; COVID-19, coronavirus disease-2019; CR, cryo-recanalization; EBUS-TBNA, endobronchial ultrasonography guided-transbronchial needle aspiration; MSSA, methicillin-susceptible *Staphylococcus aureus*; MTR, mechanical tumor resection; PPE, personal protective equipment; RT-PCR, reverse transcription-polymerase chain reaction; SARS-CoV-2, severe acute respiratory syndrome coronavirus-2; WHO, World Health Organization.

million cases (as of May 18) of infection in nearly 200 countries worldwide.¹

The route of transmission is not yet exactly understood; it is thought to be mainly transmitted through respiratory droplets or by direct contact. However, COVID-19 has also been detected in non-respiratory specimens, such as stool, blood, ocular secretions, and semen, but the role of these sites in the transmission is uncertain.⁴⁻⁶ As of 18 May, as in many countries, the number of daily new diagnosed cases in Turkey is still over 1000.¹ This is due to the ability of the COVID-19 virus to spread rapidly from human to human through direct contact or respiratory droplets. Especially within 2 m of an infected person, the transmission risk is even higher.⁷

Although bronchoscopy is a procedure used for the diagnosis and treatment of various conditions, it is also known as an aerosol-generating procedure, so it results in a high risk of infection for health care workers during the COVID-19 pandemic.⁸ On the other hand, throughout the pandemic, patients continued to be admitted with symptoms not related to COVID-19 infection, but as a result of suspected lung cancer instead. In these patients, bronchoscopy or endobronchial ultrasonography (EBUS) played an important role in both diagnosis and treatment. In this study, we reviewed the bronchoscopic procedures performed during the pandemic in an interventional pulmonology unit in Turkey and stated how we proceeded with these bronchoscopic procedures and precautions without any published guidelines on this subject.

2 | MATERIALS AND METHODS

This study was designed to be retrospective, cross-sectional, and descriptive. Patients who were referred to the Interventional Pulmonology Unit of Ataturk Chest Diseases and Thoracic Surgery Training and Research Hospital (of the Health Science University) for further examination with a diagnosis or suspected case of lung cancer were included in this study. The medical files of 126 patients following the first case seen in Turkey (11 March 2020-15 May 2020; ~8 weeks) were evaluated retrospectively.

Bronchoscopic procedures were grouped as flexible fiberoptic bronchoscopy (FOB) in an intensive care unit or a standard bronchoscopy room, interventional bronchoscopic techniques via rigid bronchoscopy, and EBUS guided-transbronchial needle aspiration (EBUS-TBNA).

All interventional procedures were performed under general intravenously administered anesthesia. Patients were intubated with a rigid Effer-Dumon bronchoscope (Effer Endoscopy, Marseille, France), and different diameters were preferred according to the type of procedure. Debulking procedures were performed by mechanical tumor resection (MTR) using the tip of the rigid bronchoscope, rigid forceps or argon plasma coagulation (APC)-assisted MTR (ERBE ICC 200/APC 300 electrosurgical unit, rigid APC probe, 50 cm length, 2.3 mm diameter; ERBE Medizintechnik GmbH, Tübingen, Germany), or cryo-recanalization (CR; ERBOKRYO CA unit, ERBE rigid cryoprobe 3 mm diameter, 53 cm length; ERBE Medizintechnik

GmbH, Tübingen, Germany). A convex EBUS probe (BF-UC180F; Olympus, Tokyo, Japan) with a dedicated scanner (EU-ME1; Olympus, Tokyo, Japan) was used to examine the lymph nodes of patients.

SARS-CoV-2 reverse transcription-polymerase chain reaction (RT-PCR) tests were performed on patients with symptoms suggestive of COVID-19 and patients from cities with high COVID-19 positivity. Patient data on gender, age, indications, diagnosis, types of procedures, and RT-PCR tests were recorded. After the procedure, the patients were monitored for COVID-19 infection for 2 weeks. The symptoms of the health care workers who performed the procedures were also monitored closely. A high-level of disinfection was used in line with manufacturer instructions and professional guidelines for the disinfection of reusable bronchoscopes.

Statistical analysis was performed using SPSS 16.0 software (IBM, New York, NY). Descriptive statistics were given as mean \pm SD, number, and percentage values.

This study has been approved by both the local ethics committee and the Republic of Turkey Ministry of Health. Informed consent was obtained from all patients.

3 | RESULTS

Of the 126 patients enrolled in the study, 100 (79.3%) were male and 26 (20.7%) were female. Bronchoscopic procedures were grouped as FOB in the intensive care unit and standard bronchoscopy room, interventional rigid bronchoscopic techniques, and EBUS-TBNA. EBUS-TBNA was performed on 74 patients, interventional procedures on 36 patients and FOB on 16 patients. The patients' mean ages were 60 ± 12 (21-86), 62 ± 8 (39-78), and 59 ± 16 (21-76) years in these groups, respectively.

All procedures were done by a minimum possible number of health care workers, such as one or two bronchoscopists, one member of the medical staff, an anesthesiologist, and a technician. All physicians and ancillary staff were tested for COVID-19 during hospital health screening and no positivity was detected. Only one ancillary staff was tested again after traveled to another city and resulted as negative but he was also isolated for 14 days then continued to work again together with us.

Indications of procedures and types of interventional techniques performed are shown in Figure 1. Accordingly, 66.7% ($n = 24$) of patients that underwent interventional procedures had a malignant central airway obstruction and, of these patients, 50% ($n = 12$) had no diagnosis (Figure 2A-F). While APC-assisted MTR was the most frequently used technique ($n = 12$), CR in addition to APC-assisted MTR was also used ($n = 7$). Dilatation with CR ($n = 2$) and MTR only ($n = 2$) were the other techniques used. All patients were presented with a diagnosis (Table 1) and treatments were started as soon as possible. A silicone Y-stent was removed in one patient due to mucostasis, which caused severe dyspnea. Nine patients with postintubation tracheal stenosis presented with severe stridor. All patients were treated by tracheal dilatation and cryotherapy to the stenosis line. Two patients underwent rigid bronchoscopy three times due to

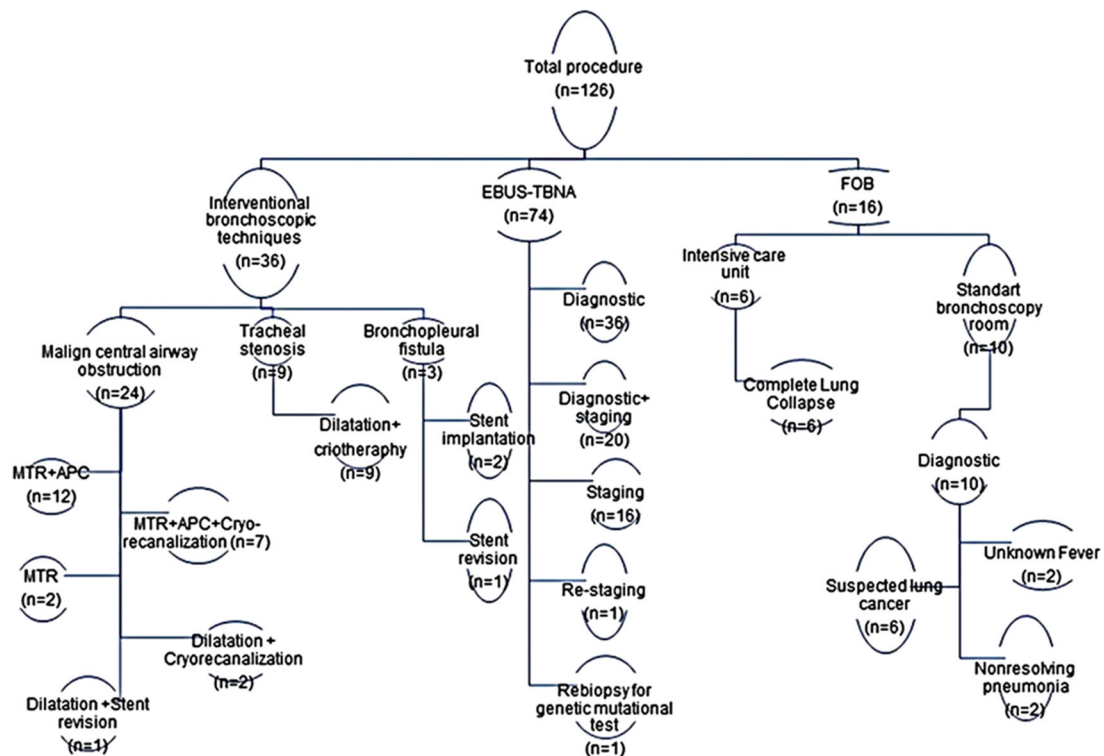


FIGURE 1 Flow chart of the study

bronchopleural fistula. Stents in two patients were deployed (Figure 2I,J), although we had to perform a second procedure on one patient due to the migration of the stent. Before the procedures, 12 patients (33.3%) were tested for COVID-19, and all results were negative.

There were 164 lymph nodes sampled in 74 patients under deep sedation (Figure 2K,L). The demographic characteristics are summarized in Table 1. EBUS-TBNA was mostly performed to diagnose suspected malignancy ($n = 36$; 49%); however, it was also used for simultaneous diagnosis and staging in 20 patients (27%) and staging in a further 16 patients (22%; Figure 1). In 61% (34/56) of patients who received EBUS-TBNA, the result was a diagnosis of lung cancer. As a result, of the patients who underwent EBUS, 59 (79.7%) were diagnosed with malignancy and quickly began treatment (Table 1). Before the procedures, 11 patients (15%) were tested for COVID-19, and all results were negative.

FOB was performed in the standard bronchoscopy room through the transnasal passage under mild sedation on 10 patients with suspected lung cancer ($n = 6$), nonresolving pneumonia ($n = 2$), and a fever of unknown origin ($n = 2$). Of the six patients who underwent FOB for suspected lung cancer, mucoepidermoid carcinoma ($n = 1$), adenocarcinoma ($n = 1$), and non-small-cell lung cancer ($n = 2$) were diagnosed in four patients; pleural effusion and lymph nodes were sampled in the remaining two patients. Methicillin-susceptible *Staphylococcus aureus* and *Pseudomonas aeruginosa* were obtained from the bronchial washings of two patients performed due to a fever of unknown origin. GeneXpert (Cepheid Inc; Sunnyvale, CA) assay for

Mycobacterium tuberculosis was positive in bronchial washing in a nonresolving pneumonia case and specific treatments were started. In addition, FOB was applied through an endotracheal tube in six patients with complete lung collapse who could not be provided with adequate oxygenation with mechanical ventilation. After mucus and fibrin plugs were removed, ventilation was provided in all patients (Figure 2G,H) and *Acinetobacter baumannii* positivity was also detected in two patients' bronchial washing cultures. Before the procedure, the COVID-19 PCR test via oropharyngeal/nasopharyngeal swabs were performed in 8/16 patients (50%, six patients of which were in the intensive care unit) and all were found to be negative.

4 | DISCUSSION

The first case of COVID-19 in Turkey was reported on 11 March 2020⁹ and an increasing number of infections were quickly reported. The Republic of Turkey Ministry of Health quickly made arrangements in the health system. First, pandemic hospitals were determined in all cities but specific branch hospitals, such as oncology and respiratory units, were excluded; these hospitals continued working routinely, which was extremely crucial for malignant patients with ongoing treatment and patients with suspected cancer. However, COVID-19 polyclinics were opened in all hospitals across the country and all patients who applied to these outpatient clinics were tested in line with the guidelines: cough, fever, shortness of breath, a history of coming from abroad, or a history of contact with

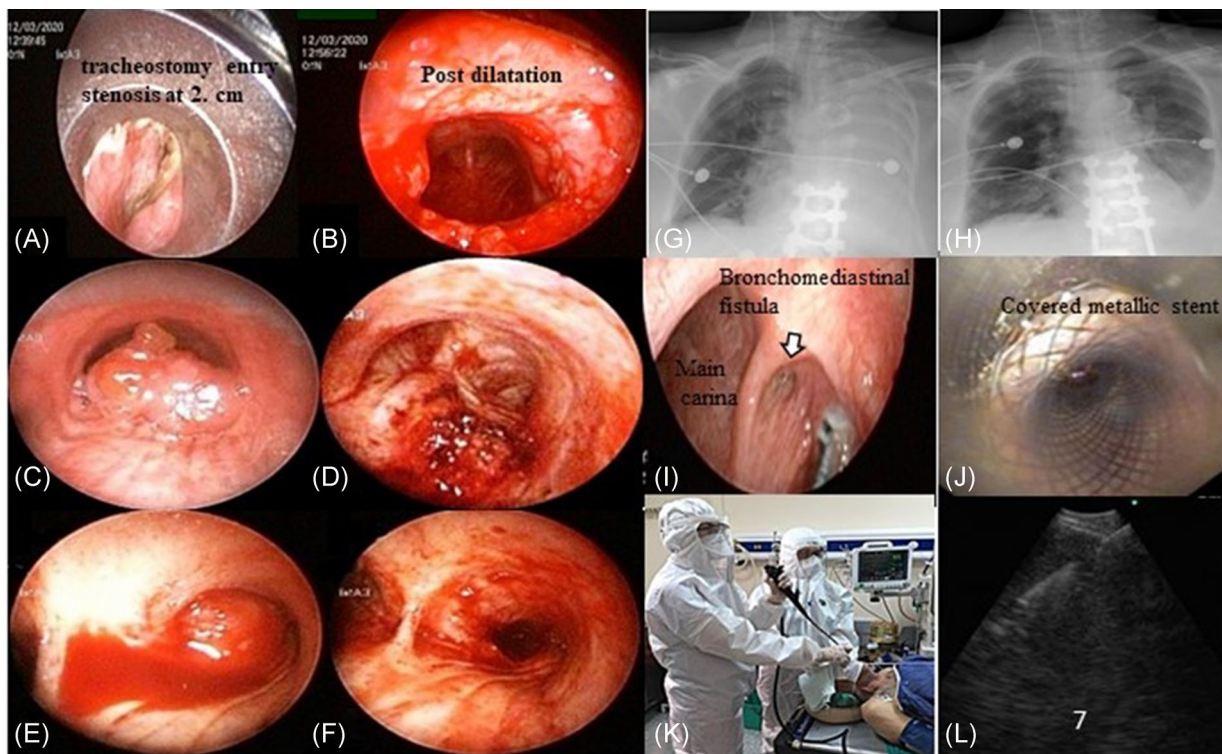


FIGURE 2 Examples of cases in the study, A–J. (A and B: pre and postprocedure view of postintubation tracheal stenosis; C and D, pre and postprocedure view of tracheal malign airway obstruction with adenoid cystic carcinoma; E and F, pre and postprocedure view of central (right main bronchus) malign airway obstruction with squamous cell carcinoma; G and H, pre and postprocedure chest X-ray of left lung complete atelectasis with mucus plaque; I and J, bronchomediastinal fistula, and after covered with metallic stent). K, Protection of health workers and patient's during EBUS-TBNA L: sonographic view of a sampled subcarinal lymph node. EBUS-TBNA, endobronchial ultrasonography guided-transbronchial needle aspiration [Color figure can be viewed at wileyonlinelibrary.com]

another patient with COVID-19.⁹ About 2 weeks following the first identified COVID-19 case, the possible case definition was changed, and all those with a cough or shortness of breath and a fever were tested for COVID-19.¹⁰ Second, an announcement that no patients with COVID-19 should be directed to appointed nonpandemic hospitals was declared. Thus, the minimization of transmission from patients with COVID-19 to other patients or health care workers was ensured. Third, health care workers were allowed to rest by applying for rotation. Lastly, guidelines were constantly updated by a scientific committee by closely following the global developments of the pandemic.

COVID-19 is known to be transmitted through respiratory droplets and direct contact; the risk of transmission is higher within ~2 m from an infected person; however, the maximum distance is still undetermined.¹¹ Bronchoscopy is an aerosol-generating procedure that leads to the pronounced formation of aerosols and thus poses a high risk of infection to proximate health care staff.⁸ In addition, nosocomial outbreaks and pseudo-outbreaks caused by various bacteria or viruses linked to inadequately processed bronchoscopes have been reported in several studies.^{7,12} The present study site is a training and research hospital for respiratory diseases and thoracic surgery specifically in Ankara, Turkey, and was, therefore, classified as a nonpandemic hospital. Therefore, during the pandemic, patients

with symptoms and signs of suspected lung cancer were referred from all over the country and admitted to our clinic for further examination and treatment. At the onset of the pandemic, there were no national or international guidelines determined for bronchoscopic procedures, which presented a significant problem. Although the COVID-19 Science Committee Guideline was updated on 14 April, there was still no clear recommendation regarding bronchoscopic procedures,¹³ so the precautions applied before, during, and after this point in relation to bronchoscopic procedures were determined together with hospital administration and an infection committee. We assigned the precise bronchoscopy indications for both outpatients and the intensive care unit patients and implemented the applications outlined below within the framework of protection measures determined by the Centers for Disease Control and Prevention in the United States.¹⁴

4.1 | In the bronchoscopy unit

All procedures were performed in an independent bronchoscopy unit with separate ventilation and high-efficiency particulate air filters, close to intensive care; we did not have a negative pressure room. Staff were reduced to a minimum throughout the day by creating a

TABLE 1 Demographic features of patients in interventional procedures, EBUS, and FOB groups

EBUS-TBNA	Sex	N (%)	Diagnosis	Patients N (%)	COVID-19 test (RT-PCR)	N (%)	City	N (%)	Sampled lymph nodes	N (%)
EBUS-TBNA	Male	60 (81%)	Lung cancer	18 (24%)	Positive	0	Ankara	45 (61%)	Subcarinal (7)	63 (38.4%)
	Female	14 (19%)	Adenocarcinoma	12 (16%)	Negative	11 (15%)	Other	29 (39%)	Right lower paratracheal (4R)	28 (17.1%)
			Squamous cell	12 (16%)	Not tested	63 (85%)				
			NOS	12 (16%)						
			Small cell lung cancer	6 (8%)					Left Lower paratracheal (4L)	26 (15.9%)
			Sarcoidosis	5 (7%)						
			Anthraxis	5 (7%)						
			Other malignancies	11 (15%)					Left interlobar (11L)	21 (12.8%)
			Reactive lymph node	3 (4%)					Right interlobar (11R)	17 (10.4%)
			Amyloidosis	1 (1.5%)					Right hilar (10R)	5 (3%)
		Tuberculosis	1 (1.5%)					Left hilar (10L)	2 (1.2%)	
								Left upper paratracheal (2L)	2 (1.2%)	
	Total	74 (100%)	Total	74 (100%)	Total	74 (100%)	Total	74 (100%)	Total	164 (100%)
INT. PROC	Male	30 (83%)	Lung cancer	23 (64%)	Positive	0	Ankara	23 (64%)		
	Female	6 (17%)	PITS	9 (25%)	Negative	12 (33%)	Other	13 (36%)		
	Total	36 (100%)	Other ^a	4 (11%)	Not tested	24 (67%)				
FOB	Male	10 (62.5%)	Lung Cancer	3 (19%)	Positive	0	Ankara	11 (69%)	Bronchial washing culture	N (%)
	Female	6 (37.5%)	Mucoepidermoid Carcinoma	1 (6%)	Negative	8 (50%)	Other	5 (31%)	Not taken	7 (44%)
	Total	16(100%)	Granulation	1(6%)	Not tested	8 (50%)	Total	16(100%)	Culture ^b (+)	5 (31%)
			Not Biopsied	11 (69%)	Total	16(100%)			Culture (-)	4 (25%)
		Total	16 (100%)							

Abbreviations: EBUS-TBNA, endobronchial ultrasonography guided-transbronchial needle aspiration; FOB, fiberoptic bronchoscopy; INT. PROC, interventional procedures; NOS, not otherwise specified; PITS, postintubation tracheal stenosis.

^aOTHER: Condroid hamartoma, lipomatous hamartoma, adenoid cystic carcinoma, and malignant melanoma metastasis.

^bCulture: +Methicillin-susceptible *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Acinetobacter baumannii* (2), *Mycobacterium tuberculosis*.

core team including a bronchoscopist, bronchoscopy assistants, nurses, and an anesthetist who carried out all the daily interventions. Preprocedure, in the bronchoscopy unit and resting area, a surgical mask was worn by all patients. All personnel in the operating room were dressed in personal protective equipment (PPE), including an N95 mask, eye protection (reusable safety glasses), disposable gloves, an impervious gown, a face shield, and a cap. All procedures were implemented under deep sedation or general anesthesia. For flexible bronchoscopy, a transnasal approach was preferred. For rigid bronchoscopy, conventional closed-circuit ventilation, and reduction of the aerosol leakage were preferred; jet ventilation was avoided.

4.2 | After bronchoscopy

Patients who underwent EBUS-TBNA and FOB were discharged on the same day and were suggested to follow-up if they experienced symptoms such as fever, dyspnea, and cough for 14 days post-procedure. When the patients returned to the clinic after 10 days to receive their results, they were asked to disclose any of the aforementioned symptoms. Standard disinfection protocols were followed for the cleaning of bronchoscopes and video monitors, and at least 30 minutes were given for disinfection and ventilation between procedures.

In line with these precautions taken during the first 2 months of the pandemic period, a total of 36 interventional procedures, 74 EBUS-TBNA, and 16 FOB were performed. Even though Ost DE recommends testing all patients before the procedure, we only tested 31 of 126 (24.6%) patients.¹⁵ Although this was due to the difficulty of accessing tests during the initial pandemic, we decided it was more appropriate to test patients with a higher likelihood of infection based on symptoms, since the false negativity of the test was about 67% in the following days.¹⁶ The first American Association for Bronchology and Interventional Pulmonology statement was published in late March; in the following days, expert opinions on the use of bronchoscopy during the COVID-19 pandemic were published one after another.¹⁷⁻²¹ While the use of PPE and bronchoscopy indications were similar between the published reports and our practice, not using negative pressure rooms, not testing all patients, using a reusable bronchoscope and only giving a 30-minute interval between the procedures are the notable differences between the reports and our practice. We proved that these differences did not cause any problems in the detection of COVID-19 in either patients and health care workers after the procedure.

Although it has been reported that a brief delay (2-3 weeks) will not harm cancer diagnosis and staging,²² how long the COVID-19 pandemic will continue is still unknown. Bronchoscopy is often required both for diagnosis and staging, and timeliness of bronchoscopic diagnosis impacts every stage of lung cancer care. Also, EBUS for staging and diagnosis as the first test in patients with T1-3, N1-3, and M0 disease has been shown to decrease complications, the number of tests required and time to treatment.²³ Moreover, delays in care may lead to missed opportunities in terms of cure or palliation

for lung cancer. So, whether it is judicious to delay bronchoscopy or EBUS of patients with known or suspected lung cancer in this unknown process is the question at hand. Based on our experience, the answer to this question is no, EBUS and/or bronchoscopy should not be postponed in patients with known or suspected lung cancer; we determined that COVID-19 transmission can be prevented by taken sufficient and necessary precautions.

CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

DATA AVAILABILITY STATEMENT

Data available on request from the authors.

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