COMMENTARY

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Bronchoscopy During Coronavirus Disease 2019 Pandemic: A Bronchoscopist's Perspective

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ABSTRACT: Bronchoscopy is a safe and commonly performed procedure for diagnostic as well as therapeutic indications. Bronchoscopy is also an aerosol-generating procedure, and due to the risk of severe acute respiratory syndrome coronavirus 2 transmission during the procedure, routine bronchoscopy has been discouraged by multiple professional societies, despite any solid evidence. There are only a few reports of bronchoscopy in patients with coronavirus disease 2019 in the literature. Bronchoscopy in this patient population plays a crucial role not only in the diagnosis of coronavirus disease 2019 but also in the identification of secondary bacterial or fungal infections and in directing appropriate antimicrobial therapy. Bronchoscopy with therapeutic interventions may be lifesaving. Based on the literature, the risk of coronavirus disease 2019 transmission appears to be low among bronchoscopists and other healthcare workers when appropriate personal protective equipment is used. Bronchoscopy in patients with coronavirus disease 2019 should be strongly considered when clinically indicated.

KEY WORDS: bronchoscopy; coronavirus disease 2019; diagnosis; intensive care unit; lung cancer; severe acute respiratory syndrome coronavirus 2

Bronchoscopy is a commonly performed procedure for diagnostic as well as therapeutic indications. Over 500,000 bronchoscopies are performed each year in the United States (1). It is considered safe with minimal risk of grievous complications and offers a significant diagnostic and therapeutic utility (2). One risk associated with bronchoscopy is accidental transmission of disease due to its nature as an aerosol-generating procedure, possibly putting healthcare professionals at risk (3, 4). As severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the pathogen responsible for coronavirus disease 19 (COVID-19), can be transmitted via aerosols, routine bronchoscopy for these patients has been a matter of great scrutiny and frequently discouraged (5, 6). Furthermore, the use of personal protective equipment (PPE) during bronchoscopy may divert resources away from frontline workers, especially in resource-poor facilities.

Performing bronchoscopy in patients with COVID-19 is not without potential risks. This includes the possibility of SARS-CoV-2 transmission to the bronchoscopist and other involved healthcare workers (HCWs). Indeed, an increased risk of SARS-CoV-2 transmission among HCWs had been reported in several studies (7, 8). Another procedural concern is the possibility of clinical deterioration in the periprocedural period, such as precipitation of respiratory failure, the necessity for mechanical ventilation, increased hospital length of stay, or even increased mortality, especially in critically ill patients. Conversely, bronchoscopy could be beneficial. Identification of SARS-CoV-2 from the lower respiratory tract may accurately diagnose patients with COVID-19 who had an initial false-negative test. Similarly, an early diagnosis of a secondary bacterial or fungal infection is paramount as a misdiagnosis can negatively affect patient

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TABLE 1.
Reported Studies on Bronchoscopies Performed for Patients With Coronavirus Disease 2019

References	Guarino et al (12)	Mondoni et al (10)	Patrucco et al (16)
Number of patients	87	109	131
Total number of bronchoscopies	87	109	131
Diagnostic	57	78	129
Therapeutic	30	31 (this number included an unspecified number of bronchoscopies that were for evaluation of secondary infection)	2
Number of diagnostic bronchoscopies with negative real-time PCR	8 patients (2 negative swabs)	78 patients (2 negative swabs)	86 patients with suspected COVID-19 (most with 2 negative swabs)
Positive COVID-19 from BAL	4/8 (50%)	43/78 (55.1%) Similar yields from BAL and bronchial wash (57.4% vs 47.1%; $p = 0.45$)	32/86 (37.2%)
Secondary infection	Of the other 4 patients, 2 patients with *Legionella* and 2 with fungal infection	15 patients with negative PCR on bronchoscopy had lower respiratory tract infection by other organism 4 patients had secondary infection *Haemophilus* *Aspergillus* 2 patients with *Aspergillus* and *Candida*	Identified in 26 additional infection for a total microbiologic diagnosis in 58/86 patients (67%)
Changes in antimicrobials	NR	NR	NR
Changes in systemic steroid	NR	NR	NR
Changes in anticoagulation	17 patients with concerns for diffuse alveolar hemorrhage All patients have evidence of alveolar hemorrhage 13/17 patients died Specific changes in antithrombotic or anticoagulation therapy not mentioned	NR	NR
Other	NA	NA	NA
Definitive non-COVID diagnosis			15 patients had definitive alternative diagnosis (8 lung cancer, 4 alveolar hemorrhage, 2 organizing pneumonia, and 1 vasculitis)

BAL = bronchoalveolar lavage, COVID-19 = coronavirus disease 2019, NA = not applicable, NR = not reported, NS = not significant, PCR = polymerase chain reaction.

Chang et al (14)	Torrego et al (9)	Bruyneel et al (13)	Mehta et al (17)	Baron et al (18)	Loor et al (11)
107	93	32	61	24	75
241	101	90	98	28	222
NS	63 38	30 60	NS	28	29 193 (evaluation for hemoptysis was considered therapeutic)
NA	NA	2	NA	13 patients with recent negative swab	NA
NA	NA	1/2 (50%)	NA	5/13 patients (38%) tested positive from BAL	NA
35/54 (65%) had secondary infection from BAL compared with tracheal aspirate (45%) 16% false-negative tracheal aspirate culture 6% of BAL had 2 organisms	18/63 patients (28.6%) had a secondary bacterial infection	30/51 samples (58.8%) had a secondary bacterial infection Fungi were found in 16 samples	53/98 patients (54%) had bacterial superinfection 7 (7.1%) had fungal infection	Positive bacterial culture in 14/28 (50%) Positive *Aspergillus* culture in 7 (25%)	NS
NR	New antibiotic was prescribed in 15/18 patients (83%)	New antibiotic was prescribed in 9/30 patients (30%)	Antibiotics were changed/escalated in 31 cases (31.6%)	Modification of antibacterial therapy in 8 (29%) Modification of antifungal therapy in 5 (18%) Introduction of antiviral therapy in 1 (4%)	Change in antimicrobials 31 (14%) Negative cultures leading to stopping antibiotic 3 (1.4%)
NR	NR	NR	Decreased steroid use in 6 patients (6%)	Initiation of corticosteroid therapy in 6 (21%)	NR
NR	NR	NR	Anticoagulation was reduced from intermediate to preventive in 6 patients (6%)	NR	Adjustment of anticoagulant 5 (2.3%)
NA	NA	NA	Fluid administration was reduced, and diuretics added in 12 patients (12.2%) based on the visual perception of pulmonary edema (frothy copious upwelling secretions)	NA	Mucus plug extraction that improved ventilation 62 (27.9%)
NR	NR	NR	NR	NR	NR

outcomes. Additionally, bronchoscopy enables the operator to perform therapeutic interventions, which can be lifesaving.

Several observational studies have shed light on the complications of bronchoscopy. Based on the available data, bronchoscopy appears to be associated with a low risk of clinical deterioration, even in critically ill mechanically ventilated patients. The most reported complication was mild transient oxygen desaturation (defined as a oxygen saturation < 90%). Torrego et al (9) performed 101 bronchoscopies in a cohort of 93 mechanically ventilated patients and "occasionally" observed transient hypoxemia. Mondoni et al (10) reported transient hypoxemia in 4.5% of 109 bronchoscopies. Loor et al (11) specified seven mild desaturation episodes (3.1%) in their cohort. In contrast, severe hypoxemia occurred when bronchoscopies were performed in patients requiring noninvasive positive pressure ventilation (NIPPV). Guarino et al (12) performed bronchoscopy on seven patients requiring NIPPV that were complicated by severe desaturation (below 60%), and five of these patients were eventually intubated. Bruyneel et al (13) also reported worsening respiratory failure needing intubation following bronchoscopy in a patient on NIPPV. Other minor complications included fever, mild hemoptysis, and repositioning of the endotracheal tube (10, 11, 14). There was no report of pneumothorax, cardiac arrhythmia, or death in any of the studies. The transmissibility of SARS-CoV-2 among bronchoscopists and other HCWs has also been described. Gao et al (15) serologically evaluated 35 bronchoscopists who had performed more than 450 procedures in 280 mechanically ventilated patients over 5 months (March to August 2020) in the ICU setting. The operators were also tested by real-time polymerase chain reaction (RT-PCR) of the nasopharyngeal swab if there was any concern for acute infection. At the end of the study, 27 of 35 bronchoscopists had serologic results available. One of 27 tested positive by serologic assay. This individual was asymptomatic during the study period and spent more than 5 weeks in the COVID-19 ICU and performed 10–30 bronchoscopies. Sixteen of 35 operators who had received RT-PCR were all negative. Torrego et al (9) reported one of the two bronchoscopists getting infected during the second week of their study requiring replacement by a third bronchoscopist. Except these two operators, there has been no other reported transmission of SARS-CoV-2 in the literature (10–14, 16–18).

It is crucial to emphasize that the authors reported strict adherence to guidelines recommended by the World Health Organization, Centers for Disease Control and Prevention, and other professional organizations. Most procedures were performed in negative pressure rooms, and all involved HCWs used appropriate PPE. In addition, measures were undertaken to reduce the risk of aerosolization, such as apneic bronchoscopy and neuromuscular blockade to eliminate cough (14, 15, 17). The number of HCWs involved in the actual procedure was also minimized. Disposable bronchoscopes were used in most studies (9, 11, 13–15). However, reusable bronchoscopes were also used without any safety concerns (16). Bruyneel et al (13) reused disposable bronchoscopes for future bronchoscopies if the same patient required repeat procedures. The data presented here suggest procedural safety and a low risk of SARS-CoV-2 transmission when appropriate recommendations are followed.

Bronchoscopy has played a crucial role in the care of COVID-19 patients. "Thick and sticky" mucus causing airway obstruction had been reported early in the pandemic (19). The airway occlusion resulted in atelectasis, radiologic chest infiltrates, worsening hypoxemia, and increased airway pressures. Chang et al (14) reported 33% of their mechanically ventilated patients requiring bronchoscopies. Loor et al (11) performed 222 bronchoscopies in their 75 ventilated patients, and 150 of these procedures were done for airway clearance. Thick "limestone like" mucus was reported by Bruyneel et al (13). Bronchoscopic mucus plug removal improved oxygenation and ventilation in 28% of cases (11). Difficult to manage airway secretion requiring frequent bronchoscopies was also reported by more researchers (9, 10, 17). A recent study found a higher risk of mortality in patients who required therapeutic bronchoscopy for mucus plugging (20). Other emergent therapeutic interventions were performed for hemoptysis, assistance with intubations, and management of airway injuries, including stent placement (10–12). **Table 1** summarizes all reported studies regarding bronchoscopy in patients with COVID-19.

Bronchoscopy for diagnosis of SARS-CoV-2 infection has been rightly discouraged. Although bronchoalveolar lavage (BAL) may provide the highest diagnostic yield (21), appropriately performed

RT-PCR of the upper airway specimen is also highly sensitive (22). Additionally, chest CT can offer further diagnostic clues (23). Several studies reported a positive yield from BAL in a significant number of patients with two negative RT-PCR from nasopharyngeal swab (10, 12, 16). However, this result is not surprising as it had been shown that the positivity of the lower respiratory tract sample might decline slower than the upper respiratory tract (24).

Appropriate determination of secondary pulmonary infection is essential. A significant number of COVID-19 patients have been reported to have suffered from superadded bacterial and fungal infections (25). Chang et al (14) identified a secondary bacterial infection (SBI) in 65% of their patients. Similarly, Mehta et al (17) and Bruyneel et al (13) reported SBI in 54% and 59%, respectively. Baron et al (18) demonstrated fungal infection among 25% of their cohort, whereas Mehta et al (17) found evidence of fungal involvement in 7%. Bronchoscopy aided in the appropriate selection of antibiotics in a significant number of patients. Torrego et al (9) needed to change antibiotics following bronchoscopy in 83% of patients diagnosed with SBI. Other authors reported such changes in approximately 30% of patients (13, 17, 18). The higher occurrence of SBI in these patients is likely related to their severity of illness and the necessity of mechanical ventilation. The organisms responsible for SBI were not different from pathogens known to cause ventilator-associated pneumonia in non–COVID-19 acute respiratory distress syndrome (9). As systemic corticosteroid has become the standard of care for critically ill patients with SARS-CoV-2 pneumonia, early identification of secondary bacterial and fungal infection is vital (26). Patrucco et al (16) identified 15 patients with a noninfectious diagnosis that could have been missed unless bronchoscopy had been performed. Eight of these patients suffered from pulmonary malignancy, four from alveolar hemorrhage, two were diagnosed with organizing pneumonia, and one with vasculitis. There had been concerns that a delay in bronchoscopic evaluation may lead to a cancer epidemic in the near future.

The risks of periprocedural complications and SARS-CoV-2 transmission among HCWs during bronchoscopy appear to be low. An outbreak is unlikely if appropriate safety measures are followed. Therefore, any patient determined to benefit from a bronchoscopic procedure should undergo such intervention. We believe that the time has come to perform all bronchoscopic procedures confidently and safely in a timely manner to prevent any potential for future harm for our patients.

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Dr. Saha conceptualized the study. All authors were involved in the collection of data. Drs. Saha, Chaudhary, Saha, and Bonnier analyzed the data and prepared the initial article. All authors finalized the article.

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REFERENCES

1. Ensminger SA, Prakash UB: Is bronchoscopic lung biopsy helpful in the management of patients with diffuse lung disease? *Eur Respir J* 2006; 28:1081–1084
2. Jin F, Mu D, Chu D, et al: Severe complications of bronchoscopy. *Respiration* 2008; 76:429–433
3. Tran K, Cimon K, Severn M, et al: Aerosol generating procedures and risk of transmission of acute respiratory infections to healthcare workers: A systematic review. *PLoS One* 2012; 7:e35797
4. Zietsman M, Phan LT, Jones RM: Potential for occupational exposures to pathogens during bronchoscopy procedures. *J Occup Environ Hyg* 2019; 16:707–716
5. Wahidi MM, Lamb C, Murgu S, et al: American Association for Bronchology and Interventional Pulmonology (AABIP) statement on the use of bronchoscopy and respiratory specimen collection in patients with suspected or confirmed COVID-19 infection. *J Bronchology Interv Pulmonol* 2020; 27:e52–e54
6. Luo F, Darwiche K, Singh S, et al: Performing bronchoscopy in times of the COVID-19 pandemic: Practice statement from an international expert panel. *Respiration* 2020; 99:417–422
7. Çelebi G, Pişkin N, Çelik Bekleviç A, et al: Specific risk factors for SARS-CoV-2 transmission among health care workers in a university hospital. *Am J Infect Control* 2020; 48:1225–1230

8. Keeley AJ, Evans C, Colton H, et al: Roll-out of SARS-CoV-2 testing for healthcare workers at a large NHS Foundation Trust in the United Kingdom, March 2020. *Euro Surveill* 2020; 25:2000433
9. Torrego A, Pajares V, Fernández-Arias C, et al: Bronchoscopy in patients with COVID-19 with invasive mechanical ventilation: A single-center experience. *Am J Respir Crit Care Med* 2020; 202:284–287
10. Mondoni M, Papa GFS, Rinaldo R, et al: Utility and safety of bronchoscopy during SARS-CoV-2 outbreak in Italy: A retrospective, multicenter study. *Eur Respir J* 2020; 56:2002767
11. Loor K, Álvarez A, Felipe Montiel A, et al: Safety, diagnostic, and therapeutic value of flexible bronchoscopy in critically ill COVID-19 patients. *Can J Anaesth* 2021; 68:434–435
12. Guarino C, Cesaro C, Fiorentino G, et al: Bronchoscopy in COVID-19 patients: When, how and why. Experience in clinical practice. *Monaldi Arch Chest Dis* 2021; 91
13. Bruyneel M, Gabrovska M, Rummens P, et al: Bronchoscopy in COVID-19 intensive care unit patients. *Respirology* 2020; 25:1313–1315
14. Chang SH, Jiang J, Kon ZN, et al: Safety and efficacy of bronchoscopy in critically ill patients with coronavirus disease 2019. *Chest* 2021; 159:870–872
15. Gao CA, Bailey JI, Walter JM, et al: Bronchoscopy on intubated patients with COVID-19 is associated with low infectious risk to operators. *Ann Am Thorac Soc* 2021; 18:1243–1246
16. Patrucco F, Albera C, Bellocchia M, et al: SARS-CoV-2 detection on bronchoalveolar lavage: An Italian multicenter experience. *Respiration* 2020; 99:970–978
17. Mehta R, Bansal S, Kumar A, et al: Bronchoscopy in COVID-19 ARDS patients on mechanical ventilation – A prospective study. *medRxiv* 2021.02.02.21250362
18. Baron A, Hachem M, Tran Van Nhieu J, et al: Bronchoalveolar lavage in patients with COVID-19 with invasive mechanical ventilation for acute respiratory distress syndrome. *Ann Am Thorac Soc* 2021; 18:723–726
19. Menter T, Haslbauer JD, Nienhold R, et al: Postmortem examination of COVID-19 patients reveals diffuse alveolar damage with severe capillary congestion and variegated findings in lungs and other organs suggesting vascular dysfunction. *Histopathology* 2020; 77:198–209
20. Arenas-De Larriva M, Martín-DeLeon R, Urrutia Royo B, et al: The role of bronchoscopy in patients with SARS-CoV-2 pneumonia. *ERJ Open Res* 2021; 7:00165–02021
21. Wang W, Xu Y, Gao R, et al: Detection of SARS-CoV-2 in different types of clinical specimens. *JAMA* 2020; 323:1843–1844
22. Sethuraman N, Jeremiah SS, Ryo A: Interpreting diagnostic tests for SARS-CoV-2. *JAMA* 2020; 323:2249–2251
23. Fang Y, Zhang H, Xie J, et al: Sensitivity of chest CT for COVID-19: Comparison to RT-PCR. *Radiology* 2020; 296:E115–E117
24. Wölfel R, Corman VM, Guggemos W, et al: Virological assessment of hospitalized patients with COVID-2019. *Nature* 2020; 581:465–469
25. Chong WH, Saha BK, Ramani A, et al: State-of-the-art review of secondary pulmonary infections in patients with COVID-19 pneumonia. *Infection* 2021; 49:591–605
26. Horby P, Lim WS, Emberson JR, et al: Dexamethasone in hospitalized patients with Covid-19. *N Engl J Med* 2021;384:693–704