Bronchoscopy on Intubated Patients with COVID-19 Is Associated with Low Infectious Risk to Operators

Bacterial coinfections in viral pneumonia are well described and are associated with significant mortality (1). Preliminary coronavirus disease 2019 (COVID-19) studies report bacterial coinfection (2), with higher rates associated with fatal outcomes (3). Appropriate treatment of bacterial coinfection may therefore improve outcomes (4). Accurate diagnosis of bacterial superinfection in ventilated patients with COVID-19 is important for appropriate antibiotic stewardship (5, 6).

Bronchoalveolar lavage (BAL) with quantitative cultures is helpful (7) and is the standard in our intensive care unit (ICU) for both clinical and research purposes (2, 8). Endotracheal aspirates have been shown to be inferior to BAL (9, 10), involve a break in the closed ventilator circuit, and induce cough (11, 12). Nonbronchoscopic BAL has similar aerosol-generating potential. We therefore shifted to a safety-modified bronchoscopic BAL technique for suspected COVID-19 pneumonia in our institution.

Concern that bronchoscopy exposes healthcare workers by generating aerosols (13) prompted professional society guidelines to discourage bronchoscopy in patients with COVID-19. However, this recommendation was based only on expert opinion (14, 15), with a paucity of data. In a single-center report, one of two bronchoscopists developed COVID-19 and had to be replaced by a third, who remained uninfected for the duration of the study (16). Other studies mentioned low provider infection rates, though details are not provided (17).

Given our high volume of COVID-19 BALs (greater than 450 to date) on more than 280 ventilated patients with COVID-19, we designed the following study to assess the incidence of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection and seropositivity among bronchoscopists. Other studies from our institution (2, 18) show the typical patient being a male in his 60s; in our study comparing nasopharyngeal (NP) and BAL samples once intubated, the median duration between samples was 1 day (interquartile range [IQR], 1–2.75 d), demonstrating most patients underwent bronchoscopy early in their course. From these other studies, participants had an average of 1.63 BAL (range, 1–9) samples collected.

A complete list of the NU COVID Investigators may be found before the beginning of the References.

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Methods

We surveyed all clinical faculty and fellows in our Pulmonary and Critical Care Division from July 30, 2020, to August 14, 2020 (survey available on request). Participants estimated the number of COVID-19 BALs that they performed, the number of weeks caring for ICU patients with COVID-19, and the results of any personal SARS-CoV-2 testing from March until August 14th. Participants assessed the difficulty of COVID-19 BALs compared with routine ICU BALs using a score ranging from 1 (easier) to 10 (harder). COVID-19 exposures outside of work were also queried. No identifiers were collected, and all respondents were offered the choice to decline to participate. The Vice Dean of Education and our Program Director gave permission to survey trainees. This study was deemed exempt by our institutional review board (STU00213164).

SARS-CoV-2 testing. NP testing for SARS-CoV-2 by polymerase chain reaction (multiple platforms) was performed on providers at the discretion of our hospital's infection control team, either in response to symptoms, after a known exposure, or as routine preprocedure screening. Serology (Architect SARS-CoV IgG; Abbott) testing was offered to all medical staff by our hospital.

COVID-19 bronchoscopy protocol. The decision to perform bronchoscopy was at the discretion of the ICU team, and bronchoscopies were performed by pulmonary critical care attendings and/or pulmonary/interventional pulmonary fellows. Our typical practice was to perform bronchoscopy on intubation while the patient remained neuromuscularly paralyzed from induction to confirm or rule out COVID-19 infection and to evaluate for any bacterial coinfection. Repeat bronchoscopies were performed as clinically indicated in response to concern for infection or otherwise at the discretion of the ICU team.

The full modified protocol is available online (19). Nurses and respiratory therapists were not in the rooms during the actual bronchoscopy. Personal protective equipment (PPE) included an N95 mask, eye protection, gloves, gown, and hair protection. Bronchoscopy was performed with a disposable Ambu aScope (Ambu, Inc.) bronchoscope. Patients were sedated per ICU protocols or at the proceduralist's discretion. Administration of cisatracurium (0.1–0.2 mg/kg) to minimize coughing during bronchoscopy was recommended. The endotracheal tube was clamped, and the inspiratory limb of the ventilator was transiently disconnected while the ventilator circuit was manipulated to accommodate scope placement.

The protocol was developed early in the pandemic by a multidisciplinary team and distributed to bronchoscopists online, through e-mail, and within the hospital's COVID-19 ICU protocols manual. Although protocol adherence was not specifically monitored, most of the providers were taught the protocol by our interventional pulmonary faculty, who also performed a large number of the bronchoscopies.

Statistical analyses. Not all continuous data were normally distributed, and so median values with IQRs were reported. Nonparametric analyses included Mann-Whitney U test and Spearman's rank correlation for continuous variables. Kruskal-Wallis rank testing was used to compare values across multiple categories.

Table 1. Survey results

	Total	Attendings	Fellows
Total surveyed providers	52	31	21
Responded to survey	47		
Agreed to complete survey	45	27	18
Weeks of COVID-19 ICU service			
0	9	7	2
1	2	2	0
2	3	1	2
3	4	4	0
4	8	6	2
>5	19	7	12
COVID-19 BALs			
0	10	8	2
1–10	9	6	3
10–30	15	9	6
30–60	5	0	5
>60	6	4	2
Perceived difficulty scores, median (IQR)	6 (6–7)	6 (6–7)	6.5 (5.25–7)
Testing results			
Had SARS-CoV-2 NP testing	18	9	9
Positive NP result	0	0	0
Had SARS-CoV-2 antibody testing	36	23	13
Positive serology result	1	1	0

Definition of abbreviations: BAL = bronchoalveolar lavage; COVID-19 = coronavirus disease 2019; ICU = intensive care unit; IQR = interquartile range; NP = nasopharyngeal; SARS-CoV-2 = severe acute respiratory syndrome coronavirus 2.
Pulmonary and critical care fellows and attendings were surveyed as to their weeks on service, number of COVID-19 BALs, perceived procedure difficulty, and SARS-CoV-2 test results.

Results

Forty-five of 52 clinical pulmonary and critical care faculty and fellows agreed to participate (90% response rate), including 18 fellows and 27 faculty members (Table 1). The majority (35/45; 78%) performed at least one COVID-19 BAL, with most respondents performing between 10 and 30.

Of respondents, 42% spent more than 5 weeks on a COVID-19 ICU service. The number of weeks on COVID-19 ICU service correlated with bronchoscopy volume (Spearman $r = 0.66$; $P < 0.05$). The overall median perceived difficulty score was 6 (6–7) and did not correlate with amount of training, bronchoscopy volume, or time spent on ICU service with patients with COVID-19 ($P > 0.05$). Two respondents reported performing bronchoscopy without full PPE under emergent situations, and 12 reported performing bronchoscopies without following the full protocol.

Of all respondents, 18/45 (40%) had NP testing, and 36/45 (80%) had serology testing. Of the subset of 35 providers performing COVID-19 BALs, 16/35 (46%) underwent at least one NP swab for SARS-CoV-2; five had a respiratory illness that prompted their testing, and eight were tested for screening purposes. No respondent reported a positive test. SARS-CoV-2 serology was negative on all but one of the 27/35 (77%) bronchoscopists tested. This individual had two sets (one positive, the second negative). This individual spent more than 5 weeks on a COVID-19 ICU service and performed 10–30 bronchoscopies but had no febrile respiratory symptoms.

Discussion

Our data represent the first detailed report of infectious risks to providers from a large-volume center that routinely incorporates BAL as part of critical care for patients with and without COVID-19 respiratory failure. We hypothesized that careful bronchoscopy technique can limit infectious risk. Although limited to a single center, our data suggest that the risk of transmitting COVID-19 to providers performing BAL is low. No provider developed COVID-19, and only one had positive serology. Our cohort's seropositivity rate was actually lower than what was found among all healthcare workers at our institution (4.8%), although they also found that bronchoscopy was not associated with increased seropositive rates (20).

Our group supports adherence to evidence-based critical care during the COVID-19 pandemic (21). Professional society guidelines cautioning against bronchoscopy for patients with COVID-19 (14, 15) are only based on expert opinion. Initial concerns about the safety of bronchoscopy in patients with COVID-19 overestimate the risk of provider infection, and our results are reassuring to the bronchoscopist community.

This survey was not a formal study of our specific bronchoscopy protocol. However, we hypothesized that careful technique during bronchoscopy can limit infectious risk. Principles of our protocol included *1*) limiting the number of providers in the room, *2*) minimizing aerosol generation by with clamping the endotracheal tube and disconnecting the inspiratory limb of the ventilator during manipulations, *3*) minimizing cough by neuromuscular blockade or heavy sedation and instillation of lidocaine into the tracheobronchial tree, and *4*) use of a disposable bronchoscope. We also had a small number of highly skilled providers (our interventional pulmonary team) performing a high number of the BALs. The interventional pulmonary team volunteered during the pandemic to provide this service for a variety of reasons, including the high workload of primary attending pulmonary critical care faculty/fellows, increased health risk of some fellows and faculty, and coverage by non–pulmonary critical care medicine staff and fellows for some cases. We worried that the increased number of steps, attention to special points, and burden of PPE would increase procedure difficulty for providers. Fortunately, most providers believed that the bronchoscopies following the protocol were only slightly more difficult than routine ICU bronchoscopy, given the increased number of steps, greater care to avoid circuit breaks, fewer providers, and increased amount of PPE. We suspect that other centers may have similar protocols, and a more scientific exploration of techniques would be needed to comment on protocol efficacy compared with standard procedure with just additional PPE.

Our study has limitations. First, this is a retrospective survey of providers and their recollection. Electronic medical records were not monitored to respect our colleagues' privacy, but we instead used voluntary responses. Bronchoscopy protocol adherence was not monitored explicitly, and some operators reported less than complete compliance. Although we were unable to capture a 100% response rate, our results are higher than most physician survey response rates (22). Despite testing being offered to all providers, only a subset was actually tested, and our results may therefore underrepresent the true infectious risk; it is also possible that asymptomatic infections were missed if providers did not seek testing in a short time period after performing COVID-19 BALs. We also did not gather specific time points of testing and cannot correlate test results directly relative to

when BAL was performed and how far in the patients' time course the BAL was done (infectivity may wane over time, although many BALs were performed upon intubation, during which infectivity would be hypothesized to be high). Some of our institution's bronchoscopy timing can be viewed in the results of other manuscripts on part of our patient cohort (2). Our results may not be generalizable to centers that do not routinely perform BAL in critically ill intubated patients.

In summary, although additional research is needed to inform optimal use of BAL to improve outcomes for ventilated patients with COVID-19, our data suggest that careful, protocolled BAL routinely incorporated into COVID-19 ICU care offers minimal infectious risk to providers.

Author disclosures are available with the text of this letter at www.atsjournals.org.

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Limited Validity of Diagnosis Code–based Claims to Identify *Pseudomonas aeruginosa* in Patients with Bronchiectasis in Medicare Data

To the Editor:

Pseudomonas aeruginosa colonization in bronchiectasis presents a significant burden (1–3). The annual incidence of bronchiectasis in U.S. adults is estimated as 29 per 100,000 persons (4), and the prevalence of *P. aeruginosa* is estimated as 9–33% in non-U.S. studies (2, 3) and as 33% in the U.S. Bronchiectasis and Nontuberculous Mycobacteria Research Registry (BRR) (5). BRR centers are specialized in bronchiectasis care, and population-based data representative of the U.S. population are needed to better understand the burden of *P. aeruginosa* in bronchiectasis. Medicare data have potential utility in studying *P. aeruginosa* in the high-risk setting of bronchiectasis because Medicare beneficiaries represent an older U.S. population (6), the age group primarily affected by bronchiectasis. Administrative healthcare data have been used to evaluate disease trends of bronchiectasis (4, 7), but the validity of using Medicare claims to identify *P. aeruginosa* infection is unknown. Accordingly, we validated Medicare claims using the BRR as a gold standard.

We identified patients with a bronchiectasis diagnosis (*International Classification of Diseases, Ninth Revision, Clinical Modification* [ICD-9-CM] codes 494.0 or 494.1) from the national 2006–2014 Medicare data set. We linked Medicare data to the BRR, a prospective cohort of patients with bronchiectasis enrolled from 13 U.S. clinical sites (5, 8). The Medicare observation period began on the later date of enrollment or data start (January 1, 2006) and ended on the earlier date of coverage end or data end (December 31, 2014). The BRR observation started 24 months before enrollment and ended at loss to follow-up. Linked patients with an overlap between BRR and Medicare observation were examined, including inpatient and outpatient ICD-9-CM claims for *P. aeruginosa* infection and excluding claims and cultures outside this overlap.

We explored the primary case definition of ICD-9-CM code 482.1 (*Pseudomonas* pneumonia) given by a clinician as well as alternate definitions using codes 482.1 and/or 041.7 (*Pseudomonas*, unspecified site). "True" cases of *P. aeruginosa* infection were identified on the basis of culture positivity in the BRR. We calculated the positive predictive value (PPV) as the proportion of those meeting the code-based definition who had a positive culture result in the BRR

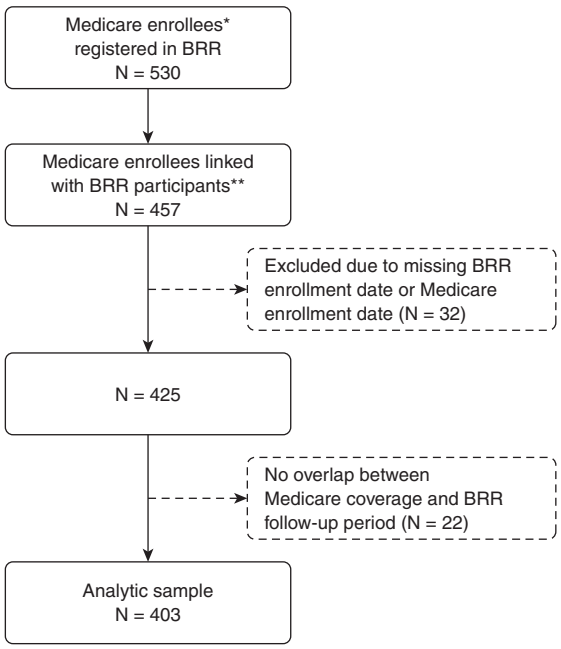

Figure 1. Flow diagram of the analytic sample of patients linked between 2006 and 2014 among Medicare enrollees and U.S. Bronchiectasis and Nontuberculous Mycobacteria Research Registry (BRR) subjects. *From parts A, B, and D but not C, excludes those with cystic fibrosis and a history of human immunodeficiency virus or organ transplant. **BRR subjects enrolled at 7 geographically varied sites (Columbia University Medical Center, Georgetown University Hospital, National Jewish Health, University of North Carolina at Chapel Hill, Oregon Health & Science University, University of Texas Health Science Center, and Mayo Clinic); subjects from these 7 of the 13 enrolling sites were available for linkage. The solid lines represent inclusion criteria and the dotted lines represent exclusion criteria.

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