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COMMENTARY

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# Risk of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) transmission during bronchoscopy in the intensive care unit

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a novel coronavirus responsible for the ongoing coronavirus disease 2019 (COVID-19) pandemic. Acute respiratory distress syndrome due to SARS-CoV-2 pneumonia is the primary cause of mortality in patients with COVID-19. Approximately 15% of hospitalized patients with COVID-19 require intensive care unit (ICU) admission for mechanical ventilation.

Bronchoscopy is a minimally invasive procedure often performed in the ICU for a number of diagnostic and therapeutic indications. There are several reasons why a bronchoscopic evaluation may be crucial for patients with COVID-19: (1) some patients might have a false negative PCR on nasopharyngeal (NP) swab for SARS-CoV-2 and mislabelling a patient would be important for epidemiologic and infection control purposes, (2) blockage of airways by mucus plugs is a common complication of COVID-19 and associated with worsening hypoxia and (3) identification of secondary bacterial or fungal superinfection is critical, as a delay in appropriate antimicrobial therapy is associated with significantly worse outcomes.

However, due to the increased risk of aerosol generation containing SARS-CoV-2 particles during bronchoscopy, occupational transmission of COVID-19 among healthcare workers (HCWs) has been a major concern. Moreover, the risk of viral transmission during bronchoscopy may also be accentuated by the close proximity of the bronchoscopist and the duration of the procedure. As critically ill COVID-19 patients have a higher viral load in their airways than patients with mild sickness, the risk could be greater. As a result, most societal guidelines at the beginning of the pandemic cautioned against routine bronchoscopy in patients with COVID-19 pneumonia. Nonetheless, this is based on expert opinion, and data to support this notion are scarce.

Several recently published cohort studies (Table 1) have assessed the risk of contracting COVID-19 during bronchoscopy among bronchoscopists and other bedside HCWs in mechanically ventilated ICU patients. These studies have included more than 650 patients who underwent approximately 1200 bronchoscopic procedures. When the exact number of bronchoscopists were specified, 60 bronchoscopists performed a total of 1008 procedures (average of 16.8 procedures).[1–6] The number of bronchoscopies performed by individual operators ranged between 14 and 42. Both attending and trainee physicians performed the bronchoscopies.[2,3] The bronchoscopies were performed between 1 and 16 days after the institution of mechanical ventilation. One study specified the duration of the bronchoscopy as being less than 10 min.[1] No significant difference in the perceived level of difficulty was reported based on the experience or training of the operator.[3]

Among the 60 bronchoscopists, only two were infected by SARS-CoV-2. No infections were reported among bedside nurses, respiratory therapists or technicians. One bronchoscopist was acutely infected during the second week of the study, requiring replacement.[1] The other operator spent 9 weeks in the ICU and could have contracted the infection at times other than the bronchoscopy.[3] These data are intriguing because the transmission rate of SARS-CoV-2 among HCWs has been reported to be much higher. For example, transmission risk among HCWs was as high as 18% in England and 7.1% in Turkey. In the United States, a tertiary care centre reported a seropositivity of 4.1% among HCWs.

There was significant heterogeneity among studies regarding methods used to identify HCWs who contracted COVID-19 during bronchoscopy. These modalities included (a) clinical observation, (b) clinical observation followed by molecular testing by nucleic acid amplification (NAA) testing if symptoms emerged, (c) serologic testing and (d) a combination of both NAA and serologic testing. Mehta et al. reported clinical surveillance followed by real-time PCR (RT-PCR) of the NP specimen if the HCW became symptomatic.[5] In contrast, Baron et al. performed serologic testing for at-risk individuals.[6] Chang et al. primarily used RT-PCR, whereas Gao et al. used both RT-PCR and serologic testing.[2,3] Some authors reported a positive diagnosis by non-specified test(s).[4] The follow-up period also varied. Most studies did not specify the exact follow-up period. One study[2] followed up at-risk individuals for 2 weeks after the last bronchoscopy, and two others reported following for the duration of the study.[3,5]

Bronchoscopy was performed following the general guideline provided by the World Health Organization (WHO), Centers for Disease Control and Prevention (CDC) and other professional societies. Flexible bronchoscopy was the preferred modality, and all studies reported using a disposable bronchoscope. Bruyneel et al. reused the disposable bronchoscope for 15 patients when they required repeat procedures. The bronchoscopes were handled the standard way by the staff, and no one involved in the process was

  

**TABLE 1** Studies reporting bronchoscopy in mechanically ventilated patients with COVID-19

| Author | Study design | COVID-19 diagnosis for patients | Setting | Age median (IQR)/ mean ± SD | Sex | Number of patients | Number of bronchoscopies | Total number of bronchoscopists | Protective equipment |
|---|---|---|---|---|---|---|---|---|---|
| Chang et al.[2] | Retrospective study | Positive RT-PCR of NP swab | Mechanically ventilated ICU patients | 62<br>IQR (47–69) | M, 87 (83.1%) | 107 (33% of all intubated patients) | 241 | 10 | Hair cover, N95 mask, face shield, gown and gloves |
| Gao et al.[3] | Observational retrospective study by survey of HCWs | Positive RT-PCR of NP swab<br>Patients with negative test but still suspected to have COVID-19 | Mechanically ventilated ICU patients | NS<br>Reported as 60s | Male predominant | 280 | More than 450 | 35 | Hair cover, N95 mask, face shield, gown and gloves<br>Two bronchoscopists performed emergent procedure without full PPE |
| Torrego et al.[1] | Observational retrospective study | Not specified | Mechanically ventilated ICU patients | NS | NS | 93 | 101 | 3 | N95 or FPP3 goggles, double gloves, plastic protective gown including head and neck cover |
| Bruyneel et al.[4] | Observational retrospective study | 30 confirmed by RT-PCR<br>Two suspected from CT chest | Mechanically ventilated ICU patients except three patients | 59 ± 8.5 years | NS | 32 | 90 | 7 (3 main) | FFP2<br>Double layered disposable medical protective uniform<br>Double layer of long disposable latex gloves<br>Head cover with powered air-purifying respirator |
| Mehta et al.[5] | Prospective observational study | Confirmed by RT-PCR | Mechanically ventilated ICU patients | 62.1 ± 11.5 years | M, 51 (83.6%) | 61 | 98 | 3 | P-100 respirator<br>Impermeable coverall<br>Face shield<br>Double layered gloves |
| Baron et al.[6] | Retrospective observational study | Confirmed by RT-PCR<br>Two patients had suspected COVID-19 with negative RT-PCR | Mechanically ventilated ICU patients | NS | NS | 24 | 28 | 2 | NS |
| Loor et al.[7] | Retrospective study | Confirmed by RT-PCR | Mechanically ventilated ICU patients | 60 (54–67) years | M, 72% | 75 | 222 | NS | Safety glasses<br>Gown<br>Double gloves Cap<br>Shoe cover<br>FFP3<br>Most patients were not in negative pressure room |

(Continues)

**TABLE 1** (Continued)

| Author | Ventilator management during bronchoscopy | Number of other HCWs | Follow-up period | Method for estimation of positive transmission | Number of infected bronchoscopist | Number of infected HCWs | Outcome if infected |
|---|---|---|---|---|---|---|---|
| Chang et al.[2] | On standby mode, disconnected from the patient during bronchoscopy<br>If the oxygen saturation dropped below 90%, the patient underwent preoxygenation | Bedside nurse immediately available outside | 2 weeks after the last bronchoscopy | RT-PCR assay of NP swab | None | None | N/A |
| Gao et al.[3] | ET clamped and inspiratory limb disconnected from the ventilator during bronchoscope insertion<br>Bronchoscopy was performed while the patient underwent mechanical ventilation | Nurses and RTs were not inside the room during bronchoscopy | Duration of the study | RT-PCR assay of NP swab and serologic testing | One positive serology in (27/35)<br>All RT-PCR were negative (16/35) | Not specifically tested | No respiratory illness reported by this individual |
| Torrego et al.[1] | Pressure control ventilation | Ancillary staff was not in the room | NS | NS | One, replaced by a third bronchoscopist | NS | NS |
| Bruyneel et al.[4] | NS | One bedside nurse | 3 months | Tested for COVID-19 by non-specified modality | None | None | N/A |
| Mehta et al.[5] | Ventilator was disconnected during bronchoscopy for approximately 1 min at a time | One ICU nurse, one RT and one technician | The duration of the study | Clinical monitoring and if symptomatic, RT-PCR | None | None | N/A |
| Baron et al.[6] | NS | One bedside nurse (out of three dedicated nurses) | NS | Serologic testing | None | None | N/A |
| Loor et al.[7] | Respiratory apnoea only during insertion and removal of the bronchoscope | NS | NS | NS | None reported | NS | N/A |

Abbreviations: COVID-19, coronavirus disease 2019; CT, computed tomography; ET, endotracheal tube; FFP, filtering facepiece respirator; HCW, healthcare worker; ICU, intensive care unit; IQR, interquartile range; N/A, not applicable; NP, nasopharyngeal; NS, not specified; PPE, personal protective equipment; RT, respiratory therapist; RT-PCR, real-time PCR.

infected.[4] Nearly all bronchoscopies were performed in negative pressure rooms. Personal protective equipment (PPE) was used universally across the studies. PPE included respirator masks (N95, filtering face piece level 2 [FFP2] and P100), eyeglasses or face shields, hair covering, gown, gloves and shoe covering. In one study, the bronchoscopists used personal powered air-purifying respirator.[4]

The personnel used for the actual bronchoscopy procedures varied among research teams. Four groups reported one bronchoscopist performing the procedure,[2,4–6] whereas two reports described a secondary bronchoscopist being present in the room.[1,3] The secondary bronchoscopist was responsible for ventilator management during the bronchoscopy. In three studies, no other HCWs were present inside the room during bronchoscopy (the nurse was available outside the room).[1–3]

Bronchoscopy was performed in both supine and prone patients without changing positions. Preoxygenation with 100% oxygen (between 2 and 20 min) was undertaken in two studies.[2,5] Torrego et al. titrated the $FiO_2$ to obtain an $SpO_2$ between 95% and 98%.[1] Apnoeic bronchoscopy was performed in two studies.[2,5] The bronchoscopy was interrupted if the oxygen saturation dropped below 90%. Three papers reported disconnecting the ventilator from the endotracheal tube during insertion and withdrawal of the bronchoscope, but mechanical ventilation was continued during bronchoscopy.[1,3,7] Neuromuscular blockers were generally used to prevent cough, which would further increase the risk of aerosolization.

The current data are limited to assess the risk of SARS-CoV-2 transmission during bronchoscopy accurately. Still, overall, the risk appears to be low when recommended precautions are followed, and the HCWs use appropriate PPE. Until more data are available, the use of a disposable bronchoscope is prudent. We advocate for bronchoscopic evaluation when clinically indicated in mechanically ventilated patients with COVID-19.

## KEYWORDS

bronchoscopy, COVID-19, healthcare worker, ICU, SARS-CoV-2, transmission risk

## CONFLICT OF INTEREST

None declared.

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## REFERENCES

1. Torrego A, Pajares V, Fernández-Arias C, Vera P, Mancebo J. Bronchoscopy in patients with COVID-19 with invasive mechanical ventilation: a single-center experience. Am J Respir Crit Care Med. 2020; 202:284–7.
2. Chang SH, Jiang J, Kon ZN, Williams DM, Geraci TC, Smith DE, et al. Safety and efficacy of bronchoscopy in critically ill patients with coronavirus disease 2019. Chest. 2021;159:870–2.
3. Gao CA, Bailey JI, Walter JM, Coleman JM, Malsin ES, Argento AC, et al. Bronchoscopy on intubated COVID-19 patients is associated with low infectious risk to operators. Ann Am Thorac Soc. 2021;18: 1243–6.
4. Bruyneel M, Gabrovska M, Rummens P, Roman A, Claus M, Stevens E, et al. Bronchoscopy in COVID-19 intensive care unit patients. Respirology. 2020;25:1313–5.
5. Mehta R, Bansal S, Kumar A, Thorbole A, Chakravarthi L, Kalpakam H. Bronchoscopy in COVID19 ARDS patients on mechanical ventilation – a prospective study. medRxiv. [Preprint] posted 5 Feb 2021. https://doi.org/10.1101/2021.02.02.21250362
6. Baron A, Hachem M, Tran Van Nhieu J, Botterel F, Fourati S, Carteaux G, et al. Bronchoalveolar lavage in patients with COVID-19 with invasive mechanical ventilation for acute respiratory distress syndrome. Ann Am Thorac Soc. 2020;18:723–6.
7. Loor K, Álvarez A, Felipe Montiel A, Ferrer R, Roca O, García-de-Acilu M, et al. Safety, diagnostic, and therapeutic value of flexible bronchoscopy in critically ill COVID-19 patients. Can J Anaesth. 2021;68:434–5.

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