



SCIENTIFIC LETTER

Bronchoscopy in COVID-19 intensive care unit patients

To the Editors:

Working in the coronavirus disease 2019 (COVID-19) era has changed the habits of bronchoscopists who perform bronchoscopies. The safety of healthcare workers (HCW), through personal protective equipment (PPE) and an adapted environment, has become the priority when bronchoscopy is required, as it is considered to be an aerosol-generating procedure, with the risk of personal contamination.¹ The Argentine, Spanish, Chinese, German and American bronchology societies have published recommendations, mainly based on previous outbreaks of severe acute respiratory syndrome (SARS), Middle East respiratory syndrome (MERS) and influenza.² However, uncertainties remain, such as the risk of contamination during the procedure or the impact of bronchoscopy on patient management due to the lack of available data on bronchoscopy in COVID-19 patients.

Our manuscript aims to assess the indications, procedures, complications and impact on clinical course of bronchoscopy in intensive care unit (ICU) COVID-19 patients.

We included in our analysis 90 bronchoscopies performed on 32 patients in the ICU between 6 March and 21 April 2020. The study protocol was approved by the Saint-Pierre University Hospital Ethics Committee (CE/20-04-21).

The bronchoscopies were requested by ICU physicians according to the following indications: unexplained worsening of hypoxaemia, microbiological sampling (tracheo-bronchial aspirates or bronchoalveolar lavage) to guide the selection of appropriate antimicrobials or to remove bronchial plugs. They were all performed by a trained bronchoscopist (in total, seven different) and one trained nurse, with disposable bronchoscopes (Ambu aScope Bronchosampler, Ambu, Ballerup, Denmark), as recommended by international scientific societies.²

The staff was protected with the best recommended equipment for conducting bronchoscopies in these patients,^{1,2} including protective mask (FFP2), a double-layered disposable medical protective uniform, a double layer of long disposable latex gloves and head cover with powered air-purifying respirator (PAPR). The PAPR head cover was personalized and reused after disinfection. After the bronchoscopy, the screen and microbiological samples were taken out of the patient's isolation room with necessary precautions to avoid HCW contamination. In 15 patients, disposable bronchoscopes were used more than once in the same patient as they required repeat procedures. For this

purpose, the inner side of the bronchoscope was cleaned with enzymatic detergent and 70% alcohol. The outer side was cleaned using Trio disinfectant wipes (Tristel Trio Wipes System, Tristel Solutions Ltd, Fordham, United Kingdom). The bronchoscope was then stored in a dry closed bag in the patient's isolation room. For performing the next bronchoscopy, the device was taken out of the bag by the nurse wearing a third layer of gloves, cleaned again with Tristel Sporidical Wipe and plugged into the screen. The nurse removed their gloves before starting to assist the bronchoscopist with clean gloves (two layers). The procedure was safe as of the current data, 27 July 2020, none of the bronchoscopy staff has developed COVID-19 symptoms, and the three main bronchoscopists were tested negative for SARS-CoV-2.

Ninety-four patients were admitted to the ICU for COVID-19 during this period. Overall unadjusted mortality through the 21 April 2020 was 19%, whereas unadjusted mortality in patients who underwent a bronchoscopy was 28% ($P = 0.44$). Among the 32 included patients, 30 had PCR-confirmed COVID-19 and the two remaining had a chest computed tomography (CT) very suggestive for COVID-19 pneumonia. Mean age was 59 ± 8.5 years and the majority suffered from comorbidities: hypertension (41%), diabetes (28%) and obesity (22%).

All the procedures were performed in intubated patients (via Halyard multi-access port closed suction system), except for three, performed easily via bite block. The results are summarized in Table 1. Purulent plugs were removed during 33 procedures. In the majority of these patients, very thick and dry plugs (like limestone) were stuck in the endotracheal tube. The tube became quickly dirty and needed to be replaced more often than usual. Among the 51 microbiological samples, 30 resulted in a positive bacterial culture (*Staphylococcus aureus* and *Pseudomonas aeruginosa* were the most frequent agents) that led to antibiotic change in nine cases. Fungi were found in 16 samples. The samples were negative for viral culture ($n = 5$), mycobacteria ($n = 5$) and *Aspergillus* (galactomannan) ($n = 13$). Bronchoalveolar lavage allowed COVID-19 diagnostic confirmation in one additional patient.

The present study shows that bronchoscopy in ICU COVID-19 patients, performed with disposable devices and the best PPE, is a safe procedure for HCW and seems useful in these severe patients mainly for two indications: removing of bronchial plugs and adaptation of antimicrobial agents.

Regarding HCW safety, PPE and PAPR appear to have protected our team adequately as none of the HCW involved in the bronchoscopic procedures has developed COVID-19 symptoms with a follow-up

Received 11 June 2020; invited to revise 27 July 2020; revised 27 July 2020; accepted 4 August 2020

Handling Editors: Philip Bardin and Paul Reynolds

Table 1 Summary of bronchoscopic procedures

Indication (n = 90)	
Removing bronchial plugs	60
Microbiological sampling	22
Unexplained worsening of hypoxaemia	8
Extubation	1
Endobronchial examination	
Few secretions	44
Purulent plugs	33
Mucosal bleeding	11
Diffuse inflammation	7
Normal	7
Endotracheal tube malposition	4
Blood plugs	2
Microbiological sampling	
Tracheobronchial aspirates	34
Bronchoalveolar lavage	17
Complications	
Intubation	1
Bronchoscope technical problem	1

period of 3 months. We must, however, emphasize that working with such PPE, particularly PAPR, induces fatigue (PAPR generates noise up to 75 dB and weighs 2–2.5 kg), overheating and mucosal dryness. It is also time-consuming to get dressed and take off PPE, and infection prevention measures are clearly an additional workload.^{3,4} The discomfort associated with the use of maximal protection is, however, largely offset by the associated safety.

In accordance with bronchology society recommendations,² we worked with disposable bronchoscopes in all patients. This was of real value, as it helped to avoid HCW contamination while manipulating devices after the procedure (outside infected rooms) and allowed for good quality examinations. According to the large demand for bronchoscopy and the high cost of disposable endoscopes, we have decided at this time to re-use devices in the same patient for a new indication. The cleaning procedure, performed inside the patient's isolation room, was systematically performed and easy to apply. As disposable bronchoscopes are dedicated for single use, each institution should clear the use of these devices for repeat use in their own institution.


As shown in the current work, these patients suffer frequently from bacterial and fungal co-infection. Despite the fact that the majority of patients were already receiving broad-spectrum antibiotics, bronchoscopic procedures led to antibiotic adaptation in 18% of the total microbiological samples and in 31% of the positive microbiological samples, a benefit which is clinically relevant to accurate patient management.

Sixty-seven percent of the bronchoscopies were requested to improve ventilation through bronchial plug removal. This is much more common than that observed with ICU non-COVID patients—about 25%⁵ and could be explained by technical ventilation adaptations related to the pandemic. Usually, during invasive ventilation, warming and moistening of inhaled gases is obtained by the addition of heated humidifiers (HH) or heat-moisture exchangers (HME). In case of

thick secretions, HH seems to be superior to HME for avoiding bronchial plugs.⁶ However, according to the necessary current changes in the context of COVID-19, expert consensus recommends using HME rather than HH in ventilated patients in order to prevent nosocomial transmission in critically ill COVID-19 patients.⁷ These recommendations were applied in our centre and have potentially favoured the occurrence of plugs.

The unadjusted mortality rate was slightly higher in the bronchoscopy group compared to the COVID-19 ICU population who did not require bronchoscopy but this difference was not significant. This finding also suggests that the requirement for bronchoscopy is not associated with worse prognosis in COVID-19 patients but caution is required because of the limited sample size. Finally, the ICU mortality observed in our centre was comparable to Italian data, where 26% of critically ill COVID-19 patients died in the ICU,⁸ and lower than the 30–40% recently reported by REVA (Réseau européen de recherche en ventilation artificielle⁹).

In conclusion, bronchoscopy in ICU COVID-19 patients is a safe and useful procedure in these patients who exhibit frequent bronchial plugs, probably related to the use of HME rather than HH. Bronchoscopy can positively impact the clinical course of these patients as it frequently allows antibiotic treatment adaptation in this very fragile population whose mortality is high.

Marie Bruyneel,^{1,2}  Maria Gabrovska,^{1,2}
 Peter Rummens,^{1,2} Alain Roman,^{2,3} Marc Claus,^{2,3}
 Etienne Stevens,^{2,3} Philippe Dechamps,^{2,3} Lucas Demey,^{1,2}
 Laurent Truffaut^{1,2} and Vincent Ninane^{1,2}
¹Department of Pneumology, CHU Saint-Pierre, Brussels, Belgium; ²Université Libre de Bruxelles, Brussels, Belgium;
³Department of Intensive Care Medicine, CHU Saint-Pierre, Brussels, Belgium

Correspondence: Marie Bruyneel, Department of Pneumology, Saint-Pierre University Hospital, Rue Haute, 322, 1000 Brussels Belgium. Email: marie_bruyneel@stpierre-bru.be

Key words: bronchoscopy, COVID, intensive care unit, protective personal equipment.

Abbreviations: COVID-19, coronavirus disease 2019; HCW, healthcare worker; HH, heated humidifier; HME, heat-moisture exchanger; ICU, intensive care unit; MERS, Middle East respiratory syndrome; PAPR, powered air-purifying respirator; PCR, polymerase chain reaction; PPE, personal protective equipment; SARS, severe acute respiratory syndrome

Acknowledgement: The authors would like to acknowledge the contribution of medical writer, Sandy Field, PhD, for editing this manuscript.

Author contributions: Conceptualization: M.B., V.N. Formal analysis: M.B., V.N. Investigation: M.B., M.G., P.R., A.R., M.C., E.S., P.D., L.D., L.T. Methodology: M.B., M.C., V.N. Project administration: M.B., M.G., P.R., M.C., E.S. Resources: M.G., P.R., A.R., M.C., E.S., P.D., L.D., L.T. Supervision: M.B., A.R., P.D., V.N. Validation: M.B., M.G., P.R., A.R., M.C., E.S., P.D., L.D., L.T., V.N.

Writing—original draft: M.B., V.N. Writing—review and editing: M.B., M.G., P.R., A.R., M.C., E.S., P.D., L.D., L.T., V.N.

REFERENCES

- 1 Liang T (ed). *Handbook of COVID-19 Prevention and Treatment*, 1st edn. The First Affiliated Hospital, Zhejiang University School of Medicine, 2020.
- 2 Lentz RJ, Colt H. Summarizing societal guidelines regarding bronchoscopy during the COVID-19 pandemic. *Respirology* 2020; **25**: 574–7.
- 3 Houghton C, Meskeel P, Delaney H, Smalle M, Glenton C, Booth A, Chan XHS, Devane D, Biesty LM. Barriers and facilitators to healthcare workers' adherence with infection prevention and control (IPC) guidelines for respiratory infectious diseases: a rapid qualitative evidence synthesis. *Cochrane Database Syst. Rev.* 2020; **4**: CD013582.
- 4 Powell JB, Kim JH, Roberge RJ. Powered air-purifying respirator use in healthcare: effects on thermal sensations and comfort. *J. Occup. Environ. Hyg.* 2017; **14**: 947–54.
- 5 Álvarez-Maldonado P, Núñez-Pérez Redondo C, Casillas-Enríquez JD, Navarro-Reynoso F, Cicero-Sabido R. Indications and efficacy of fiberoptic bronchoscopy in the ICU: have they changed since its introduction in clinical practice? *Int. Sch. Res. Notices* 2013; **2013**: 217505.
- 6 Branson RD. Secretion management in the mechanically ventilated patient. *Respir Care* 2007; **52**: 1328–42.
- 7 Respiratory care committee of Chinese Thoracic Society. Expert consensus on preventing nosocomial transmission during respiratory care for critically ill patients infected by 2019 novel coronavirus pneumonia. *Zhonghua Jie He Hu Xi Za Zhi* 2020; **17**: E020.
- 8 Grasselli G, Zangrillo A, Zanella A, Antonelli M, Cabrini L, Castelli A, Cereda D, Coluccello A, Foti G, Fumagalli R *et al.* Baseline characteristics and outcomes of 1591 patients infected with SARS-CoV-2 admitted to ICUs of the Lombardy region, Italy. *JAMA* 2020; **323**: 1574–81.
- 9 Dupré R, Mandard S. “Le Monde”. 2020. Accessed Apr, 27. Available from URL: https://www.lemonde.fr/planete/article/2020/04/27/coronavirus-la-mortalite-en-reanimation-beaucoup-plus-forte-qu-annoncee-en-france_6037853_3244.html