Bronchoscopy in COVID-19 Patients with Invasive Mechanical Ventilation: A Center Experience

Authors & Affiliations:

Alfons Torrego, MD[1,3,4], Virginia Pajares, MD, PhD[1,3,4], Carmen Fernández-Arias, MD[1,3,4], Paula Vera, MD, PhD[2,3,4], Jordi Mancebo, MD, PhD[2,3,4]

1 Respiratory Medicine Department, Hospital de la Santa Creu i Sant Pau, Barcelona, Spain

2 Intensive Care Department, Hospital de la Santa Creu i Sant Pau, Barcelona, Spain

3 Institut Investigació Biomèdica Sant Pau, Barcelona, Sapin

4 Universitat Autònoma de Barcelona, Spain

Corresponding author:

Alfons Torrego

Respiratory Department, Hospital Santa Creu i Sant Pau

Mas Casanovas, 90

Barcelona (08025)

Spain

Phone: +34 935565972

Fax: +34 935565601

Email: atorrego@santpau.cat

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To the Editor:

Severe coronavirus disease 2019 (COVID-19) caused by SARS-CoV-2 infection leads to acute respiratory distress syndrome (ARDS) and hypoxemic respiratory failure (1).

The University Hospital de la Santa Creu i Sant Pau serves an area of downtown Barcelona, Spain, of about 420.000 citizens. First case of COVID-19 at our hospital was detected on March 7th 2020. The first two cases in the ICU were detected in March 13th and the number of beds dedicated to intensive care multiplied by 4, with 163 new ICU admissions and 139 patients requiring mechanical ventilation between March 13th and April 4th. Fifty-nine patients could be discharged during this period, twenty-three patients died and eighty-one were still in the ICU.

Bronchoalveolar lavage (BAL), bronchial wash and protected specimen brush are bronchoscopic procedures to provide microbiological samples from lower respiratory airways. However, due to risk of viral transmission, bronchoscopy is not routinely indicated for the diagnosis of COVID-19 (2).

Bronchoscopy in COVID-19 critically ill patients has been required to manage complications (atelectasis, haemoptysis, etc.) as well as to obtain samples for microbiological cultures and to assist in the management of artificial airways (guide intubation, percutaneous tracheostomy) (3).

Since no series of intubated COVID-19 patients submitted to bronchoscopy has been published so far, we describe our experience in performing flexible bronchoscopies in COVID-19 patients with severe acute hypoxemic respiratory failure requiring invasive mechanical ventilation during the first 3 weeks of the

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epidemic outbreak.

Between March 16th and April 4th 2020, a total of 101 bronchoscopies were performed in 93 COVID-19 patients. Eight patients required two bronchoscopies.

Indications for bronchoscopy were: radiological and/or clinical deterioration suggesting possible superinfection (63/101), as well as airways secretion management with/without atelectasis (38/101). Intensivists indicated procedures 6.6 days (range 1-17) after intubation. At the time of indication the median FiO_2 was 0.8 (IQR 0.67-0.82), the median PEEP was 10 cm H_2O (IQR 9-11), and the median PaO_2/FiO_2 ratio was 111 (IQR 103-125).

Procedures were performed either, in supine (74/101) or prone (27/101) position, under usual intravenous sedation and with pressured controlled ventilation mode. Disposable scopes were used in all cases (Ambue®aScope™ 4, Large5.8/2.8, Columbia, MD) and minimal staff attended the procedure bedside (one expert bronchoscopist occasionally accompanied by a staff intensivist). One out of two bronchoscopists got infected with SARS-CoV-2 and developed COVID-19. As a consequence, our colleague had to be replaced by another bronchoscopist during the third week.

Before the procedure, all the necessary equipment and material were prepared outside the patient room, including saline, syringes, mucoactive drugs, microbiological recipients, connections, and bronchoscopy system (scope and screen). No negative pressure room was always available for the procedures due to the variety of locations adapted for intensive care support. As recommended (2), level III of personal protective equipment was used including N95 or FPP3 mask,

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goggles, double gloves, and a plastic protective gown including head and neck cover.

Bronchoscopic examination included orotracheal tube positioning check, direct inspection of tracheal and bronchial mucosa, suctioning of secretions, mucoactive agent instillation if necessary (hypertonic saline combined with hyaluronic acid) and, in 63 cases a mini-BAL with 60cc saline aliquots at room temperature was performed just before the end of procedure for microbiological sampling. The bronchial segment to perform the BAL was chosen according to the radiological information.

Duration of procedures was never more than 10 minutes. Before procedure FiO_2 was increased so as to reach a peripheral oxygen saturation of 95-98%. Bronchoscopy was well tolerated in most cases. Transient drop in pulseoxymeter saturation (spO_2) below 90%, was occasionally observed during procedure. In those patients, the bronchoscope was removed for a few seconds until spO_2 recovery (i.e. >90%). Major desaturation did not force to abort any procedure. The mini-BAL was not associated with a greater number of complications as compared to patients in whom BAL was not performed. Apart from transient drops in spO_2, no other complications were detected during the procedures.

Bronchoscopy results showed normal or mildly hyperemic bronchial mucosa. The presence of diffuse, white and jelly secretions, difficult to suction, was observed in 95% (88/93) of patients. In 12 cases, muco-haemathic plugs occupying the main or lobar bronchi were observed and removed after instillation of saline and a mucolytic agent. Figure 1 shows examples of the described findings, which to the best of our knowledge have not been reported in peer review journals. The fact that we used closed-circuit suctioning systems together with heat and moisture exchangers

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(EdithFlex HME, Vyaire, Helsinki, Finland) may also help explaining why this complication was encountered so often. Since our usual way to provide proper inspired gas conditioning is the use of heated humidifiers, we cannot ascertain if thick secretions are due to the viral infection “per se” or the change in our humidification strategy. Nevertheless, in past scenarios in which our patients used the same kind of passive humidification, this observation was uncommon. Main results are summarized in table 1.

Regarding BAL results, 18/63 (28.6%) had positive cultures for: *Pseudomonas aeruginosa* (n=7), *Staphylococcus aureus* (n=2), *Klebsiella aerogenes* (n=2), *Enterobacter cloacae* (n=2), *Enterobacter faecalis* (n=2), *Escherichia coli* (n=1), *Streptococcus anginosus* (n=1), *Prevotella melaninogenica* (n=1). These results are similar to microbiological flora usually observed in ventilator-associated pneumonia (4). As a result of BAL, a new antibiotic was prescribed in 15/18 (83%) patients. The present isolates do not differ from those obtained during non-epidemic periods (table 1,2). BAL processing did not yield mycobacteria, fungi (including *Aspergillus* sp., verified by microbiological culture) or other viruses. BAL galactomannan was determined only in one patient.

In summary, in critically ill COVID-19 mechanically ventilated patients, airway thick hyper-secretion is the most common complication observed in these patients that can benefit from specific bronchoscopy management. Guided mini-BAL can be of help to confirm a clinical suspicion of superinfection. However, with this observational study it is impossible to weigh the benefits from bronchoscopy to the potential harms to patient and bronchoscopist. A different study design would have been required to address the influence on patient centered outcomes.

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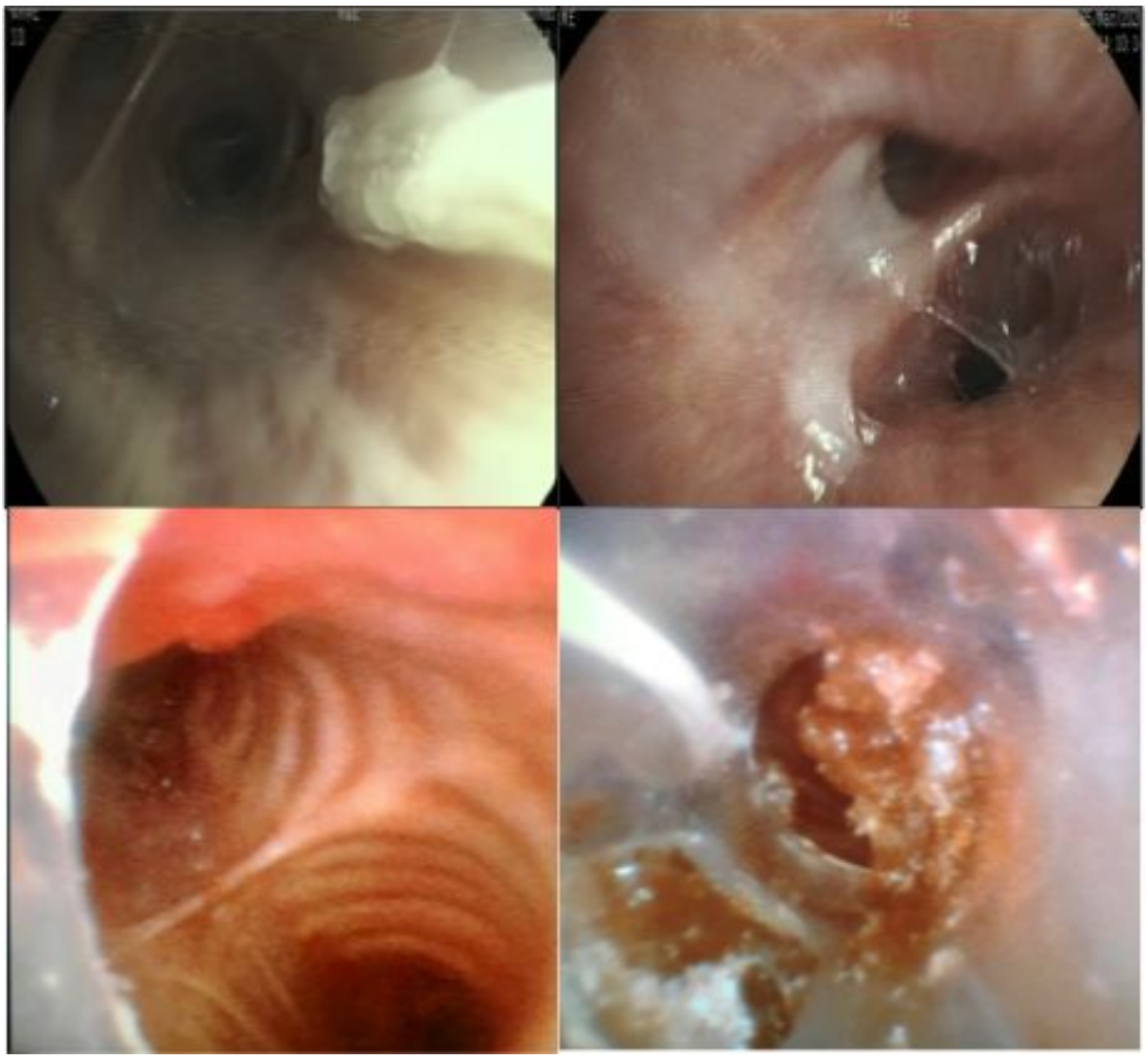
Figure 1



Bronchial findings in COVID-19 cases. White and jelly secretions and normal colour mucosa (top pictures), hyperemic bronchial mucosa (low left) and thick muco-haemathic plug distal to endotracheal tube (low right).

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Table 1

Bronchoscopy in intubated severe COVID-19 patients

Main results summary (n=101)
27% performed in prone position 29% positive BAL cultures 95% presence of airways thick secretions * BAL (60 cc.) was not associated with more desaturation as compared to bronchoscopy without BAL One bronchoscopist (out of three) got infected **
* Possibly related to humidification and closed suctioning system ** We do not have definitive evidence relating the infection to the procedure

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Table 2

Microbiological isolations from ICU bronchoscopic studies in immunocompetent patients during year 2017 (n=137) (left) and COVID-19 patients (n=63) (right).

Microbiological isolations (year 2017) *		**Microbiological isolations (COVID-19, March 2020)**	
Positive results	57 / 137 (41.6 %)	Positive results	18 / 63 (28.6 %)
Polymicrobial	8 (14%)		
Pseudomonas aeruginosa	9 (15.8%)	Pseudomonas aeruginosa	7 (38.8%)
Staphylococcus aureus	6 (10.5%)	Staphylococcus aureus	2 (11.1%)
Enterobacter cloacae	4 (7%)	Enterobacter cloacae	2 (11.1%)
Serratia marcescens	4 (7%)	Enterobacter faecalis	2 (11.1%)
Stenotrophomona maltophilia	3 (5.3%)	Klebsiella aerogenes	2 (11.1%)
Influenza virus	3 (5.3%)	Prevotella melaninogenica	1 (5.3%)
Streptococcus pneumoniae	2 (3.5%)	Escherichia coli	1 (5.5%)
Klebsiella pneumoniae	2 (3.5%)	Streptococcus anginosus	1 (5.5%)
Candida sp.	2 (3.5%)		
Prevotella melaninogenica	2 (3.5%)		
Streptococcus pyogenes	1 (1.7%)		
Actynomices israeli	1 (1.7%)		
Acinetobacter baumannii	1 (1.7%)		
Citrobacter freundii	1 (1.7%)		
Acinetobacter pittii	1 (1.7%)		
Haemophilus influenza	1 (1.7%)		
Streptococcus viridans	1 (1.7%)		
Herpes virus	1 (1.7%)		
Proteus mirabilis	1 (1.7%)		
Enterococcus faecalis	1 (1.7%)		
Escherichia coli	1 (1.7%)		
Klebsiella oxytoca	1 (1.7%)		
Staphylococcus epidermidis	1 (1.7%)		
Acinetobacter ursingii	1 (1.7%)		
Capnocytophaga sp.	1 (1.7%)		
Mycobacterium tuberculosis	1 (1.7%)		

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