

Bronchoscopy and tracheostomy in COVID-19 patients

Broncoscopia y traqueostomía en pacientes con COVID-19

Francina V. Bolaños-Morales^{*}, Teresa de J. Aguirre-Pérez, Patricio Santillán-Doherty^{},
and Julio de J. Herrera-Zamora^{}

Instituto Nacional de Enfermedades Respiratorias Ismael Cosío Villegas, Mexico City, Mexico

Abstract

The COVID-19 pandemic led to an unprecedented surge in critically ill patients, 5 to 20% of whom required invasive mechanical ventilation. Mortality in this group was substantial, and survivors often faced prolonged hospital stays. In this context, bronchoscopy became an invaluable tool for both the diagnosis and management of severe complications in the Intensive Care Unit. Bronchoalveolar lavage demonstrated greater diagnostic sensitivity than nasopharyngeal swabs. However, as an aerosol-generating procedure, bronchoscopy was strictly classified as either urgent or elective, with an emphasis on protecting healthcare personnel, preventing cross-transmission, and optimizing resource utilization. Tracheostomy was subject of considerable debate regarding its timing. During the pandemic, it was recommended to delay the procedure for 14 to 21 days to allow viral load and the risk of transmission to decrease. The procedure played a strategic role in facilitating ventilator weaning, reducing the need for deep sedation, and improving critical care bed turnover. Safety was reinforced through protocols that included planned periods of apnea during key surgical steps and close coordination between the anesthesia and surgical teams. The health crisis reshaped respiratory management, underscoring the importance of a multidisciplinary approach focused on protecting both patients and healthcare professionals.

Keywords: COVID-19. Bronchoscopy. Tracheostomy.

Resumen

La pandemia de COVID-19 generó un aumento sin precedentes de pacientes críticos, donde entre el 5 y 20% requirió ventilación mecánica invasiva. La mortalidad en estos casos alcanzó niveles significativos, con sobrevivientes enfrentando estancias hospitalarias prolongadas. En este contexto, la broncoscopia surgió como una herramienta invaluable, tanto para el diagnóstico como para el manejo de complicaciones graves en la unidad de cuidados intensivos (UCI). El lavado broncoalveolar demostró una sensibilidad diagnóstica superior en comparación con los frotis nasofaríngeos. Sin embargo, al ser un procedimiento generador de aerosoles, se categorizó estrictamente en intervenciones urgentes y electivas; priorizando la seguridad del personal, evitando la transmisión cruzada y optimizando los recursos. La traqueostomía presentó controversias sobre su temporalidad; durante la pandemia, se recomendó diferirla entre 14 o 21 días para permitir la disminución de la carga viral y el riesgo de contagio. Este procedimiento fue estratégico para facilitar el destete, reducir la sedación profunda y optimizar la rotación de camas críticas. La seguridad se reforzó con protocolos que incluyeron periodos de apnea controlada durante los pasos quirúrgicos críticos y una comunicación estrecha entre los equipos de anestesia y cirugía. La crisis sanitaria transformó el manejo respiratorio, destacando un enfoque multidisciplinario basado en la protección tanto de pacientes como de profesionales de la salud.

Palabras clave: COVID-19. Broncoscopia. Traqueostomía.

*Correspondence:

Francina V. Bolaños-Morales
E-mail: valezka1976@gmail.com

Date of reception: 16-02-2026
Date of acceptance: 23-03-2026
DOI: 10.24875/NCTE.M26000034

Available online: 21-10-2026
Neumol Cir Torax (Eng). 2025;84(4):310-318
www.revistanct.org.mx

3082-0006 / © 2026 Sociedad Mexicana de Neumología y Cirugía de Tórax. Published by Permanyer. This is an open access article under the license CC BY-NC-ND (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

The COVID-19 pandemic, caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), led to an unprecedented increase in the number of critically ill patients requiring mechanical ventilation, fundamentally transforming medical practice and, in particular, the management of respiratory diseases worldwide. It is estimated that between 5% and 20% of patients hospitalized for COVID-19 developed severe respiratory failure requiring orotracheal intubation.¹

Mortality among patients requiring invasive ventilation was significantly high, ranging from 45% to 50%, and reaching as high as 70-88% in the initial reports from the pandemic. Those patients who survived generally faced prolonged hospital stays, with a median of 13 days of advanced respiratory support.²

Bronchoscopy

Bronchoscopy is considered an aerosol-generating procedure. During the COVID-19 pandemic, this made bronchoscopy a high-risk procedure for healthcare workers, owing to the elevated viral load present in the airways of patients infected with SARS-CoV-2.³

In response to this situation, international scientific societies were compelled to rapidly issue guidelines to stratify the risks and indications for these procedures. At the outset of the pandemic, many institutions postponed non-urgent procedures in order to prioritize efforts against the virus and conserve resources such as personal protective equipment (PPE). Nevertheless, bronchoscopy maintained a critical role in specific situations, both for diagnosis in uncertain cases and for the management of severe complications in critically ill patients.¹

Importance of bronchoscopy during the pandemic

Bronchoscopy has proven to be an invaluable, albeit cautiously used, tool for diagnosis when initial tests, such as nasopharyngeal swabs, yield negative results despite high clinical and radiological suspicion of COVID-19. Bronchoalveolar lavage (BAL) has been observed to have superior diagnostic sensitivity and specificity compared to upper respiratory tract samples, achieving significant diagnostic yields in patients with severe pneumonia. BAL has a sensitivity of up to 93% compared with 63-72% for nasopharyngeal swabs. Beyond its diagnostic function, it is essential for

identifying bacterial or fungal co-infections, which have been reported in up to one-third of mechanically ventilated COVID-19 patients. In the ICU setting, therapeutic bronchoscopy is fundamental for managing complications such as lobar atelectasis caused by thick mucus plugs, massive hemoptysis, or for assisting with procedures such as percutaneous tracheostomy. The ability to remove distal secretions unresponsive to physiotherapy or prone positioning is one of the most common indications in intubated patients. Despite the risks, when performed with appropriate protective measures, it is considered a safe procedure with a low rate of serious complications in this patient population.

To understand the risk associated with bronchoscopy during a pandemic, it is essential to understand epidemiological concepts such as the basic reproduction number (R_0) and the effective reproduction number (R). R_0 represents the expected number of cases directly generated by a single case in a population where all individuals are susceptible; it is a measure of the potential transmissibility of a pathogen. The effective R , on the other hand, is the number of cases generated in the current population at a given point in time, taking into account that not all individuals are still susceptible and that interventions are ongoing.⁴

When the value of R is greater than 1, the infection can spread; when it is less than 1, transmission tends to cease. During the pandemic, it was observed that even with $R < 1$, “superspreading” events can occur, in which a single infected individual transmits the virus to multiple people, particularly in hospital settings where healthcare workers have close contact with vulnerable populations. Bronchoscopy can act as a catalyst for “superspreading” events if adequate precautions are not taken. Interestingly, some studies suggest that, with appropriate PPE, the risk of transmission during bronchoscopy may be lower than during intubation.⁵

Due to the risk of infection, the use of bronchoscopy has been strictly stratified between urgent and elective procedures:³

- Urgent bronchoscopy: justified when the clinical benefit outweighs the risk of transmission – those situations that are life-threatening. This includes cases of massive hemoptysis, central airway obstruction by foreign bodies or tumors, severe lobar atelectasis caused by mucus plugs unresponsive to physiotherapy, and assistance with difficult intubations or tracheostomies.⁶
- Elective bronchoscopy: not recommended as a first-line tool for diagnosing SARS-CoV-2 infection; procedures should preferably be postponed until

the epidemiological situation is more favorable (ideally more than 2 weeks) or until the patient has a negative SARS-CoV-2 test. A notable exception is lung cancer, where delays in diagnosis and staging can negatively affect survival.

Rigid bronchoscopy is reserved for situations requiring complex instrumentation, such as massive hemoptysis, difficult-to-manage foreign bodies, pediatric endoscopy, stricture dilatation, stent placement, and tumor cauterization/fulguration. Flexible bronchoscopy, by contrast, allows a more distal approach within the bronchial tree, enabling higher-quality optical assessment and access to sites that are blind to rigid instruments; it also allows sample collection via lavage, brushing, or direct biopsy, as well as access to the pulmonary parenchyma through transbronchial biopsy.⁷

Protective measures and procedural environment

Strict standards must be met in the procedural environment to minimize the dispersal of droplets and aerosols:

- Procedures should ideally be performed in negative-pressure rooms with at least 12 air changes per hour, although these rooms are not widely available. When available, adequate ventilation with an airflow of at least 160 l/s per patient is required. During hospital reconversion, multiple areas were repurposed for the care of critically ill patients, allowing procedures to be performed at the bedside, thereby avoiding patient transport to the bronchoscopy suite.^{1,8}
- The number of personnel in the room should be limited to the essential minimum (normally two or three).
- The procedure should be performed by the most experienced operator to reduce exposure time.

The use of single-use flexible bronchoscopes is recommended when available, as they require neither reprocessing nor disinfection between patients, thereby minimizing healthcare personnel exposure to aerosols and infectious fomites. This eliminates the possibility of cross-transmission between patients, since the device is used on a single individual and then discarded. The use of disposable devices reduces the waiting time between the request and the performance of the procedure, as there is no need to wait for equipment to be disinfected. Moreover, they can be discarded directly at the point of care, avoiding the transport of contaminated equipment to cleaning areas. Current

fourth-generation devices offer improved image quality and wide angulation ranges, comparable to reusable instruments. They are also available in a wide variety of diameters to accommodate different clinical needs. These systems typically come with reusable portable screens that are easy to clean. Furthermore, they facilitate information management by allowing procedure images or videos to be saved and downloaded easily.

The use of full PPE is mandatory and non-negotiable for all personnel present:^{9,10}

RESPIRATORY PROTECTION

- High-filtration masks such as FFP3 or N95/FFP2 if the former are unavailable.
- Facial and ocular protection: full-face visors or safety goggles.
- Additional physical barriers: devices such as “aerosol boxes” or transparent plastic barriers with hand openings have been developed to help contain droplets during bronchoscope insertion.
- Advanced alternatives: powered air-purifying respirators or dive masks adapted with bacterial/viral filters may be used, offering greater comfort and a clear field of view during prolonged procedures.
- Fluid-repellent gowns.
- Gloves.

In order to continue routine bronchoscopy unit activities for non-COVID patients, a clinical screening filter has been implemented, requiring a reverse transcription-polymerase chain reaction test for SARS-CoV-2 on a nasopharyngeal swab within the 72 hours prior to the procedure.

Ventilatory strategies during the procedure

Airway management varies depending on whether the patient is intubated or not. Prior to the procedure, the patient should receive supplemental with oxygen at a fraction of inspired oxygen (FiO₂) of 100% until oximetry values exceed 95% in order to increase tolerance during apneic periods. In patients with poor apnea tolerance who develop significant oxygen desaturation, it is recommended to withdraw the bronchoscope when the monitor reads 85% and to resume ventilation using a closed circuit. In such cases, the procedure is recommended to be performed in a staged manner during intermittent apnea periods. In non-intubated patients, high-flow oxygen therapy may be used; it is well tolerated during the procedure, although it requires maintaining a surgical mask over the patient’s mouth

to reduce dispersal. Non-invasive ventilation or continuous positive airway pressure via specialized oronasal masks with access ports for the bronchoscope may also be employed.^{11,12} In intubated patients, the use of a rotating adapter with a perforated diaphragm is recommended for inserting the bronchoscope without disconnecting the ventilator circuit, thereby maintaining positive end-expiratory pressure (PEEP) and preventing aerosolization.¹

Sedation and patient management

Sedation plays a crucial role in minimizing cough, the primary driver of aerosolization. Deep sedation or even general anesthesia with neuromuscular blocking agents is preferable in complex cases to ensure patient stability and personnel safety. Outside the ICU setting, the use of short-acting benzodiazepines and opioids is common to improve patient tolerance and reduce the cough reflex.¹³ To ensure safety, the following technical maneuvers are recommended:

1. Inject lidocaine directly through the working channel to anesthetize the vocal cords and minimize the cough reflex.
2. Maintain the bronchoscope at arm's length from the operator.
3. Use low suction pressure and only when strictly necessary.
4. Perform BAL with the smallest possible fluid volume to reduce aerosol formation.

Endoscopic assessment

It is essential that the endoscopic assessment focus on verifying the position of the orotracheal tube or tracheostomy cannula, ensuring an adequate distance from the tracheal carina, along with examination of the trachea, main and lobar bronchi, mucosal appearance, secretion characteristics, and airway patency. The sampling site should be selected based on bronchoscopic findings, prioritizing areas with the greatest quantity of secretions and taking into account the evolution of radiological images, particularly the appearance of new opacities. The BAL volume should be minimal, approximately 60 ml; both BAL and transbronchial pulmonary biopsies are useful procedures for obtaining microbiological samples.¹⁴

Bronchoscope reprocessing

After completing bronchoscopy, strict cleaning protocols must be followed. Some groups have suggested

the use of a double-wash reprocessing program using 50 ml of enzymatic soap diluted in 5 liters of water. The bronchoscopy tower or portable monitor used must always be sanitized before being moved out of the area where the procedure was performed to prevent nosocomial infections.¹⁰

Reusable bronchoscopes must undergo high-level disinfection following the manufacturer's instructions, as the virus is susceptible to standard disinfectants. Personnel must remove PPE in a designated area, and a decontamination shower is recommended afterward. A log of all personnel present must be maintained to facilitate contact tracing in the event of a confirmed exposure.

Conclusions and future of the practice

Bronchoscopy is a safe and essential procedure when performed under rigorous protection standards and with judicious patient selection. Personnel must be adequately trained not only in endoscopic technique but also in the correct donning and doffing of PPE and in environmental management to minimize risks. The pandemic has accelerated the adoption of technologies such as disposable bronchoscopes and has reinforced the importance of evidence-based medicine for critical decision-making in times of uncertainty.

Looking ahead, many of these precautionary measures, particularly in patients with acute respiratory symptoms, will likely become part of standard practice to prevent future outbreaks of infectious disease. Ongoing research into the efficacy of protective barriers and the impact of delays in lung cancer services will be fundamental to optimizing respiratory care in the post-COVID era.⁸

Tracheostomy

During the COVID-19 pandemic, the sudden surge in patients requiring intubation and mechanical ventilation exceeded the capacity of health systems worldwide. This situation made it imperative to immediately implement management strategies that would optimize medical care while simultaneously reducing the risk of transmission to healthcare personnel and addressing the shortage of personal protective equipment.¹⁵

This situation gave rise to controversy regarding the most appropriate timing for tracheostomy, driven by the high mortality in the early stages of the disease, the elevated viral load, and the increased risk of aerosolization during the procedure. During the pandemic,

Table 1. Steps to follow before initiating the anesthetic procedure

Step	Action to be performed
1	A team member will read the protocol steps aloud. The entire team will operate in “closed-loop” communication mode.
2	Confirm each step as it is completed and ask: “Understood?” (await the response “understood” from ALL).
3	The critical point is tracheal puncture and bleeding. If visibility is lost from that point onward or a technical complication occurs, the procedure is halted, the endotracheal tube is advanced toward the puncture site without deflating the cuff, ventilation is resumed, PPE is changed with all necessary precautions if required, and the technical difficulty is resolved.
4	Record the surgical and anesthetic time (start-end).
5	Before handling the patient, the anesthesiologist will have prepared the medications to be used in a pre-established order as indicated in the template.
6	The patient must have an extension on the venous access to facilitate drug administration by the anesthesiologist.
7	The anesthesiologist must familiarize themselves with the patient’s ventilator.
8	The bronchoscopist must position the bronchoscope screen in the cephalic position and to the left of the patient.
9	The assistant must prepare the percutaneous tracheostomy set, verify cuff integrity, and tracheostomy gauge, non-fenestrated.
10	The reader must perform a time-out: Patient’s name Age Bed Diagnosis Procedure to be performed Confirm the correct team (anesthesia, surgeons, and bronchoscopist).
11	Ask whether all team members have adequate visibility with their protective goggles. If anyone does not, pause to correct the problem.
12	Verify that all team members have a third pair of gloves in their size.
13	“Anesthesiologist, administer anesthetics.”
14	“Anesthesiologist, ensure that the airway connections are secure.”
15	“Anesthesiologist, ensure that the patient is ventilated with FiO ₂ at 100% for at least 3 minutes.”
16	“Anesthesiologist, do we have deep neuromuscular blockade?” If the answer is no, we must wait until this is achieved.
17	Place a bolster between the scapulae for maximum cervical extension.
18	“Assistant, perform antisepsis and asepsis of the neck region and place sterile drapes.”
19	“Anesthesiologist, have a syringe for cuff manipulation and a strong clamp ready” (demonstrate).

PPE: personal protective equipment; FiO₂: fraction of inspired oxygen.

tracheostomy practice changed drastically. Whereas in the pre-pandemic era it was performed in 8-13% of patients receiving respiratory support, during COVID-19 the reported rates varied considerably, ranging between 16% and 61%.¹⁶

Traditionally, patients with respiratory failure are candidates for tracheostomy if they require mechanical ventilatory support for 7 to 10 days or more. During the pandemic, the majority of available scientific literature agreed that tracheostomy should be significantly deferred, recommending that it not be performed before 14 days of intubation and, in some cases, waiting up to 21 days in order to allow viral load to decrease and thereby reduce the risk of contagion for the surgical team. However, other authors propose performing it around day 14, rather than delaying it until day 21, as this might favor faster recovery, reduce sedation requirements,

and optimize ICU bed availability by facilitating patient transfer to lower-acuity units.^{17,18}

Tracheostomy is a high-risk aerosol-generating procedure; therefore, the relevant sources emphasize strict protective protocols. The use of level-3 PPE, discussed earlier in this article in the context of bronchoscopy, is mandatory.

One of the most innovative strategies for this procedure was the induction of apnea during critical steps, with the objective of minimizing the dispersal of viral particles in the environment.¹⁵ This measure is complemented by deep sedation and complete neuromuscular blockade, thereby ensuring that the patient has no motor response to airway manipulation. At the Instituto Nacional de Enfermedades Respiratorias Ismael Cosío Villegas (INER) in Mexico City, a step-by-step protocol was developed to maintain absolute control over

Table 2. Steps to follow before initiating the surgical procedure

Step	Action to be performed
1	Surgeon: infiltrate lidocaine.
2	Surgeon: make a skin incision two finger-breadths above the sternal notch, transverse/longitudinal.
3	Second visibility check of protective goggles for all team members. If anyone does not have adequate visibility, pause to correct the problem.
4	Surgeon: blunt dissection with curved Kelly clamp. Question: "Is there significant bleeding?" If the answer is yes, wait until it is controlled.
5	Surgeon: tactile palpation of the 2nd-3rd tracheal ring.
6	Announce: "Everyone listen carefully to the clamping and disconnection process for placing the T-piece."
7	Ventilator on pause; patient in apnea.
8	"Anesthesiologist, clamp the endotracheal tube with a strong clamp."
9	"Anesthesiologist, disconnect the anesthetic circuit."
10	"Anesthesiologist, place the T-piece on the endotracheal tube."
11	Introduce the flexible bronchoscope with adequate lubrication as far as the strong clamp permits.
12	Reconnect the anesthetic circuit.
13	Verify that the circuit connections are secure.
14	"Anesthesiologist, unclamp the endotracheal tube, and bronchoscopist, advance the bronchoscope until the trachea is visualized."
15	Attempt to mobilize the endotracheal tube with the cuff inflated; if unsuccessful, deflate the cuff as needed to allow mobilization.
16	Withdraw the endotracheal tube until the elastic cone is visible.
17	If the cuff was deflated, re-inflate it.
18	Anesthesiologist: resume ventilation of the patient with FiO ₂ 100% for at least 1 minute before continuing.
19	Third visibility check of protective goggles for all team members. If anyone does not have adequate visibility, pause to correct the problem.
20	"Assistant, prepare a needle connected to a syringe with lidocaine" (do not puncture yet).
21	"Assistant, activate the hydrophilic coating of the dilator" (during patient preparation).
22	Suspend mechanical or manual ventilation of the patient (patient in apnea).
23	The following steps will be performed by a surgeon.
24	Puncture between the second and third tracheal rings with a needle connected to a syringe with lidocaine.
25	Once the needle is visualized within the airway (on screen), remove the syringe and introduce the guidewire through the needle (with the J-tip and curve directed downward to the second mark).
26	Remove the needle and cover the orifice with the fingers of the left hand.
27	Introduce the short blue dilator.
28	Cover the orifice with the fingers of the left hand.
29	Introduce the dilator to the black mark together with the white guide catheter.
30	Maintain the guidewire inside at all times.
31	Remove the dilator and leave the guide catheter inside together with the white introducer.
32	Introduce the tracheostomy cannula with the loading dilator corresponding to the cannula. 26 Fr loading dilator corresponds to size 6 cannula. 28 Fr loading dilator corresponds to size 8 cannula.
33	Remove the loading dilator (blue), the guide catheter (white), and the J-shaped guidewire.
34	Place the non-fenestrated cannula.
35	Inflate the tracheostomy cannula cuff, insert the inner cannula, and attach the filter.
36	"Anesthesiologist, connect the ventilation circuit with filter to the tracheostomy."
37	"Anesthesiologist, resume mechanical ventilation."
39	"Anesthesiologist, completely deflate the cuff of the endotracheal tube."
40	The bronchoscopist removes the endotracheal tube, protecting their gloves with gauze, discards it in a biohazardous waste bag, and removes the third pair of gloves.
41	Apply a universal holder to the cannula.

FiO₂: fraction of inspired oxygen.



Figure 1. INER tracheostomy surgical team, 2019-2021.

procedural safety. The steps to be followed were divided into steps prior to initiating the anesthetic procedure (Table 1) and steps prior to initiating the surgical procedure (Table 2). In this protocol, one person was designated as the reader, positioned at the foot of the bed to verify that each indicated action was carried out. As a rule, the reader was not to proceed to the next step until the prior action had been confirmed. Once confirmed, the reader would mark the corresponding checklist item and read the next step in order to minimize distractions. Specific instructions were likewise established for before the procedure, during its performance, and after the surgical event. Once the procedure was completed, a debriefing meeting was held with the participating team (Fig. 1), in which aspects amenable to improvement and actions that could have been performed differently were analyzed.

Ventilatory strategies during the procedure

Specific ventilatory parameters were identified and established, along with clear criteria for physiological stability, the fulfillment of which proved fundamental for safer and more appropriate performance of the procedure.

FiO₂ was generally kept below 60%; some guidelines suggest an even stricter limit of ≤ 40% to consider a patient suitable for the procedure, and the PEEP levels should be moderate, typically set at ≤ 8 mmHg. The ratio of partial pressure of arterial oxygen (PaO₂) to FiO₂, while an indicator of respiratory status rather than a directly adjustable parameter, has proven relevant, as multiple studies reported that patients undergoing tracheostomy presented a mean ratio of ≥ 200.

An “apnea test” is recommended prior to the procedure to simulate tracheostomy conditions. This test consists of pre-oxygenating the patient with an FiO₂ of 1.0 (100%) and adjusting PEEP to 5 cmH₂O in the supine position. If the patient demonstrates rapid desaturation during this test, the procedure should be deferred. During the controlled apnea phase (which typically lasts a median of 3 minutes), the goal is for the minimum oxygen saturation not to decrease significantly; in prospective studies, the median minimum saturation was 95%.^{15,19}

Tracheostomy care in the COVID-19 patient requires maintaining the integrity of the respiratory system to prevent leaks. Tracheostomy is indicated to improve the comprehensive management of the critically ill patient by enabling the following:²⁰

- Facilitation of weaning: it is a key tool for liberating patients from mechanical ventilation more efficiently.
- Reduction of sedation: it permits a decrease in the need for deep sedatives, which promotes early mobilization and reduces complications such as delirium.
- Pulmonary hygiene: it improves the clearance of bronchial secretions and airway toileting.
- Prevention of stenosis: it reduces the risk of laryngotracheal injuries resulting from the constant pressure of the endotracheal tube.

In the pandemic setting, tracheostomy has strategic indications:

- Resource optimization: it facilitates the transfer of patients from the ICU to rehabilitation centers or long-term care facilities, freeing up critical care beds and ventilators for new acutely ill patients.
- Personnel safety: by allowing a closed and stable ventilatory system, it may be preferable to primary extubation in high-risk cases of failure, reducing the need for non-invasive ventilation, which generates more aerosols.²¹

Care

Once the cannula is in place, cuff pressure must be monitored every 12 hours and maintained between 20 and 30 cmH₂O. This ensures a closed system that prevents aerosol leakage and avoids ischemic injury to the tracheal mucosa from overinflation.

Outcomes

A meta-analysis encompassing 2,371 patients concluded that mortality was comparable between those who received early tracheostomy (≤ 14 days after

intubation) and those who received it late. Other systematic review studies reinforce that neither the timing nor the surgical technique accounts for the heterogeneity in mortality outcomes. Although the overall trend shows no change in survival, one specific analysis found that, using a cut-off of 16.5 days, the late tracheostomy group showed higher mortality than the early group, although this finding has not been consistently validated across the literature.¹⁷

While it does not reduce mortality, early tracheostomy is associated with a significant reduction in the duration of mechanical ventilation and a shorter ICU stay. This allows beds and ventilators to be freed up more quickly, which is crucial during pandemic peaks. The reporting of low mortality in tracheostomies performed after 21 days suggests that this outcome may be due to selection bias, as only patients with a realistic probability of survival reach a stable condition at that point in the disease course to undergo the procedure.

Conclusions

The experience gained during the pandemic has transformed airway management in the critically ill patient, confirming that close communication between surgical and anesthesia teams is essential to ensure safety during the critical phases of the procedure.²² Tracheostomy, when performed at the appropriate time and with the necessary precautions, is not only safe but essential for the efficient management of hospital resources and the recovery of patients with severe respiratory failure. International collaboration and large-scale data collection through initiatives such as the Global Tracheostomy Collaborative will continue to refine best practices for future health crises. Ultimately, the pandemic has reinforced the importance of a multidisciplinary, safety-focused, evidence-based approach to tracheostomy management.

Funding

The present work received no funding.

Conflicts of interest

The authors declare no conflicts of interest.

Ethical considerations

Protection of persons and animals. The authors declare that no experiments on human beings or animals were performed for this research.

Confidentiality, informed consent, and ethical approval. The study does not involve personal patient data and does not require ethical approval. SAGER guidelines do not apply.

Statement on the use of artificial intelligence. The authors declare that they did not use any form of generative artificial intelligence in the writing of this manuscript.

References

1. Patrucco F, Failla G, Ferrari G, Galasso T, Candoli P, Mondoni M, et al. Interventional Pneumology and Lung Transplant Study Group of the Associazione Italiana Pneumologi Ospedalieri - Italian Thoracic Society (AIPO-ITS). Bronchoscopy during COVID-19 pandemic, ventilatory strategies and procedure measures. *Panminerva Med.* 2021;63(4):529-38. <https://doi.org/10.23736/s0031-0808.21.04533-x>.
2. Zhou F, Yu T, Fan G, Fan G, Liu Y, Liu Z, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. *Lancet.* 2020;395(10229):1054-62. [https://doi.org/10.1016/s0140-6736\(20\)30566-3](https://doi.org/10.1016/s0140-6736(20)30566-3).
3. Sampsonas F, Kakoullis L, Karampitsakos T, Papaioannou O, Katsaras M, Papachristodoulou E, et al. Bronchoscopy during the COVID-19 pandemic: effect on current practices and strategies to reduce procedure-associated transmission. *Expert Rev Respir Med.* 2021;15(6):773-9. <https://doi.org/10.1080/17476348.2021.1913058>.
4. Ost DE. Bronchoscopy in the Age of COVID-19. *J Bronchology Interv Pulmonol.* 2020;27(3):160-2. <https://doi.org/10.1097/lbr.0000000000000682>.
5. Kucharski AJ, Russell TW, Diamond C, Liu Y, Edmunds J, Funk S, et al. Centre for Mathematical Modelling of Infectious Diseases COVID-19 working group. Early dynamics of transmission and control of COVID-19: a mathematical modelling study. *Lancet Infect Dis.* 2020;20(5):553-8. [https://doi.org/10.1016/s1473-3099\(20\)30144-4](https://doi.org/10.1016/s1473-3099(20)30144-4).
6. Sindhwani G, Mishra M, Gangakhedkar MR, Madan K, Dua R, Sharma P, et al. Flexible bronchoscopy during the COVID-19 pandemic: A concise clinical review and practical recommendations. *Lung India.* 2021; 38(Supplement):S48-S52. https://doi.org/10.4103/lungindia.lungindia_357_20.
7. Pritchett MA, Oberg CL, Belanger A, De Cardenas J, Cheng G, Nacheli GC, et al. Society for Advanced Bronchoscopy Consensus Statement and Guidelines for bronchoscopy and airway management amid the COVID-19 pandemic. *J Thorac Dis.* 2020;12(5):1781-98. <https://doi.org/10.21037/jtd.2020.04.32>.
8. Eber E, Goussard P. Bronchoscopy precautions and recommendations in the COVID-19 pandemic. *Paediatr Respir Rev.* 2021;37:68-73. <https://doi.org/10.1016/j.prv.2021.01.001>.
9. Wahidi MM, Lamb C, Murgu S, Musani A, Shojaaee S, Sachdeva A, 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(4):e52-e54. <https://doi.org/10.1097/lbr.0000000000000681>.
10. Vergnon JM, Trosini-Desert V, Fournier C, Lachkar S, Dutau H, Guibert N, et al. French-Speaking Group on Thoracic Endoscopy (Groupe d'endoscopie de langue française GELF) of the French Language Respiratory Society (Société de pneumologie de langue française, SPLF). Bronchoscopy use in the COVID-19 era. *Respir Med Res.* 2020;78:100760. <https://doi.org/10.1016/j.resmer.2020.100760>.
11. Rochwerg B, Brochard L, Elliott MW, Hess D, Hill NS, Nava S, et al. Official ERS/ATS clinical practice guidelines: noninvasive ventilation for acute respiratory failure. *Eur Respir J.* 2017;50(2):1602426. <https://doi.org/10.1183/13993003.02426-2016>.
12. Grieco DL, Menga LS, Raggi V, Bongiovanni F, Anzellotti GM, Tanzarella ES, et al. Physiological comparison of high-flow nasal cannula and helmet noninvasive ventilation in acute hypoxemic respiratory failure. *Am J Respir Crit Care Med.* 2020;201(3):303-12. <https://doi.org/10.1164/rccm.201904-0841oc>.
13. Clark G, Licker M, Younossian AB, Soccal PM, Frey JG, Rochat T, et al. Titrated sedation with propofol or midazolam for flexible bronchoscopy: a randomised trial. *Eur Respir J.* 2009;34(6):1277-83. <https://doi.org/10.1183/09031936.00142108>.
14. 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(2):284-7. <https://doi.org/10.1164/rccm.202004-0945le>.

15. Weiss KD, Coppolino A 3rd, Wiener DC, McNamee C, Riviello R, Ng JM, et al. Controlled apneic tracheostomy in patients with coronavirus disease 2019 (COVID-19). *JTCVS Tech.* 2021;6:172-7. <https://doi.org/10.1016/j.xjtc.2020.11.016>.
16. McGrath BA, Brenner MJ, Warrillow SJ. Tracheostomy for COVID-19: business as usual? *Br J Anaesth.* 2020;125(6):867-71. <https://doi.org/10.1016/j.bja.2020.08.048>.
17. Ji Y, Fang Y, Cheng B, Li L, Fang X. Tracheostomy timing and clinical outcomes in ventilated COVID-19 patients: a systematic review and meta-analysis. *Crit Care.* 2022;26(1):40. <https://doi.org/10.1186/s13054-022-03904-6>.
18. Takhar A, Walker A, Tricklebank S, Wyncoll D, Hart N, Jacob T, et al. Recommendation of a practical guideline for safe tracheostomy during the COVID-19 pandemic. *Eur Arch Otorhinolaryngol.* 2020;277(8):2173-84. <https://doi.org/10.1007/s00405-020-05993-x>.
19. Williams T, McGrath BA. Tracheostomy for COVID-19: evolving best practice. *Crit Care.* 2021;25(1):316. <https://doi.org/10.1186/s13054-021-03674-7>.
20. Meister KD, Pandian V, Hillel AT, Walsh BK, Brodsky MB, Balakrishnan K, et al. Multidisciplinary safety recommendations after tracheostomy during COVID-19 pandemic: state of the art review. *Otolaryngol Head Neck Surg.* 2021;164(5):984-1000. <https://doi.org/10.1177/0194599820961990>.
21. Schultz MJ, Pattnaik R, Dondorp AM. Walking the line between benefit and harm from tracheostomy in COVID-19. *Lancet Respir Med.* 2020;8(7):656-7. [https://doi.org/10.1016/s2213-2600\(20\)30231-9](https://doi.org/10.1016/s2213-2600(20)30231-9).
22. David AP, Russell MD, El-Sayed IH, Russell MS. Tracheostomy guidelines developed at a large academic medical center during the COVID-19 pandemic. *Head Neck.* 2020;42(6):1291-6. <https://doi.org/10.1002/hed.26191>.