Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Strategy for Safe Bronchoscopy During the COVID-19 Pandemic

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Aerosol-generating procedures are avoided for patients with coronavirus disease 2019 (COVID-19) to lower the risk of transmission to health care providers. However, when bronchoscopy is indicated, it remains unclear whether the procedure performed while the patient is under general anesthesia leads to contamination of the surroundings and whether standard endoscopy reprocessing methods are effective in eradicating severe acute respiratory syndrome coronavirus 2. This report describes a case of bronchoscopic retrieval of a foreign body in the airway of a patient under general anesthesia who tested positive for COVID-19. The report focuses on anesthesia techniques to minimize aerosolization.

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This case involved the removal of a foreign body (FB) in the airway by flexible bronchoscopy in a patient who was under general anesthesia and who had coronavirus disease 2019 (COVID-19).

The COVID-19 crisis continues to exert enormous strain on the world's health care systems, with many countries experiencing resurgence of the disease after successfully slowing outbreaks. Indubitably, health care workers (HCWs) treating patients with COVID-19 are at the highest risk for infection. An early report found that HCWs constituted 29% of patients hospitalized for COVID-19 pneumonia.[1] The overall incidence of infection among HCWs has been reported to be 3.8%,[2] and most cases have been associated with aerosol-generating procedures.[2] Transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by droplets or aerosols has critical implications. Data showed that speaking and coughing produced aerosols that harbored viable SARS-CoV-2, which could remain suspended in the air for hours.[3]

Aerosol-generating procedures expose HCWs to contagion.[4,5] Bronchoscopy, an aerosol-generating procedure, is ideally avoided until a patient becomes noninfectious. However, when clinical urgency warrants the procedure, the team should proceed with safety measures in place to protect both patient and HCW.[6,7] In this report, we share the infection control strategy used by our center (National University Hospital, Singapore) for retrieval of an FB from the airway in a patient with COVID-19.

A 59-year-old man presented to the emergency department with fever, cough, and sore throat. He was a former smoker with asthma treated with inhaler therapy, he worked in construction, and he lived in a crowded dormitory. He was a known contact of a patient with COVID-19, and his nasopharyngeal swab tested positive for SARS-CoV-2. He was isolated in a negative pressure room. His chest roentgenogram showed a metallic FB, confirmed on chest computed tomography, that was lodged in the left lower lobe bronchus, without attendant postobstructive pneumonia, lobar collapse, or bronchiectasis. There was small airways disease consistent with asthma but no ground-glass opacities or peripheral consolidation characteristic of COVID-19 pneumonia (Figure 1).

We planned to retrieve the FB by flexible bronchoscopy with the patient under general anesthesia. The alternative was rigid bronchoscopy with jet ventilation, but the risk of virus aerosolization outweighed the benefits.[7] To mitigate the risk of infection, the procedure was conducted in an operating room (OR) with negative pressure and 20 air exchanges per hour. The patient wore a surgical mask and was escorted by 2 HCWs wearing full personal protective equipment (PPE), N95 masks, and goggles to the OR through a cordoned-off route designated for transport of patients with COVID-19, thus bypassing the reception area and other ORs.[8] The team was kept minimal, comprising 2 anesthetists, 2 nurses, and 2 bronchoscopists, all wearing N95 masks, PPE, and powered air purifying respirators. Together with N95 masks and PPE, powered air purifying respirators conferred greater protection during aerosolizing procedures such as intubation and bronchoscopy.[4-6]

Before intubation, the patient, who was wearing a surgical mask, was preoxygenated with intranasal administration of oxygen at 3 L/min. Topical lidocaine

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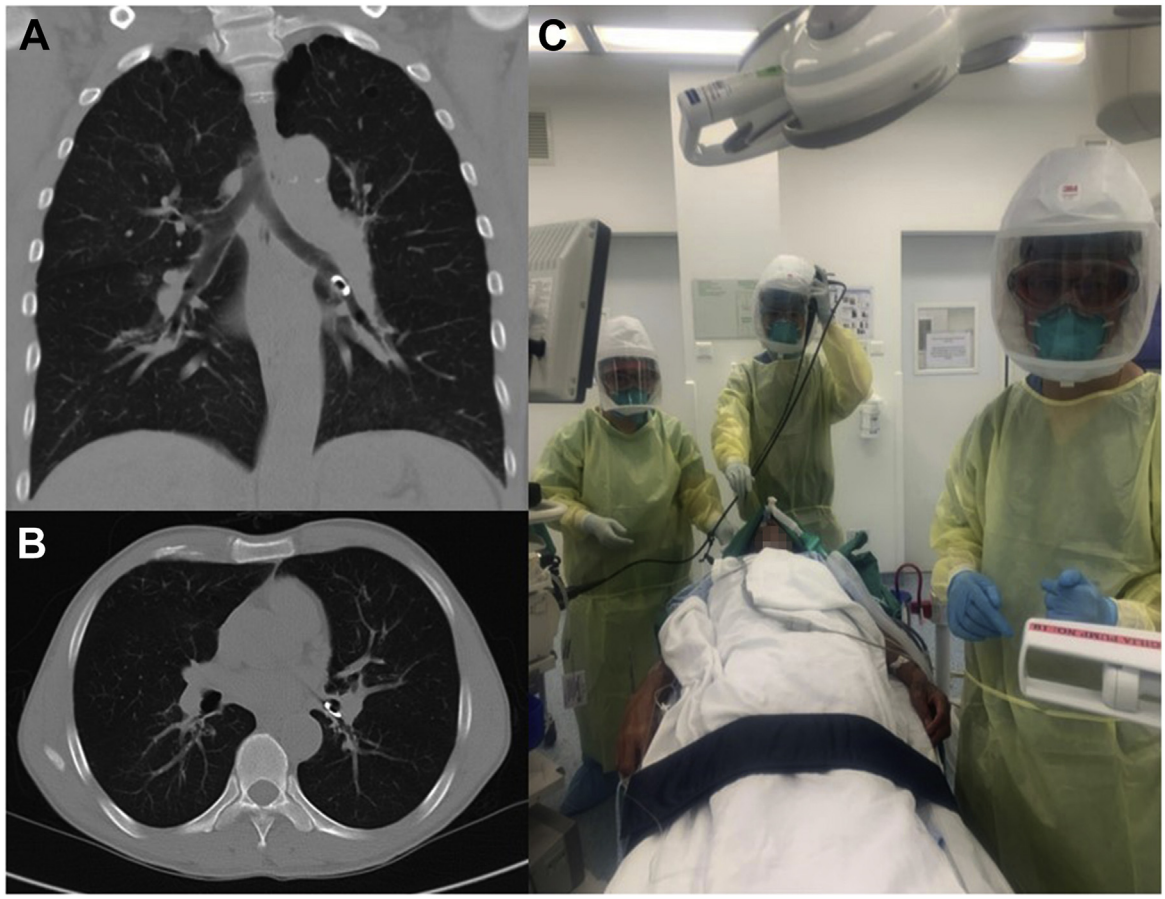

FIGURE 1 (A) and (B) Coronal and axial computed tomographic views showing a foreign body in the left lower lobe bronchus and small airways disease. (C) A bronchoscopist with an assistant and an anesthesist wearing powered air purifying respirators, personal protective equipment, and N95 masks.

spray of the vocal cords was omitted to minimize aerosolization. The patient was intubated using video laryngoscopy with a size 9 endotracheal tube after rapid-sequence induction and intravenous (IV) lidocaine (1.5 mg/kg) to prevent cough. A swivel was attached to the endotracheal tube where the distal end led to a mechanical filter to minimize contamination, and the bronchoscopy team stayed in the OR anteroom until the patient was intubated. Intermittent positive pressure ventilation with 100% oxygen alternating with periods of apnea was used. Intermittent paralysis with IV atracurium was repeated every 30 minutes, and mechanical ventilation was paused every 10 minutes, accompanied by cessation of gas flow, to facilitate bronchoscope insertion and airway intervention. Mechanical ventilation was resumed when oxygen saturation fell to less than 91%, thereby allowing the bronchoscopist approximately 10 minutes of work time.

An FB was lodged in the left lower lobe bronchus with overlying granulation tissue. This FB was retrieved by flexible bronchoscopy using a cryoprobe and forceps. The bronchoscope with the FB was removed en bloc as the patient was extubated. A disposable size 4 supraglottic airway (i-gel, Intersurgical) was inserted to maintain ventilation. Bronchoscopy through the supraglottic airway was performed (Figure 2). The time taken for bronchoscopic retrieval of the FB was 20 minutes. On successful retrieval of the FB, anesthesia was discontinued, and paralysis was reversed. IV morphine (0.5 mg/kg) was administered to minimize postoperative cough, and the patient was extubated awake. He wore a surgical mask and was monitored in the OR. A supraglottic airway was selected because it facilitated reversal of anesthesia with less cough and sympathetic activation.

Swabs for SARS-CoV-2 reverse transcription polymerase chain reaction (RT-PCR) of the bronchoscope and

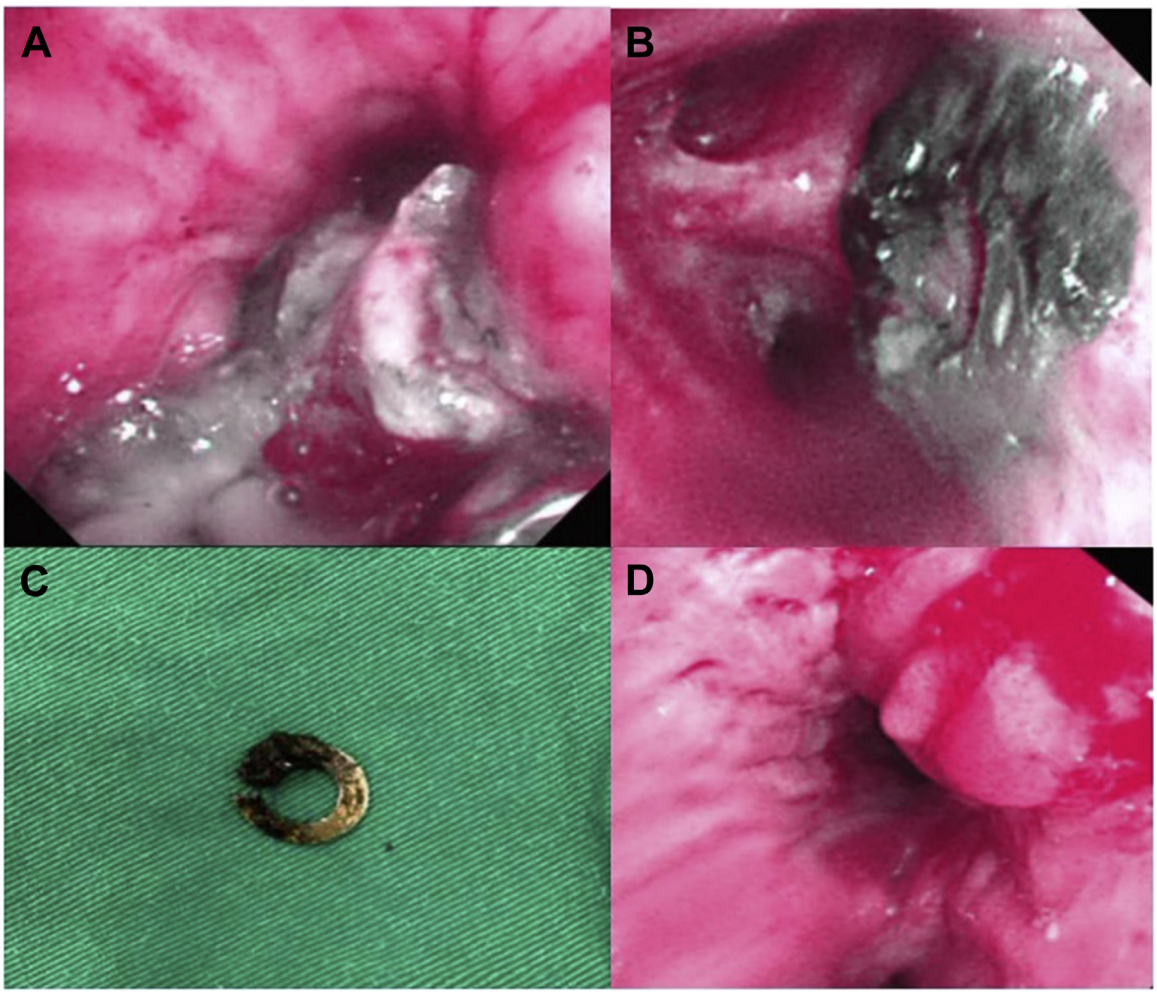

FIGURE 2 (A-C) Foreign body (metal rivet) in the left lower lobe bronchus. (D) Granuloma after foreign body removal.

working channel, cryoprobe, endoscopy processor, keyboard, and video monitor were obtained after the procedure. All the equipment was wiped down and disinfected. Swabs for SARS-CoV-2 RT-PCR were repeated after disinfection. The FLOQSwab Kit (COPAN) and the Cobas SARS-CoV-2 [RT-PCR] Test (Roche) were used for analysis. The first swabs of the bronchoscope and cryoprobe detected SARS-CoV-2. After reprocessing, repeat swabs of the bronchoscope and cryoprobe did not detect the coronavirus. Results of the initial swabs of the equipment in close proximity to the patient were negative. Our patient was transferred to a communal quarantine facility and was discharged well after 3 negative test results for COVID-19. No personnel involved in the procedure contracted COVID-19.

COMMENT

Despite meteoritic advances achieved in prevention of COVID-19 with 3 vaccines approved for emergency use, the world grapples with the relentless surge of COVID-19 cases. Although vaccines have shown efficacy in preventing symptomatic disease, they do not protect against coronavirus infection. It may not be appropriate for bronchoscopy to be deferred indefinitely, and priority tiers have been proposed.[5,6]

Our case illustrates that bronchoscopy, an aerosol-generating procedure, can be safely performed with negligible risks of viral aerosolization if infection control measures and appropriate anesthesia techniques are used (Figure 3).

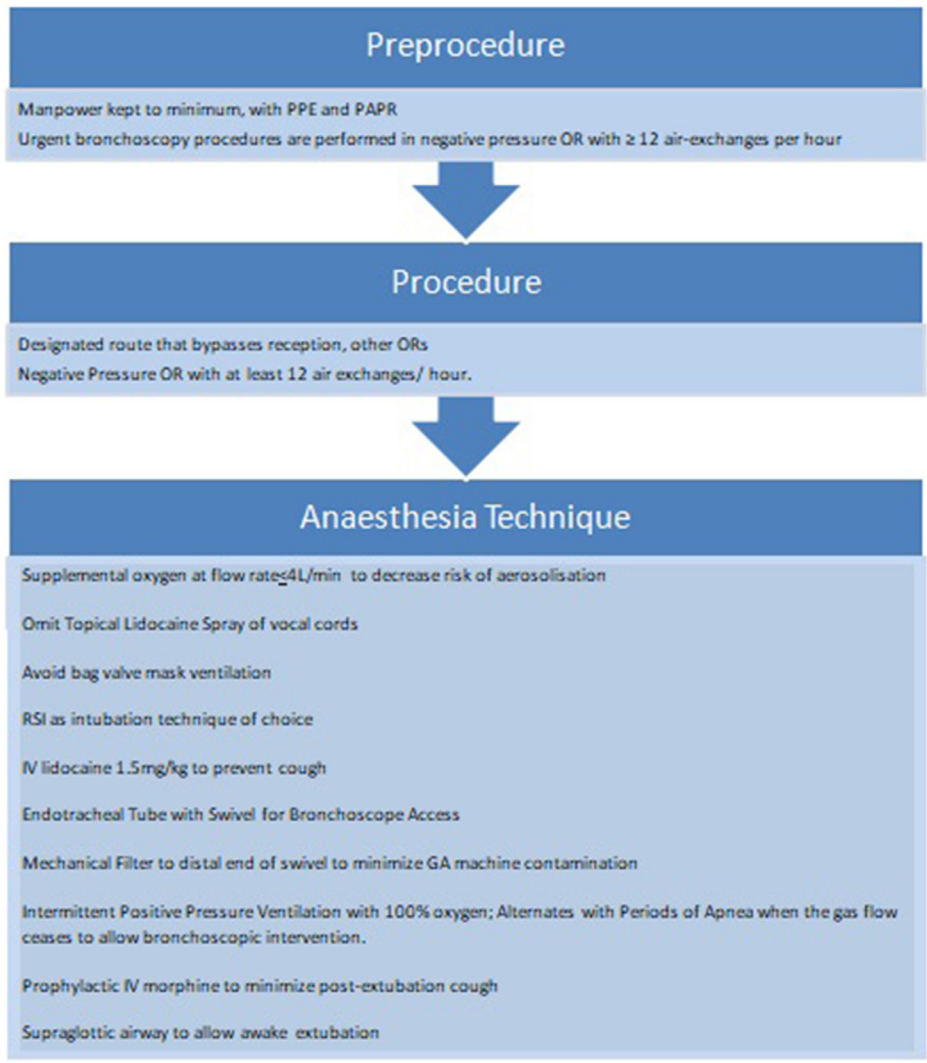

FIGURE 3 Flowchart of the suggested workflow for bronchoscopy of a patient with coronavirus disease 2019. (GA, general anesthesia; IV, intravenous; OR, operating room; PAPR, powered air purifying respirator; PPE, personal protective equipment; RSI, rapid-sequence induction.)

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