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Tracheal trauma after difficult airway management in morbidly obese patients with COVID-19

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Keywords: airway management; ARDS; COVID-19; ECMO; obesity; pneumomediastinum; tracheal perforation

Editor—Since December 2019, a pandemic infection caused by a novel coronavirus responsible for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has been spreading globally after the first respiratory cases appeared in Wuhan, Hubei Province, China.[1] In March 2020, Western Europe and France faced a huge number of SARS-CoV-2 cases. The clinical management of the most severe cases requires tracheal intubation with mechanical ventilation. In order to protect against viral transmission, airway management requires several precautions. Therefore, anticipation of difficult airway management to limit the number of attempts and procedures is recommended.

We have had two recent patients with SARS-CoV-2 infection who had airway trauma during tracheal intubation (written consent was obtained from the patients before reporting these cases).

The first case is a 59 yr old woman with a history of morbid obesity (BMI, 41 kg m^{-2}) who was admitted to a tertiary hospital for acute dyspnoea, myalgia, and arthralgia. Initial physical examination revealed the following: heart rate, 90 beats min^{-1}; arterial blood pressure, 120/70 mm Hg; tachypnoea, 30 min^{-1}; fever of 39.2°C; oxygen saturation, 80%; and bilateral dry rales on lung auscultation. Biological investigation showed a white blood count of 8400 mm^{-3}, lymphopaenia of 800 mm^{-3}, and C reactive protein of 230 ng L^{-1}. Blood gas analysis confirmed severe hypoxaemia with a Pa_{O_2} of 7 kPa and respiratory alkalosis (pH 7.5, HCO_3^- 24.8 mM, Pa_{CO_2} 18 kPa). Chest CT was compatible with SARS-CoV-2 infection as it showed bilateral ground-glass like opacities and multiple patchy lung consolidations.[2] Real-time reverse transcriptase–polymerase chain reaction (RT–PCR) of nasopharyngeal swabs was positive for SARS-CoV-2. The initial medical management consisted of high-flow nasal cannula (HFNC) oxygen therapy (100% oxygen) and administration of lopinavir and ritonavir. On Day 2 after admission, the patient's respiratory condition worsened requiring tracheal intubation and mechanical ventilation. Direct laryngoscopy showed a Grade IV view requiring use of a single bougie (Eschmann introducer, Vygon 15 Fr, Vygon, Écouen, France) without successful intubation. Cervical and thoracic subcutaneous emphysema occurred just after the first attempt during face mask ventilation. The trachea was intubated on

the second attempt using another bougie. Mechanical ventilation was then performed with low tidal volume and high positive end expiratory pressure without loss in tidal volume. However, during the first night after intubation, the patient presented with refractory hypoxaemia (Pa_{O_2}/Fi_{O_2} at 50) requiring extracorporeal membrane oxygenation (ECMO) and transfer to our tertiary hospital centre. Chest CT scan confirmed a large pneumomediastinum and a right-sided pneumothorax (Fig 1a). Fibreoptic bronchoscopy confirmed a large perforation of the membranous trachea. As the pneumomediastinum persisted with difficulty in ventilating the patient, she went for surgical tracheal repair with tracheal suture by right thoracotomy, followed by protective ventilation for severe acute respiratory distress syndrome (ARDS) under ECMO.

The second case was a 67 yr old man with a medical history of severe obesity (BMI, 34 kg m^{-2}) who was admitted on March 19, 2020 for dyspnoea and myalgia with onset of symptoms 12 days before admission. Results of his physical examination showed bilateral dry rales on lung auscultation, eupnoea, without signs of acute respiratory failure. Chest CT was compatible with SARS-CoV-2 infection with bilateral ground-glass like opacities, patchy lesions, and an extension of lesions exceeding 50%.[2] Initial blood gas analysis showed normoxaemia with a Pa_{O_2} of 19 kPa (oxygen by mask at 6 L min^{-1}), HCO_3^- of 26.5 mM, Pa_{CO_2} of 4 kPa, and pH 7.4. RT–PCR of nasopharyngeal swabs was positive for SARS-CoV-2. On Day 3 after admission, the patient worsened with acute respiratory failure and oxygen desaturation to 90% with oxygen by mask (9 L min^{-1}). To provide mechanical ventilation and correct hypoxaemia, tracheal intubation was attempted. The first attempt showed a Grade IV view on laryngoscopy requiring use of a bougie (Eschmann introducer, Vygon 15Fr, Vygon) and was unsuccessful. On the second attempt, successful tracheal intubation was performed using videolaryngoscopy (Airtraq®; Prodol Meditec, Guecho, Spain). As the patient presented criteria of severe ARDS according to the Berlin classification,[3] and required protective ventilation with high PEEP (13 cm H_2O, 6 ml kg^{-1} of ideal body weight) and high inspired oxygen fraction (100%). Despite early prone positioning, the patient developed refractory hypoxaemia and respiratory acidosis (pH 7.22) requiring veno-venous femoro-jugular ECMO and was transferred to our tertiary hospital centre. Chest CT confirmed pneumomediastinum and bilateral pneumothorax (Fig 1b). Fibreoptic bronchoscopy confirmed perforation of the cricoid membrane. Ventilation was possible without cutaneous emphysema or tidal volume loss.

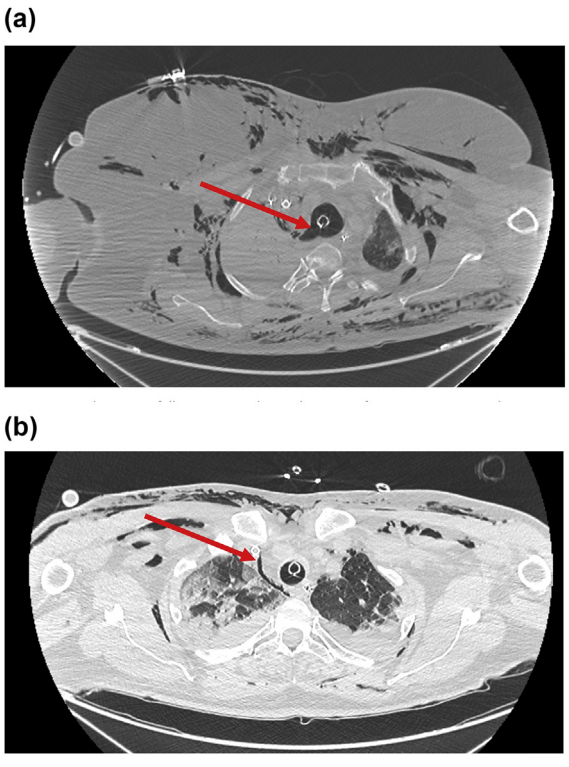

Fig 1. Chest CT scan of two patients with coronavirus disease 2019 (COVID-19) showing pneumomediastinum, subcutaneous emphysema, and pneumothorax. (a) Pneumomediastinum following tracheal trauma. The continuum between the trachea and the mediastinum is represented by a red arrow. (b) Pneumomediastinum after cricoid membrane perforation. Pneumomediastinum is represented by a red arrow.

Both patients had severe obesity with a typical presentation of SARS-CoV-2 infection, and required invasive ventilation after failing noninvasive oxygen therapy. Both rapidly evolved as a severe ARDS refractory to prone positioning, and both met criteria for difficult tracheal intubation owing to severe obesity. Protocols for managing severe ARDS[4] and guidelines for protection of healthcare personnel during aerosol-generating procedures[5] needed to be taken into account. In both cases, use of a bougie probably induced tracheal trauma thereby worsening the respiratory condition and leading to urgent ECMO. The absence of glottis visibility in both patients might enhance the risk of tracheal trauma forcing intubation with a bougie.[6] Videolaryngoscopy is recommended not only for healthcare personnel protection but also to allow successful intubation at first attempt thus avoiding potential tracheal trauma and worsening respiratory failure.

Declarations of interest

The authors declare that they have no conflicts of interest.

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Fibreoptic tracheal intubation in COVID-19: not so fast

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Keywords: airway management; apnoeic oxygenation; COVID-19; high-flow nasal oxygen; tracheal intubation

Editor—Wu and colleagues[1] recently described the use of high-flow nasal oxygen (HFNO) during fibreoptic tracheal intubation in critically ill patients with coronavirus disease 2019 (COVID-19). This study was undertaken on the premise that fibreoptic tracheal intubation reduces the risk of virus transmission to the healthcare worker compared with laryngoscopy. The authors stated that they used fibreoptic bronchoscopy to 'reduce tracheal intubation-induced coughing and subsequent spread of virus'. However, the use of a neuromuscular blocking agent (used for all patients) eliminates coughing and increases the likelihood of intubation success with laryngoscopy.[2] Furthermore, the authors stated that HFNO use is 'not associated with an increase in air or surface contamination' based on a recent study in critically ill patients with bacterial pneumonia.[3] However, whilst this study demonstrated no greater risk of contamination with HFNO when compared with a control group using oxygen mask, contamination was indeed detected in both groups. In the study by Wu and colleagues,[1] there was no use of an oxygen mask in the control arm during the apnoea period, whilst use of HFNO persisted in the intervention arm. Therefore, we cannot conclude, based on their evidence, that HFNO does not cause greater aerosolisation.

The degree of aerosolisation that is necessary to create a significant risk of COVID-19 infection to the clinician is perhaps the more relevant question, and this remains unknown. The fact that the six anaesthesiologists who undertook the study are 'currently not infected' is a positive observation, but is not an indicator of safety; this is a small number, and the rate of infection by any method of intubation is not known to be as high as 1:6 with adequate personal protective equipment.

The primary endpoint of 'intubation time' was defined as the period from the beginning of bronchoscopy until proper tracheal tube placement was confirmed. The intubation time was 7 s shorter in the HFNO arm *vs* face-mask arm. Whilst reaching statistical significance, this is arguably clinically insignificant. The higher minimum Spo_2 of 94% *vs* 91% during tracheal intubation with HFNO *vs* standard mask oxygenation is also clinically insignificant, particularly given that there was no difference between both groups in the incidence of Spo_2 <80% during intubation. The time period between the onset of apnoea and the verification of tracheal tube position is a more classical measure of the time it takes to intubate a patient, as this best represents the period where the patient is depleting their preoxygenation reserves. This period was 60 s longer than the 'intubation time' quoted, as the anaesthesiologists first waited 60 s to enable a dose of rocuronium 1 mg kg^{-1} to take effect. Based on the figures supplied, it took an estimated 2 min and 20 s from the onset of apnoea to intubate 75% of the patients. As tracheal intubation via laryngoscopy would likely not have taken this long, this represents an unnecessarily long duration of exposure. Furthermore, the authors expressed a desire to avoid bag-mask ventilation as it intensifies viral spread. However, in taking longer to secure the airway, the likelihood of oxygen desaturation was increased, which may then paradoxically require bag-mask ventilation. Bag-mask ventilation is more likely to be avoided by performing laryngoscopy in the first instance.

Whilst fibreoptic intubation may allow the anaesthetist to stand a greater distance away from the airway, optimal technique involves holding the controller vertically above the airway, limiting the distance achieved from the patient. Additionally, there is greater contact with the airway as the scope is typically stabilised with the hand over the nose or mouth—areas that can have a significant viral load. The authors do not state whether they performed nasal or oral fibreoptic intubations. This is of relevance when HFNO is being used as a nasal route of tube passage greatly limits oxygen insufflation through the nare used for the bronchoscope.

The merits of using HFNO during the preoxygenation phase of the study, as seen in this RCT, are questionable. A recent study has indicated that face-mask preoxygenation is superior to HFNO preoxygenation, likely because a tight-fitting face mask prevents entrainment of room air, and implies that any benefit from HFNO arises with apnoeic oxygenation alone.[4] For anaesthetists attempting this technique, the benefits of both a face mask and HFNO can be harnessed by using a face mask