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Guiding airway management and personal protective equipment for COVID-19 intubation teams

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Editor—Tracheal intubation of patients with coronavirus disease-19 (COVID-19) is a potentially aerosol-generating procedure that requires a careful yet efficient approach to ensure the safety of both patients and healthcare providers.[1] Faced with a rapidly escalating number of cases in New York City, the epicentre of the COVID-19 outbreak in the USA, our institution quickly created guidelines for the airway management of COVID-19 patients and an infrastructure to provide sufficient personal protective equipment (PPE) for intubating teams. Careful planning developing processes to ensure that PPE is readily available, creating standardised airway management protocols, and simulations and training of staff are crucial to ensure the safety of patients and healthcare workers.

Ensuring access to PPE

We developed an institutional protocol for use of PPE for intubations and a system to ensure our intubating teams had adequate supply. Our goal was to prevent situations in which providers had to choose between their safety and their ability to save patients' lives because adequate PPE was not readily available. With this in mind, we created 'COVID-19 bags' (Table 1) containing sufficient PPE for two providers to bring to intubations. Our goals were for PPE to (i) be easily transported by intubating teams, (ii) carry a low risk of self-contamination during doffing, and (iii) be in accordance with the Centers for Disease Control and Prevention PPE recommendations for aerosol-generating procedures in COVID-19 patients.[2]

Guidelines for tracheal intubation

Our guidelines are based on reports from the severe acute respiratory syndrome coronavirus 1 outbreak and recommendations from the Anesthesia Patient Safety Foundation.[3–5] The main objective is to reduce the risk of aerosolisation during intubation by.

(i) rapid sequence intubation and avoidance of bag-mask ventilation, if possible;
(ii) use of videolaryngoscopy to increase the distance from the patient's airway and the chance of success during first attempt;
(iii) immediate inflation of the tracheal tube cuff and connection to the ventilatory circuit, thereby avoiding manual ventilation;

Table 1 COVID-2019 bag inventory. *For double-gloving, we recommend one pair of sterile surgical gloves because their longer cuffs provide better wrist protection. The top layer should be removed immediately after intubation. †Placed on the expiratory limb of a ventilator or between the tracheal tube and self-inflating bag. ‡After the McGrath® (Medtronic, Minneapolis, MN, USA) videolaryngoscope handle is cleaned with bleach or alcohol-based wipes, it is handed to an assistant outside of the patient room, cleaned again, and placed in a plastic bag.

N95 mask respirators: Regular and small sizes
Disposable waterproof gowns for intubating provider and airway assistant
Disposable non-waterproof gowns for providers not directly involved in airway management
Head covering: bouffant or head/neck wrap
Eye/face protection: welder-style face mask or surgical mask with face shield attached
Sterile surgical gloves*
High-efficiency particulate air (HEPA) filter†
Small plastic bags‡

(iv) use of a high-efficiency particulate air filter placed on the expiratory limb of a ventilator, or between the tracheal tube and a self-inflating bag ventilator;

(v) intubation in a negative-pressure room, or, if not available, a single room with closed doors. Of note, we did not use Plexiglass 'intubation boxes'[6] as they are difficult to transport and limit mobility during intubation without necessarily providing superior protection compared with videolaryngoscopy.[7]

Intubation teams

At the beginning of the COVID-19 crisis, the anaesthesiology department created intubation teams that performed all intubations in the hospital. The team consisted of an attending anaesthesiologist and two residents. The most experienced provider performed the intubation, and the next most experienced provider administered medications, monitored vital signs, and assisted with the intubation. The most junior member remained outside the room to provide additional supplies if needed and monitor for breaches in PPE. Before entering the room, we performed a huddle with the patient's medical team, nurse, and respiratory therapist to review medical history, procedural steps for intubation, and contingency plans.

Training providers

In addition to wide distribution of the airway management protocol through e-mails, fliers, and grand rounds, we created a simulation video demonstrating PPE donning and doffing and intubation sequence. We also held PPE donning and doffing training sessions in the simulation centre using mock PPE for residents and faculty.

From March 11 to May 4, 2020, we performed 446 intubations with a peak of 32 intubations on April 8. During the height of the crisis, two intubation teams were on call at all times. The well-established airway management guidelines and COVID-19 bags allowed the intubation teams to perform a rapidly escalating number of tracheal intubations efficiently and safely.

Challenges and solutions

(i) *Ensuring adequate sedation post-intubation*: A substantial number of patients in non-ICU settings self-extubated shortly after intubation. In response, the department developed a sedation protocol that included administration of a midazolam bolus and initiation of a propofol infusion immediately after intubation.

(ii) Post-intubation haemodynamic instability: Our surgery colleagues created procedure teams that rapidly placed arterial and central lines for monitoring and infusions of vasoactive drugs after intubation [8].

(iii) Restocking supplies as demand escalates: At the beginning of the crisis, we purchased our own bags and stocked them using supplies from the operating theatre and the ICUs. When the number of intubations escalated rapidly, the hospital created a supply chain for ordering supplies and assembling the COVID-19 bags.

We strongly recommend that hospitals create a plan to ensure their intubation teams have access to appropriate PPE and airway protocols for COVID-19 patients before a crisis develops. Our airway management guidelines and COVID-19 bags were invaluable as the number of intubations rapidly accelerated. Importantly, hospitals must be prepared to modify their airway management and PPE guidelines based on feedback from clinicians on the ground and improved understanding of the transmissibility of the virus.

Declarations of interest

The authors have no conflicts of interest to declare.

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Preoperative four-dimensional computed tomography imaging and simulation of a fibreoptic route for awake intubation in a patient with an epiglottic mass

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Keywords: airway management; awake intubation; computed tomography; difficult airway; fibreoptic bronchoscopy; virtual endoscopy

Editor—The epiglottis is an important anatomical landmark during tracheal intubation by direct laryngoscopy or fibreoptic bronchoscopy. Epiglottic lesions can result in difficult intubation, difficult mask ventilation, or both. Awake intubation is considered the first-choice strategy for an expected difficult airway,[1] as it has a low failure rate (1%).[2] However, some clinicians perceive awake intubation as complex and time-consuming.[2] Training is recommended to improve the success rate of first attempt intubation and shorten intubation time.[3,4] Here, we report use of a four-dimensional CT imaging-based method to simulate a fibreoptic route and guide awake fibreoptic intubation.

As an example, we describe a 66-yr-old female who presented with dysphagia and was diagnosed with a large epiglottic mass by endoscopy and CT scan (Fig. 1a–c), and was scheduled for robot-assisted resection under general anaesthesia. During the preanaesthetic assessment, we performed CT virtual endoscopy with Advantage Workstation Volumeshare 4.5 (GE Healthcare 283 Rue De La Miniere, 78530 Buc, France), and simulated a fibreoptic route labelled in red in Figure 1b and c from sagittal and coronal sections, respectively. Following this route, we created a video (Fig. 1 online video) to guide fibreoptic intubation. Fig 1d–k shows the dynamic reconstructed images at different levels following the fibreoptic route from nostril to carina. The virtual route indicated turning left and backward could bypass the tumour. After mild sedation and sufficient topicalisation with local anaesthetic, awake fibreoptic intubation was performed successfully at the first attempt.

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Three-dimensional CT virtual endoscopy is based on image data from spiral CT scanning reconstructed by computer software which can provide stereoscopic images similar to findings by conventional endoscopy.[5,6] This can provide valuable information in evaluation of laryngeal tumours.[7] As a noninvasive, safe, and accurate technology, it has been used to assess airway diseases and to develop anaesthesia protocols.[8,9] Four-dimensional CT imaging consists of three-dimensional reconstruction with the time dimension.[10] Many studies have compared reconstructed virtual images with fibreoptic bronchoscopy and concluded that the reconstructions provided comparable images to fibreoptic bronchoscopy.[8,11] Based on this, we propose that four-dimensional CT imaging can be used to facilitate fibreoptic intubation. Briefly, the Volume Viewer software (GE Healthcare) was used to process the CT scan and to reconstruct a three-dimensional intraluminal image of the airway. We then used the navigator view to select the nostril and carina as the starting point and ending point, respectively. Several important visual landmarks included the nasopharynx, laryngopharyngeal mass, glottis, and trachea. When the required points were defined, a route was calculated and a four-dimensional navigation view was generated by the software. Reviewing the simulated video showed experienced performers how to cross the laryngeal tumour and identify the glottic entrance during awake fibreoptic intubation. We have applied this method in three patients with an epiglottic mass to guide awake fibreoptic intubation at the first attempt.

Preoperative four-dimensional CT imaging can simulate the route for fibreoptic bronchoscopy from the nose or mouth