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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

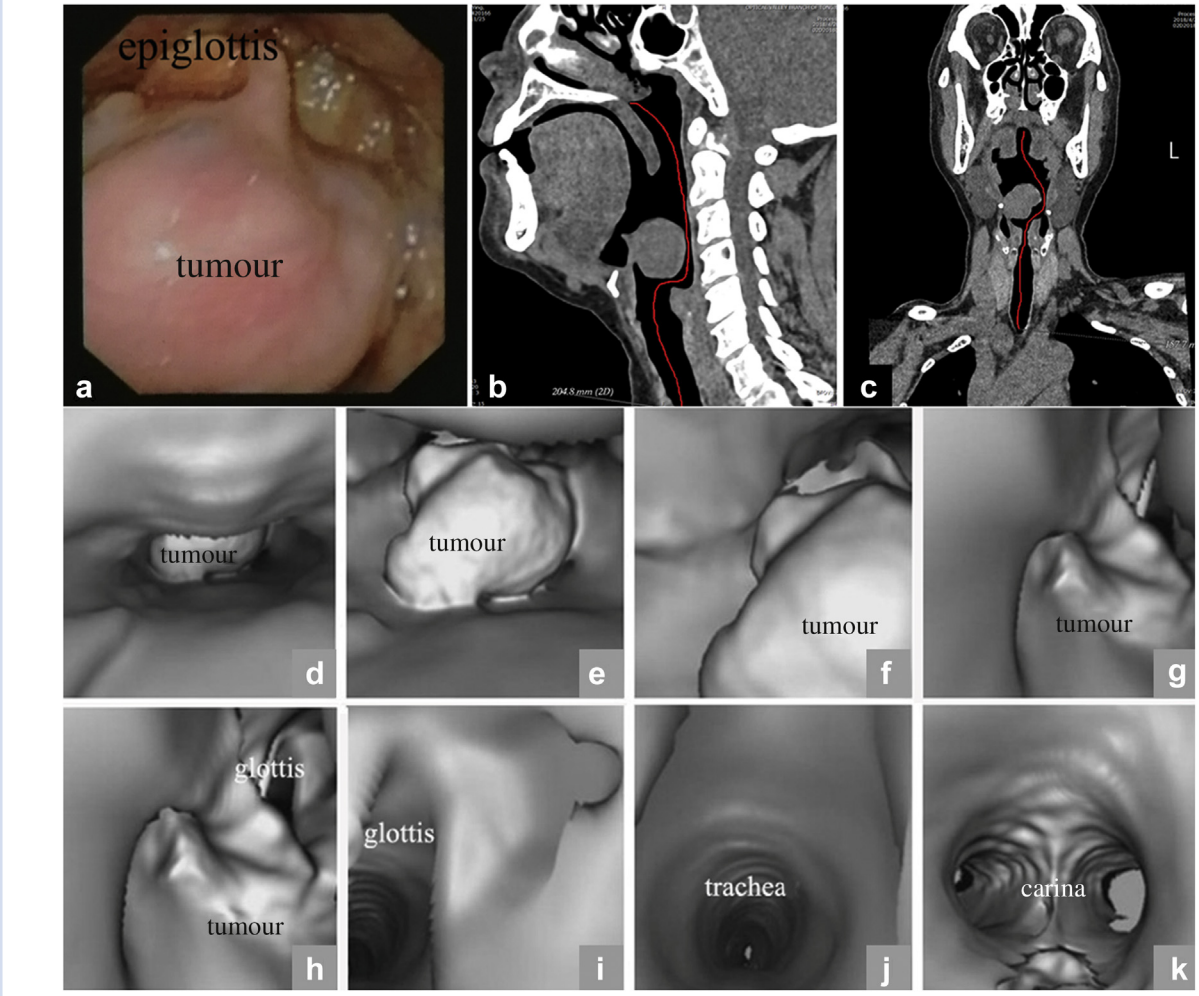

Fig. 1. Different views of the epiglottic mass. (a) Preoperative endoscopy showed a large epiglottic mass; (b) CT sagittal scan; (c) CT coronal scan; (d–k) dynamic images by virtual endoscopy at different levels from the nostril to the carina. The red line in panels (b) and (c) represents the simulated fibreoptic route.

to the carina. As a CT scan is usually performed in an awake condition, four-dimensional CT imaging is particularly suitable for awake fibreoptic intubation and indicated for managing expected difficult airways. As an aid, this method may shorten intubation time and improve successful tracheal intubation in the face of abnormal anatomy, but further study is required.

Declarations of interest

The authors declare that they have no conflicts of interest.

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Protecting staff and patients during airway management in the COVID-19 pandemic: are intubation boxes safe?

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Editor—We read with interest the correspondence by Cubillos and colleagues[1] and Yong and Chen.[2] Cubillos and colleagues[1] describe the design and manufacture of a 'negative-pressure airflow isolation chamber' to reduce the risk of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) transmission during airway management, and Yong and Chen[2] report the use of flexible plastic screens and tents for the same purpose. A number of similar reports have been published in recent literature describing the use of various 'intubation boxes' and drapes,[3–5] all of which aim to provide a physical barrier to aerosols and droplets. Although these innovations are doubtless well-meaning, we are concerned that any additional protection that such devices may afford is gained at the cost of increased difficulty in managing the airway.

The concept of difficult airway in the critically ill comprises anatomical, physiological, and environmental elements,[6] exacerbated in the current pandemic by human factors and the communication limitations imposed by highly restrictive personal protective equipment.[7,8] In our own anecdotal experience, coronavirus disease 2019 (COVID-19) appears to be associated with laryngeal oedema independent of that associated with prolonged tracheal intubation,[9] making airway management potentially more challenging.

We trialled the use of a rigid intubation box similar to that proposed by Canelli and colleagues[3] in a simulation setting, and found that the presence of a physical barrier increased the difficulty of tracheal intubation, especially during transition between airway devices and when using intubation adjuncts, such as the gum-elastic bougie (Fig. 1). A physical limitation in dexterity when using intubation boxes was predicted by Cubillos and colleagues[1] in their letter, and our experiences support this prediction. However, we are concerned that similar problems may be encountered with all barrier devices. We advise caution in adopting the use of any physical enclosure in practice, as existing airway devices were not designed to be used in conjunction with intubation boxes, and airway management training has hitherto not included their use. There is also the question of how and when to remove barrier enclosures that lack any mechanism for air extraction or exchange without dispersion of high concentrations of aerosolised SARS-CoV-2 virus.

Fig. 1. Use of a gum-elastic bougie and McGrath videolaryngoscope (Medtronic, Minneapolis, MN, USA) with an intubation box for simulated intubation.

Managing difficult airways in the critically ill is challenging,[6] and we believe this may be compounded by such