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## Clinical and educational article

### Unconventional multidisciplinary team strategy for tracheostomy in COVID-19

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The approach an institution takes to tracheostomy during the COVID-19 pandemic has broad potential to influence morbidity and mortality, as tracheostomy is at the intersection of patient-centred care, health-care worker safety and resource allocation [1]. Consensus guidance is, by necessity, based largely on expert opinion, and real-world experience is required [1]. We have accumulated extensive experience using an unconventional multidisciplinary team strategy in which percutaneous dilatational tracheostomy is undertaken at the bedside in open intensive care units by teams combining anaesthetists and surgeons. In the context of a strained critical care system, greater resource efficiency is a crucial benefit of this approach.

Our institution, Guy's and St Thomas' NHS Foundation Trust in London, has been at the epicentre of the UK pandemic, admitting hundreds of patients to regular and 'surge' intensive care units. There has been a very high requirement for intubation and mechanical ventilation, and subsequently for tracheostomy. We established mobile emergency rapid intubation teams (MERIT) early in the pandemic response, which follow specific protocols for personal protective equipment (PPE) and minimising aerosol generation and thus operator risk of infection [2]. The MERIT teams, consisting of two consultant anaesthetists and two assistants, are responsible for all COVID-19 intubations in the hospital. Our key multidisciplinary innovation was to then develop a dedicated tracheostomy team comprising two ear, nose and throat (ENT) surgeons and two MERIT anaesthetists. To our knowledge, we were the first UK centre to develop such teams and publish guidelines for tracheostomy in COVID-19, including procedures for PPE, minimising aerosolisation and improved success with minimal complications [3].

Ear, nose and throat surgeons have been involved in 'surge' tracheostomy strategies in other centres, e.g. instituting a dedicated tracheostomy theatre. However, our approach was distinct and unusual both in combining ENT surgeons with anaesthetists to form a tracheostomy team and, crucially, in this team undertaking percutaneous tracheostomies independently at the bedside in intensive care. This contrasted with normal practice where they would be undertaken either by intensive care operators alone, or alternatively in the operating theatre as a surgical tracheostomy.

The ENT/MERIT tracheostomy team has quickly developed expertise in using advanced PPE and minimising aerosolisation in accordance with carefully-devised procedures including a step-by-step protocol for bedside tracheostomy (Fig. 1). This protocol includes the use of ultrasound to identify structures and mark a 'never above' line to minimise the risk of damaging the endotracheal tube cuff, as well as videolaryngoscopy to visualise the endotracheal tube cuff and fiberoptic bronchoscopy for internal visualisation. Our self-contained team model promotes efficient use of personnel and resources by relieving ICU staff and avoiding ICU-theatre transfers. At our institution it has also exploited changing capacity of MERIT anaesthetists as the requirement for tracheostomies has progressively overtaken primary intubations. Outcomes from our first 28 tracheostomies have been favourable with no significant complications or deaths, and no operators have developed COVID-19 (Table 1).

The presence of ENT surgeons in the team may have allowed more challenging tracheostomies that would not normally be attempted in intensive care (e.g. high BMI) to still be undertaken in the most resource-efficient manner. While the ideal location for performing a tracheostomy on a COVID-19-positive patient is in a negative pressure side room or operating theatre, this may not be available, and transferring critically ill patients to theatre also has major resource and safety implications. Recent preliminary data from a national UK audit (UK COVIDTrach) indicates that percutaneous tracheostomy is at least as safe as surgical tracheostomy in COVID-19 [4]. Anecdotally, percutaneous tracheostomies may be less prone to wound site infections and dislodgement in the presence of thick tenacious secretions in COVID-19.

Until further data are forthcoming, we recommend consideration of this multidisciplinary team model and protocol for tracheostomy in COVID-19 to deliver safe patient-centred care and support healthcare worker safety while simultaneously optimising the balance between these priorities and the efficient utilisation of scarce resources.

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**Table 1** Data from 28 patients with COVID-19 undergoing percutaneous tracheostomy in ICU by dedicated multidisciplinary teams. Values are median (IQR [range]) or number (proportion).

Age; years	55 (48–61 [28–78])
Sex	
Male	18 (64%)
Female	10 (36%)
Ethnicity	
Black, Asian or minority ethnic	20 (71%)
White	8 (29%)
Weight; kg	76 (72–95 [55–118])
Height; m	1.75 (1.65–1.79 [1.52–1.93])
Body mass index; kg.m <sup>-2</sup>	29 (24–31 [22–40])
APACHE II score on admission	13 (12–16 [8–19])
Timing of tracheostomy; days following tracheal intubation	19 (14–24 [6–31])
Respiratory status at time of tracheostomy	
PEEP; cmH <sub>2</sub> O	8 (6–8 [5–10])
FiO <sub>2</sub> ; %	0.35 (0.30–0.40 [0.21–0.55])
PaO <sub>2</sub> ; mmHg	72 (68–79 [59–102])
P/F ratio	207 (183–246 [144–379])
Duration of follow-up; days following tracheostomy	40 (45–49 [9–70])
Patient status at follow-up	
Alive	28 (100%)
Discharged from ICU	24 (86%)
Decannulated	24 (86%)
Discharged from hospital	18 (64%)
Days from tracheostomy to:	
Discharge from ICU	20 (13–28 [4–48])
Decannulation	18 (14–30 [9–46])
Discharge from hospital	37 (28–45 [13–63])
Significant complications from tracheostomy (defined as Clavien-Dindo Grade II or higher[5])	0 (0%)
Transmission of COVID-19 to operators	0 (0%)
Mortality	0 (0%)

APACHE II score, acute physiology and chronic health evaluation II score;  $\text{FiO}_2$ , fraction of inspired oxygen;  $\text{PaO}_2$ , arterial partial pressure of oxygen; PEEP, positive end-expiratory pressure; P/F ratio,  $\text{PaO}_2/\text{FiO}_2$  ratio.

**Figure Legends**

**Figure 1** Anaesthetic management for percutaneous tracheostomy insertion in COVID-19 at Guy's and St Thomas' NHS Foundation Trust. 1A shows the Trust's Action Card including step-by-step protocol, minimum equipment list and instructions for ultrasound markings. 1B shows the schematic for measuring structures using ultrasound and marking a 'never above' line to minimise the risk of damaging the endotracheal tube cuff.



## T5-9: Anaesthetic management for percutaneous tracheostomy insertion

**Objective:** A proportion of COVID-19 patients require a period of prolonged ventilation, and will therefore benefit from tracheostomy insertion. This is an aerosol generating procedure that requires planning and team working.

- 1 Start preoxygenation**
- 2 Check tracheal tube**
  - ▷ Check type, size, and length at the teeth
- 3 Prepare drugs**
  - ▷ Give muscle relaxation, analgesia, and sedation
- 4 Prepare patient**
  - ▷ Have surgeon position patient for procedure
  - ▷ Scan neck and mark landmarks (see *Ultrasound markings*)
  - ▷ Measure and mark insertion safe zone (see *Insertion 'never above' lines*)
  - ▷ Check with the surgeon that the planned insertion is beneath the 'never above' line (and ideally 2-2.5cm beneath to ensure beyond the end of the tracheal tube)
  - ▷ Check tube cuff pressure
- 5 Insert videolaryngoscope**
  - ▷ The tube cuff MUST remain inflated during the following procedures
  - ▷ Visualise the larynx and withdraw the tube until cuff just herniates through the vocal cords
  - ▷ Remove the videolaryngoscope
- 6 Insert fiberoptic bronchoscope and visualise tube tip**
  - ▷ The surgeon may start the procedure; check for tenting in the midline of the trachea
  - ▷ If you can see tenting go to step **7**
    - OTHERWISE —
  - ▷ Stop the procedure and check if the cannula can be inserted at a point lower in the neck; if yes move to lower point then go to **6**
    - OTHERWISE —
  - ▷ Withdraw the tracheal tube by 1cm under vision then go to **6**
- 7 Start the tracheostomy procedure**
  - ▷ Remove flexible bronchoscope once guidewire visualised in trachea
  - ▷ Pause ventilation prior to removal of the Rhinodilator
  - ▷ Restart ventilation when circuit switched to tracheostomy and cuff inflated
  - ▷ Check for desaturation and restart ventilation if needed

### Minimum equipment list

#### Drugs

- Muscle relaxant, analgesia, and sedation
- Emergency drugs (metaraminol, atropine, adrenaline, fluid bolus)

#### Airway Equipment

- Ultrasound and probe cover
- Marker pen and ruler
- Tracheostomy tube of predicted size and one smaller and tracheal tube clamp
- Videolaryngoscope and freestanding screen
- Functioning suction
- Bronchoscopy equipment
  - Flexible bronchoscope and stack
  - Breathing circuit bronchoscopy angle piece
- Emergency airway equipment
  - Mapleson C circuit and facemask
  - Airway adjuncts
  - Supraglottic airway
  - Tracheal tube x 2 and syringe

### Ultrasound markings

#### Identify and mark the following structures:

- Mark the 'never above' line (the predicted lowest extent of the tube cuff)
- Midline of the trachea
- First and second tracheal rings

#### Note the following:

- Presence of any vessels in the operating site
- Depth of the trachea

### Insertion 'never above' lines

Measure from the top of thyroid cartilage to the distance in the table below to determine the 'never above' line. Insertion above risks damage to the tube cuff.

Tube size	SealGuard Tube	Portex Standard Tube
7	4cm	2.5cm
8	5cm	3.5cm
9	5cm	-



Flexible  
bronchoscope

Risk zone

Safe Zone

'Never above' line

Upper measure line



Level of vocal cords

Thyroid cartilage

First tracheal ring

Second tracheal ring

The distances between the *upper measure line* and *never above line* are specific to each tube.

Remember to check the tube before you begin, and consult the action card to mark the lines

