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# Tracheostomy for COVID-19: business as usual?

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The novel coronavirus (severe acute respiratory syndrome coronavirus 2 [SARS-CoV-2]) responsible for the coronavirus disease 2019 (COVID-19) pandemic has resulted in an unprecedented global surge of critically ill patients requiring mechanical ventilation.[1] Although there is significant variation, critically ill patients requiring invasive ventilation have up to 50% mortality, with survivors often requiring prolonged respiratory support and long hospital stays.[2–7] At the time of writing, the UK Intensive Care National Audit & Research Centre (ICNARC) has been notified of 13 379 admissions to critical care with confirmed COVID-19, with 10

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341 outcomes reported from the 10 624 patients with comprehensive data.[8] More than 70% of patients required prolonged advanced respiratory support, for a median of 13 (inter-quartile range 7–23) days amongst survivors.

Before the COVID-19 pandemic, a predicted or actual requirement for prolonged ventilation was the primary indication for tracheostomy, although the optimal timing of tracheostomy in critically ill patients is unclear.[9–13] COVID-19 complicates matters further in terms of timing and technique, and the pandemic raises important questions regarding risks not only for patients, but also for staff and for the wider institution, given finite advanced respiratory support resources and capabilities. Performing a tracheostomy generates aerosols that expose staff to risk. Delaying tracheostomy for patients harbouring SARS-CoV-2 may reduce the risk as the viral burden reduces, but these risks must be balanced against the complications of prolonged translaryngeal intubation. Early tracheostomy has been proposed as a way to accelerate weaning from ventilation that frees up critical equipment, personnel, and beds, although this may or may not necessarily be in the interest of an individual patient.[14]

These competing issues have been addressed by a number of guidelines developed by a variety of specialist societies and organisations. Given the limited data available early on during the pandemic, they are almost exclusively based on expert opinion.[15–17] It is notable how such guidance has evolved as our understanding of COVID-19 has developed, particularly as the predicted high risk of clinician infection from the tracheostomy procedure did not manifest. For example, shortly after the New York Head and Neck Society advocated delaying tracheostomy to beyond 14 days of invasive ventilation,[18] the New York University thoracic group published a series of 98 COVID-19 tracheostomy procedures performed at a median of 10.6. (standard deviation 5) days from intubation.[19] Notably, none of the staff involved in these procedures subsequently tested positive for SARS-CoV-2.

In this issue of the *British Journal of Anaesthesia*, the Queen Elizabeth Hospital (QEH) Birmingham COVID-19 airway team share their experiences of the first 100 COVID-19 patients to undergo tracheostomy.[20] They describe important modifications to their usual approach, reconfiguration of their service, and a comprehensive educational program. The findings from this prospective observational cohort study suggest a significant survival advantage associated with tracheostomy, regardless of the severity of illness, and that early tracheostomy may significantly reduce duration of invasive ventilation and ICU length of stay. However, as with all things COVID, closer examination is required.

The QEH team reconfigured their tracheostomy service out of necessity to manage a surge in tracheostomy candidates. As with most institutions, their pandemic response reflects local resources and existing practices that will influence the approach to tracheostomy timing, technique, and aftercare, each being considered in turn below.

## Timing of tracheostomy

The first consideration for tracheostomy timing is to decide whether the procedure is indicated. Consensus opinion is that in order to positively influence the trajectory of patients suffering from COVID-19-associated pneumonitis, tracheostomy should occur only after there are signs of improvement, and after the patient demonstrates physiological reserve to tolerate the procedure. Performing tracheostomy risks potentially life-threatening de-recruitment, as most tracheotomy techniques involve a pause in ventilation, usually accompanied by at least partial loss of PEEP. Additionally, a patient should be unlikely to require prone ventilation before proceeding with tracheostomy, because of the heightened risk of dislodgement, displacement, occlusion, or other device-related complications that may be less readily identified and managed in prone patients. Performing tracheostomy in those who are destined not to survive exposes staff to unnecessary aerosol-generating procedures during and after insertion, and does not benefit the patient.

The QEH team did not have explicit criteria for undertaking tracheostomy but used the clinical judgement of a small group of experienced multidisciplinary clinicians. The reported indications for tracheostomy included failed extubation (13%, including several multiple attempts), a failed sedation hold (52%), and anticipated prolonged respiratory wean (33%). These indications were presumably influenced by the unit culture and the expectation that an early tracheostomy would be of benefit, resulting in a 61% tracheostomy rate amongst the 164 patients who were intubated because of COVID-19 during the 6-week reporting period. This contrasts strikingly with a 16.4% tracheostomy rate reported from 11 493 ICU patients during Spain's COVID-19 pandemic[21] and tracheostomy rates of 8–13% outside of the pandemic.[22]

The QEH group report that tracheostomy timing was not influenced by SARS-CoV-2 test results, which have been used in an attempt to judge the clinical condition of the patient and the risks posed to healthcare staff, and (in some protocols) candidacy for tracheostomy. Viral load peaks around the time of symptom onset, and declines over the following 3–4 days in mild illness, but viral RNA can be detected for a prolonged period in the critically ill.[3,23] However, detection of viral RNA by polymerase chain reaction does not necessarily indicate that viable (and therefore infectious) virus is present. False negative results may also occur in around 30% of tests, as a result of a poor sampling technique and the differences in anatomical sampling location and pre-test probability also influences interpretation.[24] At the onset of the pandemic there were rightly concerns over the risks to staff from performing tracheostomy in patients still considered infectious. However, using upper respiratory tract viral polymerase chain reaction tests alone to determine infectivity and associated risks to staff is unreliable.

The same team performed more than 90% of the QEH tracheostomies, and none reported symptoms of coronavirus infection during the study period. Although this is reassuring, it should be noted that staff testing was not robust or comprehensive, and reporting was confined to the core tracheostomy team. If these data suggest that staff can be protected from coronavirus infection during tracheostomy by using appropriate mitigation strategies and personal protective equipment (PPE), when is it in the patient's best interests to perform a tracheostomy? The abundance of caution that characterised decisions for tracheostomy is giving way to a more traditional approach, where the overriding consideration is the quality of care delivered to the patient, with the caveat that the team should observe standard safety measures including the use of PPE and a surgical technique that minimises aerosols.

The QEH group have analysed their cohort and conclude that 30-day survival was significantly improved in patients receiving tracheostomy, and that early tracheostomy (within 14 days of intubation) was associated with significantly

shortened ICU length of stay. What remains unclear is the role of selection bias, as the study was not conducted in a randomised or blinded manner. Clinical judgement may, of course, have selected the improving patients destined to survive, some of whom may have undergone successful primary extubation had they not received a tracheostomy. Furthermore, if the authors hypothesised a benefit with tracheostomy, the result may have proved a self-fulfilling prophecy if life support efforts proved more purposeful in this group. Although it would be premature to conclude from these data that tracheostomy materially alters survival and overall course of COVID-19, the improved pulmonary hygiene and earlier liberation from the ventilator may have significant salutary effects ranging from rehabilitation to mitigation of post-intensive care syndrome. Data on survivorship after critical care suggest that many patients with COVID-19 who require invasive mechanical ventilation will struggle with protracted physical and cognitive impairment. Such findings underscore the importance of collaboration between members of critical care multidisciplinary teams to optimise post-COVID-19 outcomes.[25]

The group concluded that survival and length of stay were improved independently of severity of critical illness (judged by admission Acute Physiology and Chronic Health Evaluation II [APACHE II] scores). Other studies from large centres or hospital groups around the world are reporting that the time to tracheostomy for COVID-19 patients is rather less than that the 'optimum' delayed timeframe proposed by some early guidelines (>14 or >21 days), approaching windows recognisable outside of the pandemic. For example, a large Spanish observational study recently reported a median time to tracheostomy of 12 days amongst 1890 patients.[21] It therefore seems that recommendations to delay tracheostomy in order to reduce infectivity have been superseded by clinical decision making, focusing on the physiological status of the patient.

## Tracheostomy technique

Modifications to the insertion technique have been proposed by both surgical and intensive care groups for patients with COVID-19. Successful percutaneous, open surgical, or hybrid approaches have been described, occurring in operating theatres or appropriate ICU locations. Percutaneous tracheostomy has been the predominant technique in the critically ill for some time, with surgical approaches usually reserved for patients with more complex anatomy. Percutaneous techniques involve more airway manipulation and risk leakage of exhaled gas and associated aerosols during ventilation, whilst endoscopic guidance makes aerosol generation more likely.[26] A controlled open surgical approach is thought to have less aerosol potential than a percutaneous approach, although this conclusion is based largely on experiences relating to SARS.[27–29] Subtle modifications to both techniques have been advocated during the current pandemic which include pausing ventilation at key points during the procedure and distal advancement of the tracheal tube.

Both techniques can be safely performed at the ICU bedside or in an operating theatre, with the latter providing a more controlled environment and better procedural conditions, but requiring a patient transfer that risks the physiological stability of the patient and exposes multiple staff to potential infection. The QEH team provided a dedicated service able to perform percutaneous and surgical tracheostomy, with access to dedicated COVID operating theatres. The group describe that the choice of performing a surgical or percutaneous tracheostomy depended only on patient body habitus, adequate neck extension, and airway assessment. The reported 75% percutaneous tracheostomy rate is higher than most reports in the current coronavirus literature, and contrasts with a 42% percutaneous rate from other UK centres contributing to the COVIDtrach audit[30] and the 23% rate reported in a recent Spanish national report.[21]

Expert opinion guiding technique for patients suffering from COVID-19 disease is influenced by a perception that the surgical approach is more controlled. There are also practical reasons why any given institution would adopt a particular strategy, not least the relative availability of surgical *vs* critical care personnel during a surge in ICU demand. The QEH group has shown that percutaneous techniques are feasible in this cohort, however, the choice of technique should ultimately be guided by local experience and infection control considerations.

## Post-procedural management

The provision of safe tracheostomy care can be challenging at the best of times and requires planning and multidisciplinary expertise.[31] To manage the increase in tracheostomy activity during the pandemic, the QEH team rapidly provided intensive training sessions to more than 800 members of staff and supported this initial education with support from specialist staff. This comprehensive program allowed tracheostomised patients to be safely 'stepped down' to designated tracheostomy wards and although the authors did not collect comprehensive follow-up data, no significant post-procedural complications were reported. This is an impressive achievement, particularly considering that many patients were cared for by staff previously untrained in tracheostomy care and managed in newly adapted locations.

Staff education has been shown to be fundamental in improving the safety of care and it is possible to provide safe and high-quality care in a variety of settings.[32,33] Key principles of tracheostomy care during the pandemic include a focus on essential care and avoidance of unnecessary interventions (especially those that generate aerosols), early recognition of deterioration, and timely responses to emergencies.[16] A recent UK study showed that the quality and safety of tracheostomy care can be significantly improved by application of a comprehensive educational program and careful consideration of all aspects of the patient journey.[33] The pandemic has focused attention and resulted in the rapid roll-out of NHS England's *Safer Tracheostomy Care* National Patient Safety Improvement Program.[15] It remains to be seen whether higher standards of tracheostomy care will be maintained. Quality improvement programs, such as those advocated by the Global Tracheostomy Collaborative (www.globaltrach.org), should be encouraged, as evidence continues to emerge describing a positive impact on the safety and quality of tracheostomy care.[32,34]

## Conclusions

COVID-19 has produced a shock to the system. Tracheostomy management has previously largely been based on opinion, but now is now increasingly guided by evidence. Global efforts to share data and strategies that benefit patients and protect staff should be applauded and encouraged, as should reporting of local experiences in different contexts. Emerging data

suggest that tracheostomy appears safe for patients and for staff who follow appropriate precautions, and tracheostomy clearly has a role to play in the management of patients who require prolonged invasive ventilation. There are more questions to address around the direct laryngeal effects of the virus,[35] optimal timing of tracheostomy, and optimal strategies for post-procedural care that protect staff whilst encouraging laryngeal rehabilitation. In the end, it seems the more we learn, the more is seems that best practice aligns with business as usual; just with better PPE.

## Authors' contributions

Wrote, edited, and approved the final version: all authors.

## Declarations of interest

BAM is National Clinical Advisor for Tracheostomy for NHS England, Chair of the National Tracheostomy Safety Project, and serves on the Executive Committee of the Global Tracheostomy Collaborative. MJB is the President of the Global Tracheostomy Collaborative. SJW is immediate past president of the Australian and New Zealand Intensive Care Society.

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