Emergency Airway Management in the Time of COVID-19: Lessons for All?

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In this edition of Anesthesiology, Wong *et al.* publish an observational study of more than 4,000 emergency tracheal intubations in patients with COVID-19 as part of the intubateCOVID project.[1] The study includes data from 1,722 clinicians, 607 institutions, and 32 countries. Personal protective equipment compliant with World Health Organization (Geneva, Switzerland) guidance was worn by 87.8%, which many would expect to hinder individual and team performance. Of note, practical difficulties caused by physical constraints, visual impairment, and communication problems when wearing personal protective equipment were highlighted in an early report from Wuhan[2] and confirmed in simulation studies.[3]

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Important findings of the study include a very high rate of intubation first pass success (89.7%) with moderately high rates of intubation failure (0.8%) and emergency front of neck airway (0.22%). In line with several international guideline recommendations,[4,5] most intubations were conducted by skilled airway managers (81.5% anesthesiologists, 72.5% attending or equivalent). Factors associated with higher first pass success were use of a rapid sequence induction technique, use of a powered air purifier respirator, and previous experience of COVID-19 tracheal intubation. Factors not associated with increased first pass success were operator specialty or seniority and use of videolaryngoscopy or protective plastic drapes or boxes. First pass success was lower in low- and middle-income counties despite the suggestion that participating hospitals in these countries were in well-resourced locations. Potential explanations and limitations to these findings are discussed in detail in the study, but it is important to note that although first pass success is an easy outcome measure to collect, it is not of itself a key patient-centered outcome, and it is, at least partially, open to manipulation or "gaming."

Russotto *et al.* recently published a similar multicenter international observational study of tracheal intubation of the critically ill, the INTUBE study, undertaken in the pre-pandemic setting, and the two studies are worth comparing.[6] INTUBE examined almost 3,000 intubations in the critically ill from 129 centers in 29 countries but with a greater proportion of low- and middle-income countries than the intubateCOVID study. In INTUBE, compared to intubateCOVID, intubators were less likely to be anesthesiologists (54%) or attendings (31%), intubation was conducted by fewer staff (greater than three staff, 6% *vs.* 23%), less frequently with a videolaryngoscope (17% *vs.* 75%), and apneic oxygen was used less frequently (10.4% *vs.* 57%). It might be anticipated that in pre-pandemic settings without the encumbrance of personal protective equipment that success would be higher. However, in INTUBE, first pass success was almost 10% lower (79.8%) than in the intubateCOVID cohort. In INTUBE, as in intubateCOVID, the involvement of an anesthesiologist or a senior operator was associated with improved first pass success, as was use of videolaryngoscopy, despite this often being reserved for predicted difficult cases. Of note, first pass success was associated with avoidance of major complications during intubation, and such complications were associated with poor critical care outcome, although this is unlikely a fully causal relationship. In INTUBE, major complications (severe hypoxemia or hemodynamic compromise) occurred in 45% of cases,

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including cardiac arrest in 3%. This is consistent with previous studies.[2,7] intubateCOVID did not collect data on complications of tracheal intubation, but early in the pandemic, Meng *et al.* reported qualitatively on intubation in Wuhan,[8] and Yao *et al.* reported on 202 intubations in acutely hypoxemic COVID-19 patients.[9] Hypotension occurred in 18% during intubation and 22% soon afterward, pneumothorax in 6%, and cardiac arrest in 2%.

Put together, these reports highlight once again the high complication rates associated with tracheal intubation of the critically ill. Further, they hint that intubation of patients with COVID-19 during the pandemic has been associated with good procedural care and favorable immediate outcomes, despite the well-recognized complexity of that setting. This raises several questions. Who should intubate the critically ill? How can a disparity in procedural outcomes between different healthcare systems be flattened? What is the role of videolaryngoscopy in tracheal intubation of the critically ill, and what are the pre-existing requirements before it is used? More controversially, might tracheal intubation of the critically ill—in all settings—be usefully adapted to follow more closely the "safe, accurate and swift" principles described in COVID-specific airway guidelines,[4] and might this approach reduce delays and complications? These questions cannot be answered here but require further research. This will need to be undertaken in a range of care settings in multiple countries and resource environments for us to attempt to answer them.

The intubateCOVID study is a tour de force in many ways. It was established rapidly, across many countries, and enrolled huge numbers of collaborators at a time of peak pandemic surge and global healthcare stress. This in itself is a remarkable achievement. It was a time of fear, for both the safety of patients and airway managers. Learning from the SARS epidemic, it appeared that those involved in airway management of the critically ill would be at highest risk of disease transmission and harm.[10] Airway managers at this time were undoubtedly brave and exposed themselves to a very high perceived risk for the benefit of their patients. This should not be forgotten. Indeed, the prime aim of the intubateCOVID study was to explore the relationship between intubation and disease transmission.[11] For a number of reasons, the extreme concerns many had in those early months have not been realized, and with adequate precautions (most significantly good ventilation and appropriate personal protective equipment), the procedure-specific risk of infection is low.[3,9,12] Indeed, in some counties, those staff at highest risk are those working on normal wards, with lower-grade personal protective equipment, while anesthesia and critical care are the safest in-hospital environments.[13] The cause of this paradox is uncertain, and several elements likely contribute. Recent evidence challenges the prevailing view that tracheal intubation[14] (and high-flow nasal oxygen and mask continuous positive airway pressure[15,16]) are high-risk aerosol-generating procedures by showing that these procedures do not increase aerosol generation. These same studies highlight the considerable aerosol generation and dispersal during exertional respiratory activities (deep breathing and especially cough) and their likely impact on airborne disease transmission over short distances.[14–16] These joint findings have moved the focus from the procedure to the patients (or person outside hospital settings) and their environments. Challenges include determining the following: first, the relative impact of the individual patient, their respiratory activities and mechanics, room ventilation, and proximity and duration of contact on risk of infection transmission; and second, both the minimum infective aliquot of virus and the minimum effective personal protective equipment in each setting.

But perhaps above all of this, the intubateCOVID study shows what we can do together. At a time when vaccine nationalism and political isolationism are threats to global safety, the medical and academic communities have shown what can be achieved by flexibility and collaboration. Knowledge shared from China, Italy, and other counties in the early stages of the pandemic was fundamental in improving the global healthcare response. Academic collaboration was swift and central to our understanding of what we faced and how to manage it better. The intubateCOVID study is a good example of this, as are the RECOVERY[17] and SOLIDARITY[18] studies of therapeutics and many of the vaccine studies, which have so rapidly led to a possible path out of the pandemic. These studies were achieved by prompt actions, responsive collaboration, selflessness, and importantly, by light regulatory oversight. This surely shows us a way forward—the pandemic should be an inflection point in how we do research. Researchers, funders, regulators, and publishers can usefully reflect on much that has gone well in the last year and use this as a framework for better, simpler, and more generalizable future research structures, for there is so much we still need to learn.

Competing Interests

Dr. Cook is a textbook editor for Cambridge University Press (Cambridge, United Kingdom) and Oxford University Press (Oxford, United Kingdom).

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