VIEWPOINT

Surgical Considerations for Tracheostomy During the COVID-19 Pandemic

Lessons Learned From the Severe Acute Respiratory Syndrome Outbreak

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Since the emergence of the coronavirus disease 2019 (COVID-19) in December, 155 countries have reported cases of COVID-19, including sustained community transmission in several countries, such as China, Italy, and Iran. As of March 21, 2020, there have been 275 434 cases confirmed globally, including 11 399 deaths.[1] While the situation in China has improved, many countries continue to struggle with escalating case numbers and strained health care systems that are threatened to be overwhelmed by the pandemic.

One of the World Health Organization's strategic priorities is to limit human-to-human transmission, including secondary infections among health care workers, which was a key feature of the severe acute respiratory syndrome (SARS) epidemic in 2003 and accounted for one-fifth of all cases globally. Although SARS and COVID-19 are both transmitted by droplets, it is now clear that the infectivity and extent of spread of COVID-19 will far exceed that of SARS.

Despite the lower mortality rate in COVID-19 compared with SARS (2.3% vs 11%), a notable fraction of infected people (9.8%-15.2%) require invasive mechanical ventilation or extracorporeal membrane oxygenation.[2-4] In an epidemic setting, intensive care units (ICUs) will quickly reach capacity. Patients with prolonged ventilation may require tracheostomy to optimize weaning from ventilatory support. Unsurprisingly, open tracheostomy was the most common surgical procedure performed on infected patients during the SARS outbreak.[5,6]

We performed a literature review of tracheostomies during the SARS epidemic consisting of a PubMed search with the terms *SARS* and *tracheostomy*, from which 3 case series (**Table**) and 2 case reports were available for review.[5-9] Drawing from these experiences as well as our own contingency plans for SARS and COVID-19 outbreaks, we wish to highlight several important perioperative considerations when planning for open tracheostomy in an infected patient during the COVID-19 pandemic.

First, it cannot be overemphasized that barrier precautions are of critical importance. Standard personal protective equipment (PPE) is essential. This comprises an N95 mask, surgical cap, goggles, surgical gown, and gloves. Of the published cases of tracheostomies performed in Singapore, Hong Kong, and Canada during the SARS outbreak, in addition to standard PPE, all 5 health care institutions further used enhanced PPE measures ranging from face shields to powered air-purifying respirators (PAPRs).[5-9] The effectiveness of these PPE measures was validated, as all members of the tracheostomy surgical teams remained healthy after performing a total of 23 tracheostomies documented across institutions.

It is important to note that the donning and removal of PPE are sequential processes requiring proper training and mask fitting. In the event that enhanced PPE systems are used, such as PAPRs, it is crucial that the gowning and degowning procedures are carefully followed, as improper removal may result in operator contamination. In our institutions, these processes are closely supervised by dedicated infection control nursing staff.

Second, the location of the surgery should be carefully considered. In most instances during the SARS outbreak, open tracheostomy was performed at the bedside in the ICU in negative-pressure rooms.[5-8] This avoided unnecessary transport of patients and repeated connection and disconnection of ventilatory circuits during transfer. Negative-pressure ICU rooms with adjacent anterooms are ideal, as anterooms help to minimize the escape of contaminated air and also serve as an additional barrier should there be inadvertent entry of health care workers without appropriate PPE. Appropriate clinical judgment in identifying patients with high likelihood of progressing to tracheostomy, such as those with multiple comorbidities or chronic respiratory conditions, and matching them to the most appropriate ICU room can help to reduce movement of patients within the ICU.

Bedside tracheostomies in the ICU should be well-orchestrated events, meticulously planned and rehearsed. Specific considerations include the limited space in the ICU room, suboptimal positioning of the patient, and the movement of essential equipment and surgical instruments. We find that consolidating all necessary equipment into a single sterile pack greatly simplifies the movement and preparatory process in the ICU room.

In the event that tracheostomy is performed in the operating room (OR),[9] it should ideally be in negative-pressure ORs in well-demarcated areas within the OR complex with dedicated routes for patient transport. For specific considerations for reorganization of the OR complex, we highly recommend the article by Chee and colleagues.[5]

Third, the time of exposure to aerosolized secretions intraoperatively should be minimized. This may be achieved by (1) ensuring complete paralysis of the patient throughout the procedure to prevent coughing, (2) stopping mechanical ventilation just before enter-

Table. Case Series of Open Tracheostomies Performed During the Severe Acute Respiratory Syndrome (SARS) Outbreak

Characteristic	Case series		
	Chee et al[5]	Tien et al[6]	Wei et al[7]
Institution	Tan Tock Seng Hospital, Singapore	Sunnybrook and Women's College Health Sciences Centre, Toronto, Ontario, Canada	Queen Mary Hospital, Hong Kong SAR, China
No. of tracheostomies performed	15	3	3
Barrier precautions during surgery	Standard PPE,[a] shoe covers, and powered air-purifying respirator system	Standard PPE[a] and Stryker T4 Protection System	Standard PPE,[a] shoe covers, and additional plastic face shield worn outside goggles
Setting of surgery	Negative-pressure room in ICU	Negative-pressure room in ICU	Negative-pressure room in ICU or operating room
Intraoperative steps to reduce aerosolization	Complete paralysis of the patient, mechanical ventilation stopped before tracheotomy, limited suction used during the procedure, no specific avoidance of diathermy other than during tracheotomy[b]	Complete paralysis of the patient, mechanical ventilation stopped before tracheotomy, no suction used after trachea was entered, diathermy avoided when possible	Complete paralysis of the patient, mechanical ventilation stopped before tracheotomy, no suction used throughout the procedure, diathermy avoided as much as possible
Surgical team members	Single dedicated team performing all tracheostomies: experienced surgeon, experienced anesthesiologist, 1 scrub nurse, and 1 surgical assistant[b]	Senior attending trauma surgeon and most senior surgical staff member available, attending ICU anesthetist, and no circulating nurse or scrub nurse	Single surgeon, 1 intensive care specialist, and 1 standby medical or nursing staff member

Abbreviations: ICU, intensive care unit; PPE, personal protective equipment.

[a] Standard PPE consists of an N95 mask, surgical cap, goggles, surgical gown, and gloves.

[b] Personal experience from Mark Li-Chung Khoo, MBBS (February 23, 2020), surgical lead for tracheostomies at Tan Tock Seng Hospital during the SARS outbreak.

ing into the trachea via tracheotomy, and (3) reducing the use of suction during the procedure. If suction is used, this should be within a closed system with a viral filter.

In this regard, percutaneous tracheostomy involves more extensive airway manipulation, such as bronchoscopy and/or serial dilations during trachea entry. Patients with high ventilatory settings may also require repeated connection and disconnection from the ventilatory circuit. These factors result in increased aerosolization risks compared with open tracheostomy, in which entry into the trachea is performed quickly with an incision and aerosolization risks are mitigated with the aforementioned measures. As such, open tracheostomies were favored over percutaneous tracheostomies during the SARS outbreak.[5,6] It is noteworthy that techniques for percutaneous tracheostomy have advanced since then. However, to our knowledge, the considerations, safety, and PPE requirements for percutaneous tracheostomy in an infected, aerosolized setting have yet to be established in the literature.

Fourth, the experience of the team is clearly of importance to minimize time spent in the contaminated room. Having a dedicated, experienced team comprising a surgeon, an anesthetist, and a scrub nurse to perform tracheostomies will allow familiarity and minimize setup time. Communication plans within the room need to be preestablished because conversing through PPE and PAPRs can be extremely difficult.

Fifth, the postprocedure waste disposal and decontamination of equipment need careful consideration to minimize contamination of the environment. Whenever possible, disposable equipment should be used. Personnel who handle the decontamination of surgical equipment should also be appropriately protected in standard PPE.

For health care workers who experienced the SARS epidemic, memories of the fear of contracting SARS still linger, along with recollections of infection control precautions implemented then. Seventeen years on, COVID-19 is a far more extensive challenge facing the global medical community. Yet, the key principles of meticulous team-based planning among stakeholders and strict adherence to barrier precautions remain. As the COVID-19 situation escalates, so will the requirement for tracheostomies in patients with prolonged ventilation. It is thus crucial that surgical and ICU teams are well prepared and ready to act when called upon.

ARTICLE INFORMATION

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