

# Safe Tracheostomy for Patients With Severe Acute Respiratory Syndrome

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**Objectives/Hypothesis:** Severe acute respiratory syndrome (SARS) caused by coronavirus has become an epidemic affecting many regions worldwide. Fourteen percent to 20% of patients require endotracheal intubation and ventilator support. Some of these patients may require tracheostomy subsequently. This procedure, when performed without protection, may lead to infection of the medical and nursing staff taking care of the patient. **Study Design:** Based on clinical information of three patients. **Methods:** The authors carried out an emergency tracheostomy and changed the tracheostomy tube for one patient and performed elective tracheostomy in another two patients. **Results:** No medical or nursing staff member was infected after carrying out the procedure while taking all the precautions and wearing the appropriate protective apparel. **Conclusion:** The authors have prepared guidelines for performing a safe tracheostomy under both elective and emergency conditions. Surgeons who might be involved in performing the tracheostomy should become familiar with these guidelines and the appropriate protective apparel.

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## INTRODUCTION

Severe acute respiratory syndrome (SARS), which initially affected only Hong Kong, China, and Singapore, has developed into a worldwide epidemic. The disease is an infection caused by a coronavirus resulting in a clinical picture of atypical pneumonia.<sup>1</sup> Characteristic radiological features on chest radiograph and computed tomography scan could be found in most patients with SARS. The therapeutic regimens consist of antiviral agents such as Ribavirin and large doses of steroids.<sup>2</sup> Although most patients recover following this treatment regimen, 14% to 20% of patients develop respiratory failure and require endotracheal intubation and ventilator support.<sup>2,3</sup>

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SARS has caused much concern because it is highly contagious and has affected countries around the world.<sup>4</sup> The route of infection by the virus is through the mucosal membrane and conjunctiva. The mode of spread is through direct contact with the virus, which is thought to be transported through aerosol and fine droplets. This has posed a significant threat to medical and nursing staff caring for these patients, especially when the patients are receiving ventilator support in which frequent suction of the bronchial secretions is mandatory.

Tracheostomy for patients with SARS is required in two situations: following prolonged endotracheal intubation or to gain access to the airway when endotracheal intubation is unsuccessful. In the latter circumstance, a surgical airway has to be established as an emergency measure. Spillage of blood and bronchial secretions are expected to be significant during the tracheostomy. Protection of the medical and nursing staff is mandatory when this procedure is performed for patients with SARS or those suspected of having SARS. Medical personnel should be familiar with the guidelines, and all appropriate protective equipment should be available for immediate usage. This will reduce the risk of acquiring the infection during tracheostomy to a minimum.

## CASE REPORTS

### Case 1

A 48-year-old man had fever and cough and was admitted to Queen Mary Hospital (Hong Kong, Republic of China) on March 30, 2003. The fever persisted, and his chest radiograph showed left-side, lower zone patchy consolidation. Subsequent rapid development of respiratory tract symptoms associated with a low lymphocyte count showed that he was likely to have contracted SARS. This was confirmed by polymerase chain reaction analyses of his nasal aspirate, which identified the presence of coronavirus DNA. He was managed with intravenous Ribavirin; however, his pulmonary function deteriorated on day 5 after admission. A decision was then made to carry out endotracheal intubation, which was unsuccessful. The arterial oxygen saturation level of the patient was found to have decreased to 70%. Immediate tracheostomy was required at the bedside in the intensive care unit. His preoperative blood gas values showed a partial pressure of oxygen of 8.8 kPa and partial pressure of carbon dioxide of 4.2 kPa, and the patient was drowsy.

The surgeon changed into operating room garments. Protec-

tive clothing worn included a cap, a pair of goggles, and an N95 mask. After washing his hands with an antiseptic, he put on his sterilized gown and gloves before carrying out the tracheostomy. No assistant was present at the surgical procedure.

The patient was placed supine with the neck extended. 5 ml of Lidocaine (2%) was injected subintaneously as local anaesthetic. A transverse skin incision was made at 2 cm above the sternal notch; the trachea was located by palpation. The cricoid cartilage was quickly identified, and a vertical tracheotomy was performed by cutting the second and third cartilaginous tracheal rings. A No. 7.5 Portex cuffed tracheostomy tube could be inserted with ease and then connected to a ventilator. The entire tracheostomy procedure took 4 minutes. The patient regained consciousness, and his arterial oxygen saturation level returned to 100%. His postoperative blood gas values showed a partial pressure of oxygen of 27.3 kPa and a partial pressure of carbon dioxide of 5.7 kPa. There was significant coughing and thus spillage of tracheal secretion during tracheotomy and when the tracheostomy tube was being inserted. On completion of the procedure, the gloves, operating gown, N95 mask, goggles, and cap were removed in this order by the surgeon to avoid cross-contaminating other medical and nursing staff. He did not touch his face with his hands until a shower was taken.

On the following day, the balloon of the inserted tracheostomy tube was found to be leaking. Maintaining the ventilation also proved to be difficult. It was decided to change to a larger tracheostomy tube. The surgeon who performed this procedure wore the operating theater suit and a N100 mask incorporating a plastic shield that protects the eyes. No goggles were worn. The patient was again positioned with the neck extended. The patient was sedated with 30 mg morphine sulfate and 3 mg midazolam given intravenously. Immediately before the change of the tracheostomy tube, 5 mg vecuronium bromide was given to paralyze the patient. The ventilator was stopped. On removal of the previous No. 7.5 Portex tracheostomy tube, the balloon was found to be leaking. A No. 8 Portex cuffed tracheostomy tube was then inserted smoothly; there was no coughing or spillage of tracheal secretion during the procedure. The ventilator was switched on again, and the total period of apnea lasted approximately 1 minute.

The patient's condition remained critical, and ventilator support was required up to day 16 after the tracheostomy. Both surgeons who carried out the tracheostomy and subsequent procedure were well on day 16 after the procedures.

### Cases 2 and 3

There were two other patients who had coronavirus infection who required endotracheal intubation and ventilator support. On the 14th day after intubation an elective tracheostomy was carried out for both patients. This facilitated tracheal aspiration and reduced patient discomfort. Tracheostomy was performed by a single surgeon wearing gloves, operating gown, N95 mask, goggles, and cap. After the anterior tracheal wall was exposed, the ventilator was stopped and the patient was paralyzed. The endotracheal tube was removed, and a tracheotomy was performed, followed by insertion of a No. 7.5 cuffed Portex tracheostomy tube. There was no suction used throughout the procedure, and the patient was immobile during the insertion of tracheostomy tube. After the cuff of the tracheostomy was inflated it was connected to the ventilator. The surgeons who performed the elective tracheostomies remained well at 2 weeks after the procedures.

## DISCUSSION

Tracheostomy for a patient with SARS imposes a significant risk of infecting both the medical staff who

perform the procedure and the nursing staff managing the care of the patient. Our experience of carrying out an emergency tracheostomy for a SARS patient prompted us to develop appropriate procedural guidelines with safety of the patient and the medical and nursing staff in mind. Diathermy should be avoided as much as possible because coagulation with diathermy can produce small particles that may act as a vehicle for the virus. Should suction be required during the tracheostomy, the suction should be performed with a closed system and a viral filter should be used.

### Protective Apparel for Medical Staff

Waterproof cap, goggles with an anti-mist screen, N95 mask, impermeable operating room surgeon's gown and gloves, and a transparent plastic facial shield worn outside the goggles and N95 mask were considered adequate to protect the surgeon. N95 masks are effective to filter 99.5% of the particles larger than 0.75  $\mu\text{m}$ .<sup>5</sup> P100 facial masks, N100 masks, or other whole-body barrier suits are not recommended because these are cumbersome and prolong the operative procedure. This is particularly so when the surgeon has to wear spectacles. Cumbersome protective garments are also difficult to remove without causing contamination of the surrounding area. Improper removal of these garments or complicated masks is more likely to increase the chance of infecting both the surgeon and other medical or nursing staff.

### Elective Tracheostomy

**Indications, setting, and staff.** Elective tracheostomy is indicated when prolonged endotracheal intubation is considered inappropriate for the patient or when a repeated change of endotracheal tube is required. Elective tracheostomy is performed in an operating room or intensive care room, preferably with negative pressure. Staff includes one surgeon, one intensive care specialist, and one standby medical or nursing staff member.

**Protective apparel.** Protective apparel for elective tracheostomy include waterproof cap, goggles with an anti-mist screen, N95 mask, transparent plastic full-face shield worn outside goggles and N95 masks, disposable waterproof surgical apron, double surgical gloves, and plastic shoe covers.

**Surgical instruments.** A tracheostomy set of instruments is required.

**Procedure.** The procedure for elective tracheostomy is performed as follows:

1. Establish adequate preoxygenation (100% oxygen for 5 min).
2. Complete paralysis of the patient is necessary to ensure that there is no coughing or any other movement.
3. Stop mechanical ventilation before tracheotomy.
4. Withdraw the endotracheal tube to just above the tracheotomy site.
5. Tracheotomy is performed under direct vision without movement of patient; tracheostomy tube is inserted, followed by inflation of the balloon.
6. Connect the tracheostomy tube to ventilator, and when adequate ventilation is confirmed, suture the tra-

cheostomy tube to skin, in addition to tracheostomy tube strapping.

7. Remove the endotracheal tube.

8. Return all instruments to the trolley.

9. Remove the shoe cover, outer pair of gloves, surgical gown, and plastic facial shield in the intermediate area.

10. Leave the intermediate area with the standard SARS precautionary protection equipment including cap, goggles, and N95 masks and proceed to shower area, where all the protective equipment is removed.

### **Emergency Tracheostomy**

**Indications, setting, and staff.** Emergency tracheostomy is indicated when endotracheal intubation is unsuccessful and the patient is in need of ventilator support because of rapidly deteriorating pulmonary function. Emergency tracheostomy is performed in the setting of an operating room or intensive care room, preferably with negative pressure and without transferring the patient. Staff includes one surgeon, one intensive care specialist, and one standby medical or nursing staff member.

**Protective apparel.** Protective apparel for emergency tracheostomy include the following: water-impermeable cap, goggles with an anti-mist screen, N95 mask, plastic transparent full-face shield worn outside goggles and N95 masks, disposable water-impermeable surgical apron, and double surgical gloves and plastic shoe covers.

**Surgical instruments.** Instruments for cricothyroidotomy and a separate tracheostomy set are required.

**Procedure.** The procedure for emergency tracheostomy is performed as follows:

1. Adequate preoxygenation (100% oxygen for 5 min).

2. Patient and the team prepare for cricothyroidotomy. The skin incision should be made down to the cricothyroid membrane.

3. Complete paralysis of the patient is necessary to ensure that there is no coughing or any other movement.

4. Immediate incision of the cricothyroid membrane is performed with insertion of a cuffed tracheostomy tube of the appropriate size.

5. Connect the tube inserted through the cricothyroidotomy to the mechanical ventilator and wait until the patient's condition has stabilized on mechanical ventilator. Stitch the flange of the coniotomy tube to neck skin.

6. Perform a separate incision for a tracheostomy.

7. Identify anterior wall of the trachea, and stop mechanical ventilation before tracheotomy.

8. Tracheotomy is performed under direct vision with the patient paralyzed to avoid any movement; tracheostomy tube is inserted, followed by inflation of the balloon.

9. Connect the tracheostomy tube to a mechanical ventilator. When adequate ventilation is confirmed, suture the tracheostomy tube to skin, in addition to tracheostomy strapping.

10. Remove the tube inserted through the cricothyroidotomy, and close the wound.

11. Return all instruments to the trolley.

12. Remove the shoe covers, outer pair of gloves, surgical gown, and plastic facial shield in the intermediate area.

13. Leave the intermediate area with the standard SARS precautionary protection equipment including cap, goggles, and N95 masks and proceed to shower area, where all the protective equipment is removed.

Emergency tracheostomy should be avoided as much as possible because the procedure will inevitably be performed under less optimal conditions than in the elective situation. Every attempt should be made to gain access to the airway through endotracheal intubation. In the case of patients for whom difficulty of endotracheal intubation is expected, the surgeon should be notified in advance. An experienced surgeon would then put on the appropriate protective apparel and be mindful of the need to carry out the cricothyroidotomy followed by tracheostomy if intubation proved to be unsuccessful.

Surgeons who might be involved in carrying out surgical procedures for patients with SARS should become familiar with the protective apparel. They should practice performing surgery while wearing full protective apparel.

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