

Safety and efficacy of tracheostomy in COVID-19 patients: a preliminary retrospective study of 14 cases

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Keypoints

- The outbreak of COVID-19 in Wuhan, China, since December, 2019, has become a pandemic.
- This highly infectious disease increases the risk of converting to acute progressive respiratory failure, which needs the treatment with invasive mechanical ventilation, including tracheostomy.
- Up to now, there is no data describing tracheostomy cases in COVID-19 pandemic.
- we retrospectively analyzed 14 cases of critically ill COVID-19 patients with tracheostomy, concentrating on surgical indication, complication, procedure and precaution.
- Bedside open tracheostomy in COVID-19 patients is a relatively safe procedure for skilled surgeons under appropriate precautions, and the critically ill patients may benefit from it.

Introduction

The outbreak of Corona Virus Disease 2019 (COVID-19) has become a pandemic. It has been reported that in an early study, about 20% COVID-19 hospitalized patients developed into acute respiratory distress syndrome (ARDS) and required invasive mechanical ventilation.¹ For some patients on prolonged intubation, tracheostomy may be considered as an important option for optimal respiratory care. Although recent several articles described the principles and procedures of tracheostomy on COVID-19 patients,^{2,3} there is no data describing tracheostomy cases in COVID-19 pandemic. In this study, we retrospectively analyzed 14 cases of COVID-19 patients with tracheostomy in [removed for blind peer review], the only designated hospital which still has a dozen intubated patients in [removed for blind peer review], concentrating on surgical indication, complication, procedure and precaution.

Methods and materials

Fourteen confirmed COVID-19 patients treated with tracheostomy before April 3, 2020 in [removed for blind peer review] were retrospectively analyzed. All patients except case 7 underwent standard open tracheostomy (OT). Case 7 underwent an open revision tracheostomy because of thyroid bleeding and incorrect intubation position after percutaneous tracheostomy (PT). The clinical characteristics of patients were detailed in Table 1. The median age of all patients was 69 years, ranging from 45 to 80 years old. Seven (50%) patients were male. Eleven (78.5%) patients had at least one underlying comorbidity, the most common of which were hypertension (64.2%), diabetes (50%), malignancy (14.3%) and cerebrovascular disease (14.3%). The median duration from illness onset to tracheostomy was 50 (ranging from 33~90) days. The intubation period was ranged from 9~36 days with a median of 25.5 days. Case 14 had experienced reintubation for

ventilatory assistance after an unsuccessful extubation. All patients were given anticoagulant therapy due to increased coagulation activity while this therapy was suspended for the four cases after the occurrence of cerebral hemorrhage or gastrointestinal bleeding. Common coexisting disorders before tracheostomy included cerebrovascular disease (64.2%), acute kidney injury (42.8%), acute liver injury (28.7%), acute cardiac injury (21.4%). Case 2, case 3 and case 5 had experienced endotracheal cannula obstruction and replacement. Follow-up was to continue through at least 14 days after tracheostomy until April 17, 2020 or death.

Patients were placed in a single intensive care unit (ICU) room with a portable operating lamp and frequent air exchange. A tracheostomy set of instruments and a closed suction device connected to a virus filter membrane was prepared. The medical staff includes two skilled surgeons, an ICU specialist responsible for anesthesia and monitoring, and a standby nurse. Protective equipment included waterproof medical cap, medical protective mask (N95), goggles with an anti-fog screen, protective garment, anti-penetration isolation gown, surgical gloves, and plastic shoe covers and powered air-purifying respirators (PAPRs).

The patients were given preoxygenation (100% oxygen for 5 min) and then fully paralyzed. Following routine tracheostomy, mechanical ventilation was stopped when the surgeon was going to incise the trachea. The endotracheal tube was slowly pulled out to just above the tracheotomy site under direct vision. No tracheal or wound suctioning was attempted to avoid possible aerosol generation. The tracheostomy tube was inserted, followed by inflation of the balloon. We immediately connected the tracheostomy tube to the ventilator and performed suction with a closed system. The endotracheal tube was removed when adequate ventilation was confirmed.

Results

The median procedure length was 20 minutes, ranging from 15~29 minutes. The total period of airway loss was approximately 30 seconds. The massive thick tracheobronchial secretions were found after incision of the trachea in case 2, case 3, case 5 and case 13. Complications attributable to open tracheostomy, were not observed in our study. By April 17, 2020, out of fourteen patients on prolonged mechanical ventilation, five patients (cases 1-3, case 5 and case 8) achieved successful weaning in the follow-up period, and one patient (case 4) has been incompletely liberated (Table 1). Three (case 7, case 9 and case 10) had died (Table 1). No related medical staff was diagnosed with COVID-19 in a follow-up period of at least two weeks after surgeries, evidenced by absence of symptoms and negative result by polymerase chain reaction testing of a nasopharyngeal sample.

Discussion

Prolonged intubation (>7 days) remains most common indication of tracheostomy as clinical consensus guidelines. In this study, twelve (85.7%) patients received intubation for more than 14 days. It is generally accepted that for mechanical ventilation and respiratory failure, a tracheostomy should not be considered in a person who cannot readily benefit from the advantages that the airway may offer. Moreover, tracheostomy for a patient with COVID-19 imposes a significant risk of nosocomial infection. For the most patients in our study, clinicians exerted their efforts to help them weaning from the ventilator, in the hope of circumventing the need for a tracheostomy. Thus, tracheostomy was delayed to more than 14 days after the intubation. Meanwhile, the majority of patients had developed cerebrovascular disorders, which require airway protection and a slow process of recovery. With decreased use of sedation and pulmonary rehabilitation after tracheostomy, it may contribute to increase the incidence of weaning success. Our experience suggests that tracheostomy for prolonged intubation and airway protection can be considered to be the last resort to the treatment of COVID-19 patients. A initial gross examination report of a COVID-19 autopsy demonstrated the existence of massive thick secretions in bronchi and bronchiole, which indicated the importance of effective and aggressive pulmonary toilet for patients with COVID-19.⁴ Compared with intubation, tracheostomy tube bypasses the upper airway, which results in more effective suction of the secretions and less sputum crust in cannula. Case 2, case 3 and case 5 had endotracheal cannula obstruction, which is possibly related to thick secretions validated by surgical findings. The need for pulmonary toilet in patients with COVID-19,

particularly, in the condition of thick secretions is a strong indication of tracheostomy.

Powered air-purifying respirators (PAPRs) can provide higher protection, better vision, and more comfort compare with the typical headgear worn in conjunction with an N95 mask. Early in the outbreak of SARS, some anesthetists, who just wore standard surgical facemasks, gowns and gloves, contracted SARS following intubation of suspected patients.⁵ Compared with the intubation procedure, tracheostomy takes more time and increases the risk of exposure to low airway virus. Thus, we recommend PAPRs as protective equipment for performing tracheostomy on patients with COVID-19.

Sufficient hemostasis before the incision of the trachea is necessary. In our procedure, minor wound bleeding from the skin edges and blood vessel bleeding were adequately controlled with ligation and suture. We recommend to avoid the usage of epinephrine due to its temporary hemostasis effect, which increases the rebleeding rate, especially in individuals treated with anticoagulant therapy. Electrocautery should also be avoided to prevent aerosolizing viral particles. Bedside tracheostomy proves to be a reasonable and practical procedure. Multiple disconnection and reconnection of the breathing circuit during a COVID-19 patient transport may facilitate the transmission of the virus. Secondly, transport will pose significant risks and inconvenience to critically ill patients. Thirdly, in ICU, all attending medical staffs armed with PAPRs were adequately protected from virus. Finally, in our study, bedside tracheostomy was not technically challenging for skilled surgeons. The overall procedure took only about 20 minutes, with approximate 30 seconds of apnea for each patient.

PT has been increasingly used in ICU and was considered a superior alternative to OT. The addition of endoscopic guidance to PT has further increased the safety of this procedure by visualization of the tracheostomy site.⁶ The indications for PT are the same as for an OT with particular attention to some contraindications.⁶ Case 2, case 4 and case 7 with obese neck, case 8 with previous thyroid surgery, case 13 with previous tracheostomy and case 6 with a large thyroid isthmus were not ideal candidates for PT. Case 7 was selected to use PT, resulting in the injury of thyroid and constant bleeding, which leads to the requirement of revision OT.

In our study, we performed OT for all the cases. In fact, in the setting of the highly infectious disease, OT was selected over PT because it was entailed a lower risk of aerosolization.⁷ The placement of the cannula was confirmed by air aspiration and bubble formation during PT, which may produce viral droplets and aerosols.⁸ The insertion of a bronchoscope into an airway already compromised by intraluminal dilators results in further obstruction of the ventilatory path, worsening the hypoventilation.⁹ On the other hand, in order to prevent aerosols, the ventilator should be stopped when the airway was opened and autonomous respiration must be refrained.⁷ Although PT takes less time than OT for skilled surgeons, our experiences indicated that the time spent from tracheotomy to insertion of the tube during ventilation suspension in OT was shorter than the one in PT. Under such circumstances, PT may have longer duration of airway loss and more risk of hypoxia than OT in critically ill patients with COVID-19.

Conclusion

Bedside OT is a useful technique with low infection rate and complications and can be regarded as the last-resort treatment in saving critically ill COVID-19 patients.

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