

Performing Bedside Surgical Tracheostomy On COVID-19 Patients At Intensive Care Unit-Our Experiences At A Tertiary Care Indian Teaching Hospital

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Abstract: Background: Currently COVID-19 infection is a global challenge to the medical community. Acute respiratory distress syndrome (ARDS) and respiratory failure require mechanical ventilation. Tracheostomy is needed for prolonged ventilation as COVID-19 infections often escalates, so staying of the patient can be extended in ICU with ventilator.

Objective: To evaluate the details of tracheostomy including patients profile, surgical steps, complications and precautions by health care workers at the intensive care unit (ICU) of the specially assigned hospital for COVID-19 patients.

Materials and Methods: This is a retrospective study in which 22 COVID-19 patients underwent bedside surgical tracheostomy at the ICU. Clinical patient’s profiles such as age, sex, co-morbidities, complication of the tracheostomy, ventilator withdrawal after tracheostomy and nosocomial infections of the health care workers related to tracheostomy were analyzed.

Result: Out of the 22 patients with COVID-19 infections those underwent tracheostomy, 16(72.72%) were male and 6 (27.27%) were female with age ranged from 42 years to 75 years and a mean age of 64 years. The median duration from the day of the orotracheal intubation to the day of tracheostomy was 13 days.

Conclusion: Surgical tracheostomy on COVID-19 patients is a high risk aerosol generating procedure for health care workers. It should be performed with close association with otolaryngologists,

anesthesiologists and intensive care physicians along with adequate personal protective equipment (PPE) for smooth management of the general anesthesia and airway.

Keywords: *COVID-19 infection, tracheostomy, intensive care unit, invasive mechanical ventilation.*

INTRODUCTION

The novel corona virus disease 2019(COVID-19) is a rapidly spreading infection among the human being and is caused by severe acute respiratory syndrome corona virus 2(SARS-CoV-2) virus. ^[1] The COVID-19 pandemic is leading to an untold disruption in all over the world where all the countries are facing the burden irrespective of their strength and resilience of their health care system. The hospitals and intensive care units are facing a surge of the COVID-19 patients requiring urgent care or invasive ventilation. This virus is seen in high abundance at the mucosa of the upper and lower respiratory tract. ^[1] The virus SARS-CoV-2 is usually transmitted by close contact, droplet and aerosols from aerosol generating procedures (AGP) like tracheostomy. ^[2] Tracheostomy is a commonly performed surgical procedure at ICU for prolonged ventilation of the patient. Tracheostomy is often done in patients with acute respiratory failure, especially when the clinicians predict for patients' need of the prolonged ventilation. Health care workers are at high risk for getting infections during this procedure performed at the ICU patients. Currently doing tracheostomy on the COVID-19 patients is challenging for otolaryngologists and associated health professionals at the ICU because high chance of spread of SARS-CoV-2 virus to the surrounding health care workers and also for the other patients. ^[3] Despite the surgical tracheostomy being commonly done in routine clinical practice, the risk of exposure to the health care professionals to COVID-19 infection during this procedure is consistent. Because of the direct access to the airway as in mechanical ventilation, which produce high amount of droplets in case of air-leak of the cuff, so the tracheostomies make surgeons or otolaryngologists to be at the highest risk category, along with ICU nurses, intensivists and anaesthesiologists. ^[3] Surgical tracheostomy on intubated and sedated patients are preferable than awake patients where air flow cessation cannot be obtained and the droplet emission inevitably more. Till date, the profile of the tracheostomy on the COVID-19 patients in ICU is not reported adequately in medical literature. This study aims to evaluate the profile of surgical tracheostomy on COVID-19 patients at the ICU.

MATERIALS AND METHODS

This a descriptive retrospective study. This study was done at the tertiary care teaching hospital of eastern India which attached to a 500 bedded COVID-19 hospital with 125 intensive care unit beds. This COVID hospital is one of the designated hospitals assigned by the state Government to treat the COVID-19 patients. We retrospectively analyzed hospitalized COVID-19 patients between the March 2020 to August 2020 those underwent tracheostomy. This study was approved the institutional ethics committee of our hospital with reference number IEC/IMS/SOA/12/14.03.2020. A written informed consent was waived the ethics committee of our hospital owing to the rapid emergence of the disease. Here all the COVID-19 patients were admitted on the basis of the positive real time reverse transcription polymerase chain reaction (RT-PCR) test of the nasopharyngeal swab specimens. Before performing tracheostomy, RT-PCR is again advised to know the infectivity of the COVID-19 patient. At the time of treatment, discussion was not done with patient or a relative for describing the risks and benefits of tracheostomy. In this study, we describe the surgical tracheostomy on ICU patients with ventilators. All were elective tracheostomy and done for prolonged ventilation. All were done at the bed side of the patients in the ICU of the COVID hospital. During last 6 months, we performed 22 surgical tracheostomies on ARDS patients because of the COVID-19 infections. For performing open or surgical tracheostomy, the department of otolaryngology had established a COVID airway team constituted by three skilled otolaryngologists without involving any residents. All the tracheostomies were done after seven days

with ventilators. In all the cases of the elective tracheostomy, the cuffed and non-fenestrated tracheostomy tubes were used for limiting the diffusion of the virus. Before performing surgical tracheostomy on COVID-19 patients, adequate sedation was given to the patient to paralyze the patient for eliminating the risk of coughing during the surgery. Initial advancement of the endotracheal tube was done prior to window made on the anterior wall of the trachea. Ventilation was ceased before inserting the tracheostomy tube. All efforts were made for not piercing the cuff of the tracheostomy tube during the surgical procedure. All the surgeries were performed by senior author/consultant surgeon, a scrub nurse and with presence of one intensivist/anesthetist with adequate PPE to avoid transmission of the infections and also to complete the surgery in less time at the uncomfortable ICU setting. In this study, all the data were recorded and analyzed by using Statistical Package for Social Science (SPSS) software, v20.

RESULTS

The study included 22 patients those underwent tracheostomy where 16 males (72.72%) and 6 females (27.27%) were present with male to female ratio of 2.67:1. The age ranges from 42 years to 75 years with mean age of 64 years. All of them underwent bed side surgical tracheostomy at COVID-19 hospital ICU. The mean time between the intubation and performing tracheostomy date was 13 days. All of them were associated with co-morbidities. Out of the 22 patients, 7(31.81%) were diabetes, 5(22.72%) with hypertension, 4(18.18%) with chronic obstructive pulmonary disease, 1(4.54%) chronic liver disease, 1(4.54%) kidney disease, 4 (18.18%) obesity and 3(13.63%) were with habit of chronic smoking (Table.1).The details of the tracheostomy of this study including techniques and precautions by health care workers and comparison with others are described in Table.2. prerequisites towards for personal protections to perform the tracheostomy on study patients are given in Table.3. Mean time of our study patients in ICU was 25 days. No tracheostomy was done within 7days of COVID-19 patients at the ICU with mechanical ventilation. Two patients (9.09%) presented with complications bleeding during surgery as they were with therapeutic anticoagulation. In this study, except one, none of the health care workers associated with tracheostomy and tracheostomy care were infected with COVID-19 infections. Out of 22 patients those underwent tracheostomy, 13(59.09%) died at the ICU during post-tracheostomy care. The causes of the death were not related to the complications of the tracheostomy. Out of 9 alive patients, one was faced weaning failure because of the deterioration of their poor cognitive status. Among the alive patients, mean time between tracheostomy and decannulation was 24.5 days (with minimum 16 days and maximum of 32).Among dead patients, mean time between the intubation and death was 23 days and the mean time between the tracheostomy and death was 14.6 days.

DISCUSSION

COVID-19 is a highly infectious disease of the respiratory tract due to beta corona virus called SARS-CoV-2. The first case of COVID-19 infection was reported at Wuhan, China in late December 2019. [4] By 27 th February, 2020, more than 82,000 COVID-19 positive cases with death more than 2800 have been reported of which approximately 95% of the positive cases and 97% of deaths were in China. [5] By the march 26th, 2020, there were 462684 patients with COVID-19 infections reported in 199 countries. [4] By the 16th august2020, over 1.8 million new cases of COVID-19 and 39 000 new death were reported by WHO and this gives the cumulative total to 21.2 million confirmed cases of COVID-19 including 761000 deaths. [6] The novel SARS-CoV-2 virus is transmitted from one person to another by respiratory droplets or contact with infected person. The procedures which deal with nose, nasopharynx, oral cavity, pharynx, larynx and trachea generates respiratory droplets which lead to high risk for infections. [7] The common clinical symptoms of the COVID-19 patients are cough, fever, fatigue and dyspnea. [7] There are also symptoms like anosmia and taste alterations are two important features are associated with this patient. There are some patients those are asymptomatic and considered as silent carriers in this pandemic. So health care professionals should be aware about this clinical scenario and so can prevent infection transmission to them and other patients. SARS-CoV-2 often affects the lower respiratory tract and leads to pneumonia in human being. [8] In the hospital setting, patients of COVID-19 infections may

land in respiratory failure where he or she require ventilatory support with orotracheal intubation and changed to tracheostomy in case of prolonged ventilation. The non-invasive methods for ventilations include continuous positive airway pressure (CPAP), bi-level positive airway pressure (BiPAP), high flow nasal oxygen therapy (HFNO) which are useful to correct hypoxemia and avoid the endotracheal intubation or may delay the intubation with potential complications. However, the invasive mechanical ventilation (IMV) by endotracheal tube was done in all of our study cases with ARDS. Early orotracheal intubation may be better than late as performing emergency orotracheal intubation in rapidly deteriorate Covid-19 patients may be associated with higher risk, both the health care professionals and patients.^[9] In all cases of this study, tracheostomy was done after 7 days of intubation. As long term mechanical ventilation in critically ill patients often require tracheostomy, so this current pandemic likely to increase the number of patients requiring new tracheostomy. Tracheostomy is an aerosol generating procedure and makes a risk to surgeons and other health care staffs in the operating room. A study in SARS epidemic suggested that health care staff or surgeon who performed tracheostomy had fourfold increased chance of the developing COVID-19 infection.^[10] Adequate personal protective equipment (PPE) must be used by the health care staffs during the tracheostomy as failure can lead to infections to them.^[11] In one study, 6.30% COVID-19 patients require tracheostomy during current COVID-19 pandemic.^[12] Study showing 7.3% to 32% of the COVID-19 patients progress to severe respiratory failure or critically ill where patient require tracheostomy.^[13] The clinicians or medical community are facing unprecedented challenges during dealing with airway procedures such as tracheostomy during the current COVID-19 pandemic, so University of California, San Francisco (UCSF) COVID-19 working group recommended that patient should be negative for performing the tracheostomy (Patient must have two negative COVID-19 PCR tests before the surgery).^[14] However, this is practically not possible to wait for two negative reports before performing the tracheostomy. In all of our study cases, RT-PCR was done to know the status of the infectivity for performing the tracheostomy. Because of the overburden of the ICU beds, performing early tracheostomy helps earlier and safer weaning attempts and then patients can be managed at the recovery rooms or wards or sub intensive care units. Performing early tracheostomy may reduce the use of sedatives. However, as the crisis is evolving very rapidly, the exact timing (early or late) tracheostomy in COVID-19 patients is still undefined. The decision for performing tracheostomy is made on a case to case basis after multidisciplinary assessment with considering clinical condition and severity of the patients, benefits or disadvantages of the tracheostomy and resources of the hospital. Performing the percutaneous tracheostomy affect more extensive airway manipulation like serial dilations during the tracheal entry and bronchoscopy, so increase the chance of exposure to the aerosol secretions.^[15] Patients with high ventilatory settings need repeated disconnection and connection from the ventilatory circuit in case of percutaneous tracheostomy. These things lead to increased aerosolization risks as comparison to the open tracheostomy where entry into the trachea is done very quickly with an incision and the risks of aerosolization are minimized by different adopted methods. So, the open or surgical tracheostomy is preferred than percutaneous tracheostomy in COVID-19 patients.^[16, 17] The general complications rates in percutaneous tracheostomy are largely similar to the open/surgical tracheostomy.^[18] On the basis of the aerosol exposure to the health care staffs, open is safer than percutaneous tracheostomy. In our center, surgical tracheostomy was given choice for COVID-19 patients than percutaneous tracheostomy by otolaryngologist.

All the surgical/open tracheostomies were performed at the bed-side in the ICU for avoiding unnecessary transport of the patients and minimal risk for the surrounding contamination. Use of electrocautery is avoided as much possible as coagulation by diathermy can generate small particles which act as a vehicle for the SARS CoV-2 virus, so in case of bleeding harmonic scalpel used. As majority of the COVID-19 patients in ICU receive high dose of heparin infusion, there is high chance of bleeding.^[19] In this study, two patients (9.09%) presented with bleeding during tracheostomy as they were with therapeutic anticoagulation. We used only cuffed non-fenestrated tracheostomy tubes in all our patients. During the tracheostomy, surgeons and assisting staffs were used enhanced PEP, which consisted of the standard PPE with shoe cover and helmet with positive air-powered respirator to give complete barrier from

patients. During the test period, we performed 22 surgical tracheostomies where the median timing for tracheostomy was 13 days after intubation. As the surgical/open tracheostomy is an aerosol generating procedure (AGP) and carries a high risk for contamination through exposing the airway secretions to the health care staffs, so this procedure should require a through plan and proper execution to ensure the safety of the staff and patient.^[19] Tracheostomy provides several advantages like less requirements of sedations, less medical support and also reduce dead space of the airway. The overall surgical procedure for tracheostomy should thoroughly and appropriately planned, explained to all concerned staff and executed in order for ensuring the safety of the staff and patients.^[20] Early tracheostomy is avoided in COVID-19 patients because of the high viral load. Early tracheostomy is also not associated with improved mortality or reduced to the stay period at the intensive care unit.^[21] Before performing surgical tracheostomy on COVID-19 patients, adequate sedation should be provided to the patient even paralyze the patient for eliminating the risk of coughing during the surgery. During performing the tracheostomy, there is high chance of spreading of the aerosols to the surrounding persons including surgeon so, to avoid such aerosol, the endotracheal tube should be pushed down beyond the location chosen for the tracheal stoma. The endotracheal tube should goes down and reaches near the carina, so the cuff will be distal to the tracheostomy site. By pushing down the endotracheal tube and the cuffed it at the site of the carina may prevent spread of the aerosol which adds an extra security for the health care staffs during performing the tracheostomy from high risk generating aerosol. Before making an opening on the trachea, 5cc of lidocaine (5%) can be injected intra-tracheally through the tracheal wall for reducing the cough reflex.

Before performing the surgical tracheostomy, bracelets and other jewelry of the health professionals should be removed before surgical scrubbing. Surgeon and assistants should wear use adequate PPE like FFP3 or N95 mask. He or she should wear goggles along with face shield. Use if the double gown is preferred along with gloves. The head protection with a hood cap is better than a simple cap in order to prevent any skin exposure. A full face shield/visor or airtight protective glasses .Head light should be covered by a head cap. An impermeable protective apron or an overcoat must be worn under the surgical gown as it is not sterile. The surgical team must ensure all the required equipments such as suction catheter, cannula and all surgical instruments required for surgery along with cuffed tracheostomy tube. The use of the electrocoagulation should be minimized as it can generate the aerosolization of the virus when the trachea is open to outside. If possible, a sterile transparent interface between the patient and surgeon should be there for restricting the risk of contamination. Ventilation should be paused when the trachea is entered and anytime the ventilation circuit is disconnected. A non-fenestrated cuffed tracheostomy tube is useful for preventing the spread of infections. The cuff is inflated to limit the spread of the virus via the upper airway. Clinicians or nursing staff should perform tracheostomy suctioning by using a closed suction system with a viral filter. Heat moisture exchanger device should be used instead of tracheostomy collar during weaning for preventing the spread of the viral infections of the patients. Changing of the tracheostomy tube is avoided until the viral load is as low as possible. The tracheostomy tube is usually sutured if a prone position for patient is planned. The detail of our study is compared with other studies in terms of techniques and precautions.^[22, 23, 24]

Some patients with tracheostomy during COVID-19 pandemic may develop some complications such as ulcers in the pharynx and bleeding from the stoma or tracheostomy tube which need further care by Otorhinolaryngologists. Tracheostomy should be avoided or delayed even beyond two weeks because of the high chance of the infections during the procedure and subsequent tracheostomy care.^[26] When the acute phase of infection is subsided or the likelihood of the recovery of infection is high, tracheostomy can be done for less likelihood of infection transmission. Early tracheostomy should be avoided in case of COVID-19 patients because of the higher viral load. Early tracheostomy is not related to the improved mortality or less ICU stay.^[25] In all of the study cases, tracheostomies were done after 7days of orotracheal intubation.

For tracheostomy care, the British Association of Otorhinolaryngologists-Head and Neck Surgery (ENT UK) has made a recommendation for decreasing the risk of aerosolization and contamination to the surrounding environment by keeping the cuff inflated and delay tracheostomy change till the COVID-19 pandemic has passed. [26] However, it is not practically possible always for adhering the guidelines and recommendations. In this current crisis with COVID-19 pandemic in the world, clinicians should consider the local hospital resource. So, early cuff deflation and change of the tracheostomy tube may facilitate the steps towards the rehabilitation. During the tracheostomy care, health care professionals should be equipped with full PPE. In this study except one nursing staff, none of the team members were infected SARS-CoV-2.

CONCLUSION

Health care professionals are presently facing greatest challenge to the COVID-19 infections. In current global COVID-19 pandemic, acute respiratory distress syndrome and respiratory failure require mechanical ventilation which is a common problem. Prolonged ventilation is the common indications for tracheostomy at COVID-19 ICU. Tracheostomy is considered as a high risk aerosol generating procedure because of the exposure to droplets and aerosols leakage which is infected with SARS-CoV-2 during performing this surgical procedure. An increasing number of tracheostomy is expected because of the increase number of the COVID-19 patients globally with acute respiratory distress. The otolaryngologists and intensivists should pay meticulous attention for infection control, to reduce the cross-contamination and their own risk for contracting the infection. Tracheostomy with adequate PPE helps to reduce the droplet and aerosol exposure to the surgeon and other health care workers.

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Figure Legend



Fig.1: Surgeon wearing PPE before performing bed side tracheostomy at the ICU of the COVID-19 Hospital.

Table.1: Patient profile those underwent tracheostomy on COVID-19 patients

| Patient profiles | Number of the patients(n=22) | Percentage (%) |
|---------------------------------------|------------------------------|----------------|
| Age(years) | 64(42-75) | |
| Gender | | |
| Male | 16 | 72.72 |
| Female | 6 | 27.27 |
| Diabetes | 7 | 31.81 |
| Hypertension | 5 | 22.72 |
| Chronic obstructive pulmonary disease | 4 | 18.18 |
| Malignancy | 1 | 4.54 |
| Chronic liver disease | 1 | 4.54 |
| Kidney diseases | 2 | 9.09 |
| Obesity | 4 | 18.18 |
| Chronic smokers | 3 | 13.63 |

| | | |
|--|----|-------|
| Complications during tracheostomy- Bleeding | 2 | 9.09 |
| Death of the patients those underwent tracheostomy | 13 | 59.09 |

Table.2: Different case series of Open tracheostomies done at the time of COVID-19 pandemic.^{[22,23,24].}

| Parameters | Wei et al ²² | Chee et al ²³ | Tien et al ²⁴ | Present study |
|---|---|---|---|--|
| Hospital | Queen Mary Hospital, Hong Kong SAR, China | Tan Tock Seng Hospital, Singapore | Sunnybrook and Women's College Health Sciences Centre, Toronto, Ontario, Canada | A tertiary care teaching hospital, India |
| Number of tracheostomies done | 3 | 15 | 3 | 22 |
| Barrier precautions at time of surgery | Standard PPE, shoe covers, face shield, goggles | Standard PPE, Shoe covers, powered air-purifying respirator system | Standard PPE, Stryker T4 protection system | PPE, shoe cover, face shield, goggles |
| Setting | Negative pressure room in ICU or OR | Negative pressure room in ICU | Negative pressure room in ICU | Negative pressure in ICU |
| Intraoperative steps to minimize aerosolization | Complete paralysis of patient, mechanical ventilation stopped before tracheostomy, no suction used during procedure, diathermy avoided as much possible | Complete paralysis of the patient, mechanical ventilation stopped before tracheostomy, limited suction used during procedure, no specific avoidance of diathermy other than during tracheostomy | Complete paralysis of the patient, mechanical ventilation stopped before tracheostomy, no suction used once trachea opened, diathermy avoided as much as possible | Complete paralysis of patient, mechanical ventilation stopped, no suction used once trachea opened, electrocautery avoided |
| Surgical team | Single surgeon, one intensive care specialist, one standby medical or nursing staff | An experienced surgeon, an experienced anesthesiologist, one scrub nurse and one surgical assistant | Senior attending trauma surgeon, most senior surgical staff member available, attending ICU anesthesiologist and no circulating nurse or scrub nurse. | Senior and experienced surgeon performed the procedure along with minimum staff |

Table.3: Requisites for performing tracheostomy on COVID-19 patients

| | | | |
|-------------|----------------|--------------------|--------------------|
| Precautions | Operating area | During opening the | Nursing and airway |
|-------------|----------------|--------------------|--------------------|

| | | trachea | management |
|--|--|---|---|
| Full PPE Cap face shield, Goggles, Double gloves, Mask-N95,FFP3 or FFP2 Gowns(Double gowns if available) Consider powered hoods | <ul style="list-style-type: none"> • Isolation area with negative pressure • Limited number of people involved • Tracheostomy team with expertise • Surgical instruments should be ready | <ul style="list-style-type: none"> • Paralyze the patient • Push the endotracheal tube cuff caudally to avoid air leakage • Hyper inflate the cuff of the tube • Avoid electrocautery • Smoke evacuator if electrcautery is used | <ul style="list-style-type: none"> • Safe suction of the secretions • Regular cuff pressure check • Stoma care |