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Tracheostomy in Critically Ill COVID 19 Patients: A Review of Outcome

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Abstract

Objective: To determine the outcomes of tracheostomy in critically ill COVID-19 patients.

Background: The novel human coronavirus disease (COVID-19) is an infectious disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) which can result in serious respiratory illness requiring endotracheal intubation, mechanical ventilation, and tracheostomy. Resources on the indication, ideal timing and outcomes for tracheostomy in COVID-19 patients are still limited. Tracheostomy in COVID-19 patients carry the risk of disease transmission to healthcare providers. Thus, a trained surgeon, adequate safety equipment and measures are essential to reduce timing of exposure through this aerosol-generating procedures and reduce risk of complications.

Methods: A retrospective, observational study was conducted for all COVID-19 patients who underwent open tracheostomies in a general hospital from April 2020 to October 2021. Case notes were retrieved and data on patient's demographic information, vaccination status, co-morbidities, ventilation history, intraoperative and post-operative complications, duration of weaning and decannulation post tracheostomy and living status were obtained and analysed.

Results: There were a total of 45 patients underwent tracheostomy from April 2020 to October 2021; 31 (68.9%) were male and 14 (31.1%) were female. The mean age of patients was 60.56+/-10.11 years old. For the vaccination status, 17 (37.8%) were unknown, 14 (31.1%) unvaccinated, 4 (8.89%) partially vaccinated and 10 (22.2%) fully vaccinated. 42 (93.3%) patients had at least one comorbidity. The mean day from intubation to tracheostomy were 18.47+/-5.93 days. Four (8.89%) patients had post operative complications; 1 (2.22%) subglottic stenosis, 1 (2.22%) subcutaneous emphysema and 2 (4.44%) suprastoma granulation tissue. 22 (48.9%) out of 45 patients survived, of which 19 (86.4%) were successfully decannulated. Among those survivors, the mean duration of weaning off oxygen post tracheostomy procedure was 23.73+/-11.47 days while the mean duration of decannulation post tracheostomy were 54.47+/- 43.03 days. There were no reported intraoperative difficulties and disease transmission to healthcare providers involved in tracheostomy procedures.

Conclusions: Tracheostomy is a relatively safe procedure for both COVID 19 patients and health care workers. Tracheostomy aids in ventilation liberation for COVID-19 patients but the survival outcome still rely on individual's condition.

Keywords: COVID-19, SARS-CoV-2, intubation, tracheostomy. aerosol-generating procedure, vaccine

Introduction:

The first case of novel human coronavirus disease 2019 (COVID-19) was discovered and reported in December 2019 in Wuhan, China before it emerged globally. First case of COVID-19 detected in Malaysia was confirmed on January 25, 2020. The World Health Organization (WHO) has declared COVID-19 a worldwide pandemic on March 11, 2020 [1].

COVID-19 is a spectrum of disease ranging from mild to severe respiratory symptoms in infected individuals. Severely infected individual may require endotracheal intubation and mechanical ventilation to maintained oxygen saturations to vital organs. It is highly transmittable from one person to another primarily via airborne spreads.

Sibu Hospital is the second largest hospital in the state of Sarawak, Malaysia. It is located in the central region of Sarawak and received referral from eight district hospitals in midzone of Sarawak which are Kanowit, Kapit, Mukah, Dalat, Daro, Sarikei, Saratok, and Betong. The number of COVID-19 cases increased significantly from March 2021 to October 2021. Severe cases requiring invasive mechanical ventilation from midzone of Sarawak were referred and transferred to Hospital Sibu for further management. Hence, the number of ICU beds and ventilators usage increased. There were about six to eight cases of open tracheostomies per month to accommodate the above issues.

Open tracheostomy is a common surgical procedure performed by ENT surgeon. Ideally, it is a procedure done to create airway in the trachea by making a transverse incision over anterior neck. It is done in proper operation theater setting under anesthesia in order to provide better anatomical view of surgical procedure and direct visualization of tracheostomy tube placement, with reduced complication and better outcome [2]. One of the many benefits of tracheostomy is to facilitate weaning from mechanical or assisted ventilation by reducing anatomical dead space, lowering the airway resistance, and easing tracheobronchial toileting [3].

The National COVID-19 Immunisation Programme was implemented in phases by Malaysian government since February 2021 aimed to achieve herd immunity among Malaysian population in order to curb the spreading of COVID-19 infection. The Health Ministry reported that 75.2% of the population had received full vaccination by 7th of November, 2021 [4].

This study was conducted to determine the outcomes of tracheostomy in critically ill COVID-19 patients in our center.

Materials And Methods:

Study Design

This was a retrospective and observational study done by Department of Otorhinolaryngology, Sibu Hospital, Sarawak. All patients who were tested positive for COVID-19 by RT-PCR, required invasive mechanical ventilation and underwent open tracheostomy were included. A total of 45 patients were included over a period of 18 months from April 2020 to October 2021.

Data Collection

Patients's data were retrieved from medical record unit which included demographic data, vaccination status, co-morbidities, ventilation history, intraoperative and post-operative complications, duration of weaning and decannulation post tracheostomy and living status.

Tracheostomy Preparation

Open tracheostomy procedures were electively done in COVID operation theater (OT) by ENT surgeons with full personal protective equipment (PPE) and powered air-purifying respirator (PAPR). Decision for tracheostomy was made by the treating physicians and anesthetists, with further assessment by ENT team and optimization of blood parameters prior to procedure. Indications for tracheostomy in this study included prolonged ventilation secondary to poor lung function with high ventilation setting, failed extubation, and poor GCS recovery.

Statistical Analysis

Categorical data were presented as numbers (%). Normally distributed data were presented as the mean (SD). Early tracheostomy refers to tracheostomy within 21 days of intubation, and late tracheostomy refers to tracheostomy after 21 days. Chi-square test was used in analyzing categorical variables to compare the survival rates between gender, age, vaccination status, number of comorbid, ventilation setting, early and late tracheostomy. P-value <0.05 was considered significant. All statistical analyses were performed using the IBM SPSS Statistics 26.0 and Jamovi version 2.2.5.

Results

A total number of 45 patients underwent open tracheostomy from April 2020 till October 2021 were included in this study (Figure 1). The mean age of patients was 60.56 +/- 10.11 years old and 31 (68.9%) were male. For the vaccination status, 17 (37.8%) were unknown, 14 (31.1%) unvaccinated, 4 (8.89%) partially vaccinated and 10 (22.2%) fully vaccinated. 42 (93.3%) patients had at least one comorbidity. The mean day from intubation to tracheostomy were 18.47 +/- 5.93 days. Four (8.89%) patients had post operative complications; 1 (2.22%) subcutaneous emphysema, 1 (2.22%) subglottic stenosis, and 2 (4.44%) suprastomal granulation tissue. 22 (48.9%) out of 45 patients survived, of which 19 (86.4%) were successfully decannulated. Among those survivors, the mean duration of weaning off oxygen post tracheostomy procedure was 23.73 +/- 11.47 days while the mean duration of decannulation post tracheostomy were 54.47 +/- 43.03 days (Table 1). There were no reported intraoperative difficulties and disease transmission to healthcare providers involved in tracheostomy procedures. There were no significant association between survival rate versus age, vaccination status, number of comorbid, timing of tracheostomy; with *p*-value >0.05 (Table 2).

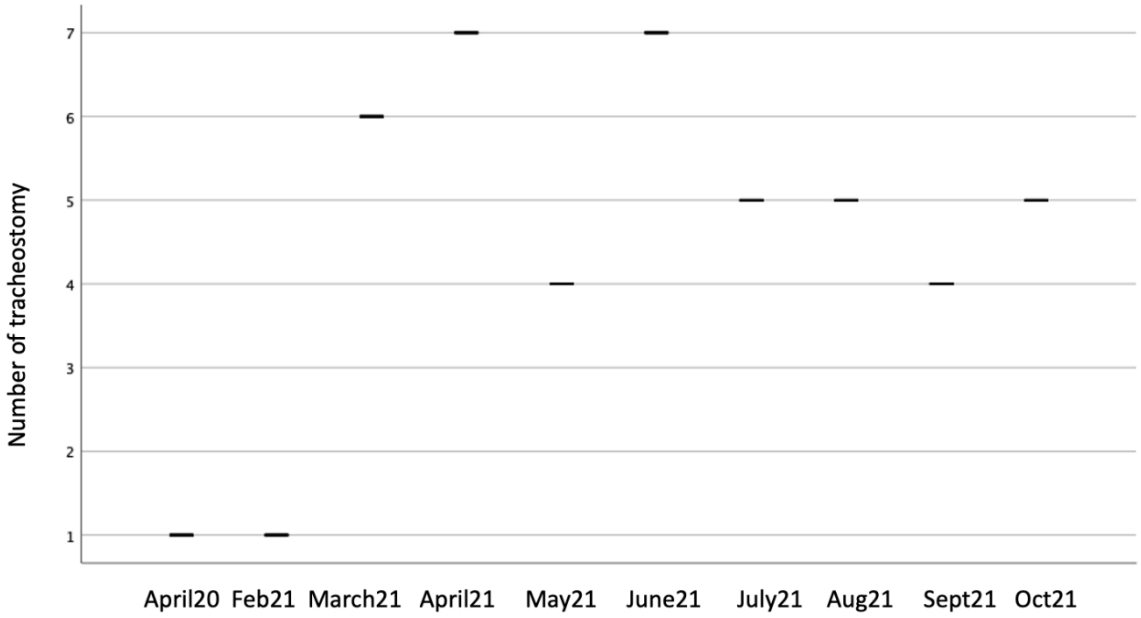

Figure 1: Number of tracheostomy done per month

Demographic Report of COVID-19 ICU Patients Who Underwent Tracheostomy	
Characteristic	**Total (n = 45)**
Age – mean (SD)	60.56 (SD 10.11)
Gender :	
Male – no. (%)	31 (68.9%)
Female – no. (%)	14 (31.1%)
Vaccination status:	
Unknown – no. (%)	17 (37.8%)
Not vaccinated – no. (%)	14 (31.1%)
Partially vaccinated – no. (%)	4 (8.9%)
Complete vaccination– no. (%)	10 (22.2%)
Comorbidities :	
Obese - no. (%)	12 (36.3%)
Hypertension - no. (%)	37 (82%)
Diabetes Mellitus - no. (%)	20 (44.4%)
Chronic Renal Disease - no. (%)	9 (20%)
Ischemic Heart Disease - no. (%)	10 (22.2%)
Chronic Hepatic Disease - no. (%)	3 (6.6%)
Timing of tracheostomy :	
Early tracheostomy (< 21 days) – no. (%)	33 (73.3%)
Late tracheostomy (>/= 21 days) – no. (%)	12 (26.7%)
Durations :	
No of days from admission to intubation – mean (SD)	2.96 (SD 5.27)
No of days from intubation to tracheostomy- mean (SD)	18.47 (SD 5.93)
No of days wean off oxygen post tracheostomy – mean (SD)	23.73 (SD 11.47)

No of days decannulation post tracheostomy – mean (SD)	54.47 (SD 43.03)
Complication post tracheostomy - no. (%)	4 (8.9%)
Intraoperative - no. (%)	0 (0%)
Post operative :	
-Subcutaneous emphysema - no. (%)	1 (2.2%)
-Subglottic stenosis - no. (%)	1 (2.2%)
-Suprastoma granulation tissue - no. (%)	2 (4.4%)
Overall survival rate - no. (%)	22 (48.9%)
Successful decannulation - no. (%)	19/22 (86.4%)
Still requiring trachoestomy tube - no. (%)	3/22 (13.6%)

Table 1: Demographic report of COVID ICU patients underwent tracheostomy

Variable	Survived (n=22)	Died (n=23)	χ^2 statistic[a] (df)	P value[a]
Age:			0.0687 (1)	0.793
<55 years old	6	5		
>55 years old	17	17		
Vaccination:			2.92 (3)	0.404
Unknown	8	9		
Not vaccinated	8	6		
Partially vaccinated	3	1		
Complete vaccination	3	7		
Number of comorbids:			0.311 (1)	0.577
<1 comorbids	2	1		
>1 comorbids	21	21		
Early and Late tracheostomy:			1.58	0.208
- < 21 days	15	18		
- >/= 21 days	8	4		

[a] **Chi-square test for independence**

Table 2: Correlation between survival rate and gender, age, vaccination status, number of comorbid, ventilation setting, early and late tracheostomy

Discussion:

Tracheostomy is an aerosol generating procedure with risk of transmission of airborne disease to healthcare workers (HCWs) [5]. We had no reported incidence of disease transmission to HCWs involved in tracheostomy with proper PPE and preventive measures. Chen et al. (2009) reported 6 out of 17 HCWs performing tracheostomy developed SARS [6].

Ideally, surgery should be done in negative pressure rooms [7]. However, our COVID-19 operation theatre is not a negative pressure operation theatre. It is a closed environment system with a proper donning and

doffing room to prevent cross infection. Staffs involved in the procedure are all well-trained on the usage and handling of PPE and PAPR. Limited personnel are allowed in the operation theatre; one senior OT nurse, one scrub nurse, one anesthesiologist, one senior anesthesiology medical officer, one ORL surgeon and one senior ORL medical officer. OT room will be decontaminated after use.

The operative procedures were similar to tracheostomy in non-COVID-19 patient with additional preventive measures listed in Tracheostomy guidelines by Ministry of Health Malaysia [8]. Zhang X et al. proposed to push the endotracheal tube (ETT) close to carina so that the ETT cuff is placed deeper than the tracheostomy incision site to prevent accidental damage to the cuff and leakage during tracheal incision while ventilator connection is being paused [9]. The use of closed suction system technique and the use of heat and moister exchanger (HME) when patient is disconnected to ventilator are encouraged to reduce risk of aerosol spread [10,11].

Timing for tracheostomy varies, depending on center. SARS viral load is most abundant during the time of onset of symptom, and it can be confirmed by PCR of viral RNA from mucosa samples of upper respiratory tract [12]. American Academy of Otorhinolaryngology and Head and Neck Surgery suggested tracheostomy to be carried out 2-3 weeks after intubation in patients with stable pulmonary status under strict precautions, preferably after negative COVID-19 test [13]. A multidisciplinary approach is important in discussing prognosis, risk, benefits and outcome for the patients besides considering organization resources, manpower and risk to healthcare provider [14]. Evrard, Diane, et al. suggested that timing of tracheostomy should be assessed on a case-by-case basis rather than depend on a rigid rule [15]. Most of tracheostomies (73.3%) in our center was performed within 21 days. Tracheostomy has the potential to accelerate weaning off ventilator and promote early transfer of COVID19 patients from ICU to general ward, therefore free up resources [16].

There was no significant immediate complication post tracheostomy although we believe that there are a few numbers of cases with self-limiting bleeding were under reported. We have reported 4 (8.9%) delayed complications post tracheostomy which were subcutaneous emphysema 1 (2.22%), subglottic stenosis 1 (2.22%), and suprastomal granulation tissue 2 (4.44%). Queen Elizabeth Hospital Birmingham encountered 2 cases of vocal cord palsy of uncertain etiology post tracheostomy [17]. Botti et al. reported 60% of cases complicated with local infection, hemorrhage, and subcutaneous emphysema post procedure [18].

Survival rates in early tracheostomy versus late tracheostomy were not statistically significant in our study. A multicenter, retrospective study suggested that early tracheostomies (within 14 days) were associated with high mortality rate [19]. Meta analysis studies by Griffiths et al. and Siempos et al. suggested that early tracheostomy was not associated with lower mortality [20, 21].

Until February 2022, 19/ 22 (86.4%) patients who survived were successfully decannulated with mean duration of decannulation post tracheostomy 54.47 (+/- 43.03) days. This duration of decannulation after tracheostomy was longer as compared to Chao TN et al. which reported 16 (+/- 5.0) days and Breik O et al. which reported 14 (+/- 7.9) days [22, 17]. In our centre, the decision for decannulation was made depending on individual's performance and proper assessment by otorhinolaryngology team and speech

therapists. A study has standardized a mandatory step to perform FEES in their decannulation process [23].

Conclusions:
Tracheostomy is a relatively safe procedure for both COVID 19 patients and health care workers. Tracheostomy aids in ventilation liberation for COVID-19 patients but the survival outcome still rely on individual's condition.

Abbreviations:
Coronavirus disease 2019 (COVID-19)
World Health Organization (WHO)
Polymerase chain reaction (PCR)
Intensive care units (ICU)
Operation theater (OT)
Standard deviation (SD)
Healthcare worker (HCW)
Otorhinolaryngology (ORL)
Endotracheal tube (ETT)
Personal protective equipment (PPE)
Powered air-purifying respirator (PAPR)
Fiberoptic endoscopic evaluation of swallowing (FEES)

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