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The Precautions Efficacy Taken among Health Care Workers While Performing Tracheostomies on COVID-19 Patients: Systematic Review

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Abstract

Background & objectives: Coronavirus disease 19 (COVID-19) has been declared by World Health Organization as a global pandemic disease in March 2020. Acute respiratory distress syndrome is frequent complication of COVID-19 disease. Tracheostomy is needed in cases of prolonged mechanical ventilation (7 - 10 days) in patients with acute respiratory distress syndrome. Tracheostomies are highly aerosol generating procedures, Otorhinolaryngologists and Health Care Workers (HCWs) are at high risk of virus exposure. The aim of this review is to evaluate the risk of transmission of COVID-19 during tracheostomy procedure, and to review the practical recommendation and scope of the timing to reduce risk of transmission to HCW. **Methods:** PubMed database was searched between April 2020 to Jan 2021 using the terms "Tracheostomy AND COVID-19 AND Health Care Workers". All the articles that shared the same aim were screened which resulted in 243 references without duplicates. The title and abstract screening excluded further 202 studies. Eventually 9 full-text studies were included. **Results:** Five hundred and two COVID-19 patients underwent tracheostomies during the study period. Sixty-three percent of the procedure were done through open technique, while 37% of them were done through percutaneous technique. Seventy-eight percent of them used full Personal Protective Equipment (PPE) and 44.4% used Powered Air Purifying Respirator (PAPR). Negative Pressure Rooms (NPR) were used in 67%. **Conclusion:** The studies showed similar

negative results on HCW infection despite much variance in using PPE. However, there should be global unified recommendations and guidelines regarding tracheostomies in COVID-19 patients to prevent future HCW infection.

Keywords

Tracheostomy, COVID-19, Health Care Workers

1. Introduction

Coronavirus disease 19 (COVID-19) has been declared by World Health Organization (WHO) as a global pandemic disease in March 2020 [1]. In Saudi Arabia, the first case was reported on the 2nd of March, 2020 [2]. As of current times, there have been over 96 million cases of coronavirus COVID-19 worldwide, the pandemic has impacted more than 210 countries and territories, with the United States confirming around one-fifth of all global cases. Furthermore here in Saudi Arabia cases went over 365,563. Moreover, with the high spread worldwide and over 2.1 million people having died after contracting the virus, over 84,000 of these deaths occurred in Italy and with more than 6402 cumulative deaths in Saudi Arabia [1] [3]. The main mode of transmission of COVID-19 is droplets (diameter > 5 μm), spitting, coughing and sneezing, which can travel one to two meters before falling down on the surrounding surfaces [1] [4]. Acute respiratory distress syndrome (ARDS) is frequent complication of COVID-19 disease, 5% - 15% of the patients require admission to Intensive Care Unit (ICU) [5] [6] [7]. Almost 70% of the ICU admitted patients require mechanical ventilation with a median length of 13 days [8]. Tracheostomy is a surgical procedure on the anterior trachea to facilitate breathing, which is needed in cases of prolonged mechanical ventilation in patients with ARDS due to COVID-19 viral pneumonia [9] [10] [11] [12]. Tracheostomies are highly aerosol generating procedures, Otorhinolaryngologists and Health Care Workers (HCWs) who provide tracheostomies to COVID-19 infected patients are at high risk of exposure to COVID-19 virus, therefore high risk of COVID-19 infection [6] [13] [14]. A study has been done in Italy showed that 8.4% of all COVID-19 cases were HCW [8]. Also, another study was made in May 2020 for Safe and effective management of tracheostomy in COVID-19 patients, as there are no absolute recommendations or guidelines for the best period and the best technique to perform tracheostomy on COVID patients to better manage the patient and implicate safety for health workers as stated in other papers, the choice between open or percutaneous which facilitate less aerosol exposure but with short coming such as patients with short neck or neck malignancy, early or delayed, an elective case or emergent, so the decision is a case by case [15] [16].

Despite the widespread COVID-19 infection and the requirement for tracheostomies to be done for COVID-19 patients frequently, there's no unified

global recommendations guideline for tracheostomy. The aim of this review is to evaluate the risk of transmission of COVID-19 during tracheostomy procedure, and to review the practical recommendation for effective strategy of tracheostomy procedure and scope on the timing to do tracheostomy to reduce risk of COVID-19 transmission to HCWs.

2. Methods & Materials

A systematic review of articles was conducted through PubMed search using the terms "Tracheostomy AND COVID-19 AND Health Care Workers". The authors focused mainly on the infectivity of COVID-19 to HCW who provide tracheostomies and updated recommendations and guidelines of tracheostomies in COVID-19 patients, regarding safety, period, technique and approach. All the articles that shared the same aim since April 2020 to Jan 2021 were reviewed. The authors have excluded any articles that didn't focus on tracheostomies-related COVID-19 infections.

Our search resulted in 243 references without duplicates for screening. The title and abstract screening excluded further 202 studies. We screened the remainder of full-text studies, 9 full-text studies were included (**Table 1**).

Eligibility criteria are original all peer reviewed articles concerning tracheostomies on COVID-19 positive patients were considered for example (open/conventional or percutaneous, type of precautions undertaken during and after the procedure, staff and patents safety, self or not self proclaimed guidelines)

For inclusion articles must have reported sufficient results to be allowed to be calculated of the number of procedures done, type, safety precautions and results of the procedures on staff.

3. Results

Tracheostomies have been performed on 502 COVID-19 patients as cumulative from 9 studies. From those tracheostomies, 63% of the procedure (318) were done through open technique, while 37% of them (184) were done through percutaneous technique. Seven out of 9 articles (78%) used full PPE and 4 out of 9 articles (44.4%) used PAPR (**Figure 1**).

Furthermore, 6 out of the 9 studies (67%) used NPR in the performing the procedure (**Figure 2**). Eventually all 9 studies showed 0 (0%) Positive results of COVID-19 infection among HCWs that were involved.

The majority of HCWs underwent serial checking of symptoms and signs until two weeks after the procedure. As such with adequate PPE, none had clinically proven COVID-19 infection regardless of procedure technique, room type or using PAPR.

4. Discussion

This article's aim is to evaluate the risk of transmission of COVID-19 during tracheostomy procedure, and to review the practical recommendation to effective

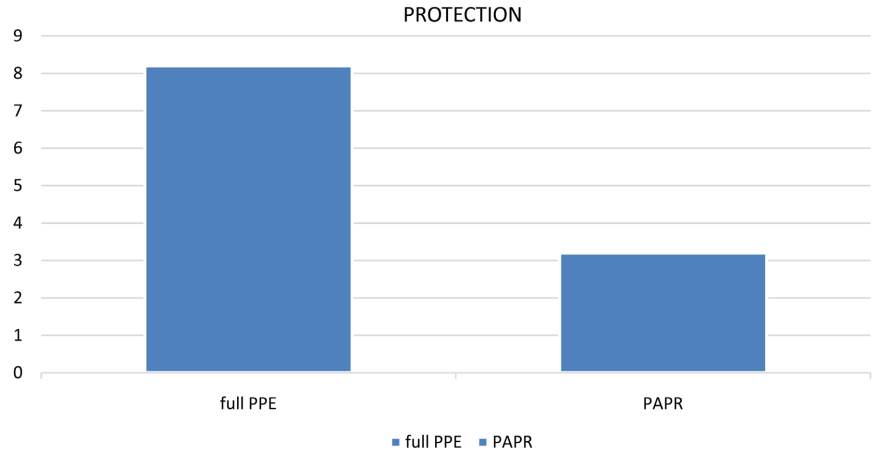

Figure 1. Type of protection.

Table 1. Tracheostomy studies.

Reference	No. of procedures	Open	Percutaneous	Precaution taken	# of Infected (HCWs)	Following up (HCWs)
Omar *et al.*, 2020 [17].	100	25	75	Only full PPE*, in regular rooms	8 members All Non infected	Not specified
Yokokawa T *et al.*, 2021 [18].	35	35	0	All used PPE, 164 used N95 + eye protection, 25 used PAPR, 16 in NPR, 19 in regular rooms	184 members All Non infected	Not specified
Chao TN *et al.*, 2020 [19].	53	24	29	All used PPE, 26 used N95 + eye protection, 30 used PAPR All in regular rooms expect 1 in NPR	11 members All Non infected	By symptoms
Weiss KD *et al.*, 2020 [20].	28	1	27	Procedures performed under controlled apneic conditions, all used full PPE*	9 members All Non infected	By symptoms
Volo T *et al.*, 2020 [21].	23	22	1	All used full PPE*, all done in NPR	6 members All Non infected	By nasopharyngeal swabs
Angel L *et al.*, 2020 [22].	104	6	98	All used full PPE*, 96 in NPR	8 members All Non infected	By nasopharyngeal swabs and symptoms
Sun BJ *et al.*, 2020 [23].	12	0	12	All used full PPE*, 1 used PAPR, all procedures in NPR	4 members All Non infected	Not specified
Picetti E *et al.*, 2020 [24].	66	66	0	All used full PPE*, in regular room	6 members All Non infected	By nasopharyngeal swabs, serology and symptoms
Takhar A *et al.*, 2020 [25].	81	5	76	All used full PEE*, all used PAPR or FFP3, not mentioned if any done in NPR	71 members All Non infected	By symptoms

*Full PPE: Including gloves, gowns, shoe covers, head covers, masks, eye protection, face shields, and goggles. HCWs: Health Care Workers; PAPR: Powered Air Purifying Respirator; FFP3: Filtering Face Pieces 3; NPR: Negative Pressure Room.

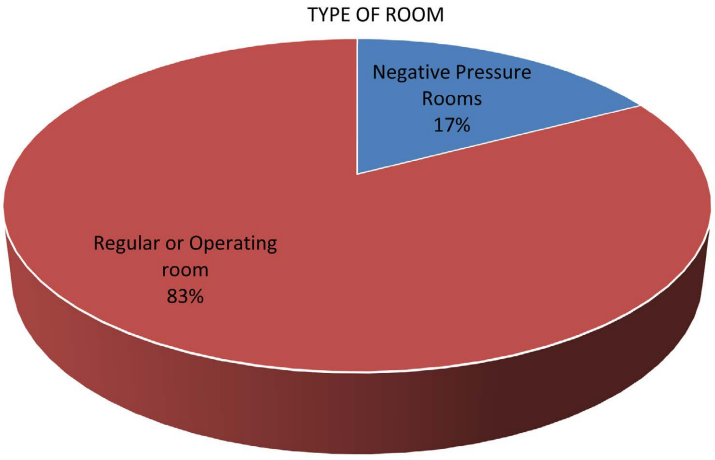

Figure 2. Type of room.

strategy of tracheostomy procedure and scope on the timing to do tracheostomy to reduce risk of COVID-19 transmission to HCWs. In Italy, 20% of HCWs were infected by COVID-19, while in United Stated, 11% of the reported cases are Health Care Workers (HCWs) [26]. Otorhinolaryngologists are at higher risk to be infected by COVID-19 while examining the patient's upper airway and performing aerosol-generating procedures such as tracheostomies, since the upper airway has high concentration of coronavirus in COVID-19 patients [27]. A study in UK was done on 73 Otorhinolaryngologists who have been infected by COVID-19, over half of them were not wearing PPE and/or infected before Public Health England Covid-19 PPE guidelines has been established [28]. Tracheostomy has many benefits over the prolonged mechanical ventilation in COVID-19 patients such as decreasing the risk of subglottic stenosis, decreasing ICU stay and decreasing the need of sedation [29] [30].

Due to the rapid spreading and emerging cases that needed tracheostomy for prolonged mechanical ventilation, unified and clear guidelines and recommendations for tracheostomies on COVID-19 patients are yet to be established, such many establishments, societies and hospitals came up with their own recommendations, based on their knowledge and experience throughout the pandemic.

However, this articles' results showed that despite the variance in protection equipment and guidelines, all of them are effective, sufficient and safe for HCWs in performing tracheostomy procedures on COVID-19 patients.

As such data collected shows that adequate PPE consisting of gloves, gowns, shoe covers, head covers, masks, eye protection, face shields and goggles, in addition to regular or operating room is highly protective against transmission of the aerosols from the procedure. Furthermore, despite that open technique was used more frequent than percutaneous, no data to support clear advantages of one technique over the other. In Sun BJ *et al.* paper the use of only percutaneous technique was to prove that the percutaneous technique is safe if done with care, however the technique used wasn't simple, it was modified to reduce aerosols

formation and hypoxia by inducing apnea on patients [23]. A similar technique was described by Weiss KD *et al.* In his article they used controlled apneic conditions during percutaneous tracheostomies. However, one case was done with open technique due to anatomical concerns, which shows that the dissection of technique choosing is individual based that is involved by many factors either related to patient, HCWs or sitting and equipment [20]. Moreover, Picetti E *et al.* study, all tracheostomies were performed by the open technique in case patients have no coagulation abnormalities, as a preference non the less [24].

In a randomized clinical trial done by Young D *et al.* was suggested that early tracheostomy should be delayed after 14 days due to high viral load. In addition, there is no data to support that early tracheostomy was associated with decrease mortality rate or decreased ICU stay [31]. In addition, McGrath *et al.* study concluded that tracheostomy needs to be done on day 16 - 30 after the onset of COVID-19 symptoms, to reduce the viral infectivity as much as possible (**Figure 3**) [7]. Furthermore, The American Academy of Otorhinolaryngology-Head and Neck surgery recommendations are: 1) Tracheostomy in COVID-19 patient should be after 14 days of intubation, with no evidence of optimal time of tracheostomy; 2) Before tracheal incision the patient should be paralyzed, pre-oxygenated and ventilation held to minimize aerosolization; 3) Minimize electrocautery and suction use; 4) Use cuffed, non-fenestrated tracheostomy tube; 5) Delay tracheostomy tube change until the patient's swab is negative for COVID-19 [32].

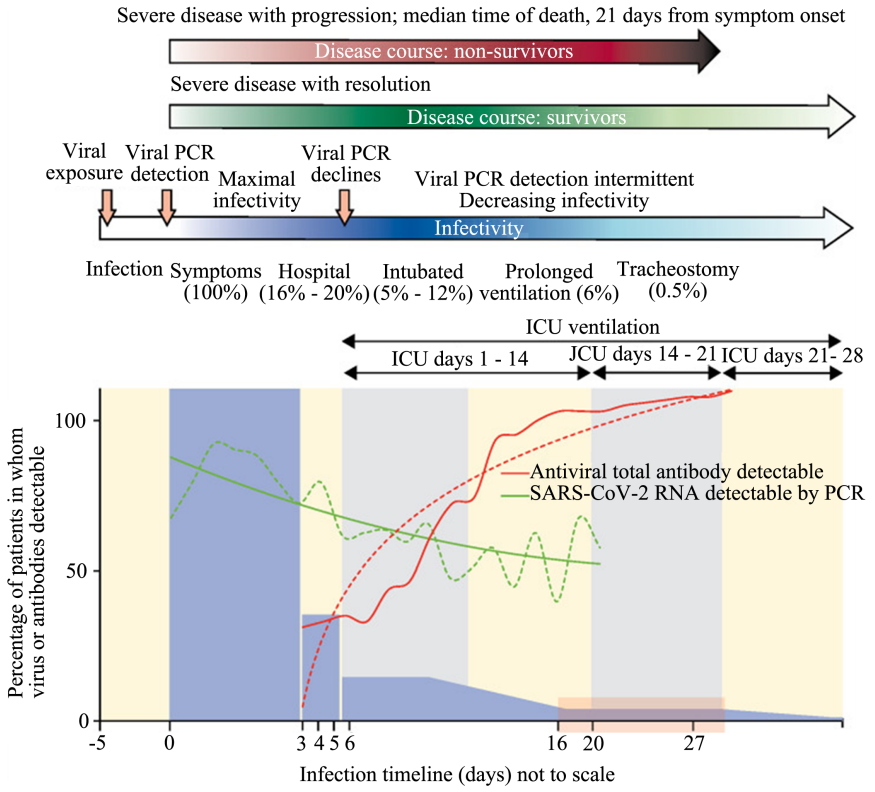

Figure 3. Infection timeline and viral load.

Our study had some limitations. First, the variables we chose are the goal and aim of the study to investigate, many articles had more variables that could or could not add new incite to the study results. Second, due to the lack of strict and global guideline for investigating such procedures in such times there were no points that could be compered for our variables to be discussed in details on how and why. Finally, the studies of tracheostomies and HCWs COVID-19 infection in not sufficient despite the high demand of tracheostomies for COVID-19 patients. We recommend involving more studies and variables, focusing on the time of the tracheostomy and including other aerosol-generating procedures.

5. Conclusion

This article's aim is to evaluate the risk of transmission of COVID-19 during tracheostomy procedure, and to review the practical recommendation for effective strategy of tracheostomy procedure and scope on the timing to do tracheostomy to reduce risk of COVID-19 transmission to HCWs. In conclusion, most of the studies showed similar negative results on HCWs infection by using PPE while performing tracheostomies, with much variance in type of protection equipment on HCWs. However, there should be global unified recommendations and guidelines regarding tracheostomy procedures in all patients, including COVID-19 patients to prevent future the HCWs infection.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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