INSTITUTIONAL EXPERIENCE OF ENDOTRACHEAL INTUBATION IN SEVERE COVID-19 PATIENTS AT PKLI&RC

SALMAN SHAHZAD[1], MOHSIN ALI[2], TAHIRA YOUNAS[3], YASIR BUTT[4]
[1]Consultant Anesthesia, [2]Medical Officer, [3, 4] Senior Registrar (Anesthesia)
Pakistan Kidney and Liver Institute & Research Center

ABSTRACT

Millions of people worldwide have been affected by the Coronavirus disease (SARS-CoV-2 or COVID-19) pandemic. Intensive care unit admissions are frequent and some patients with hypoxic respiratory failure need invasive mechanical ventilation. We retrospectively reviewed the medical records of 22 critically ill patients with SARS-CoV-2 pneumonia who required endotracheal intubation from March 2020 till August 2020 at our institute, a tertiary care government designated center for treating moderate and severely ill COVID patients. Patient's demographics, clinical features, use of personal protective equipment (PPE) for intubation, intubation process, adverse events and anesthesiologist infection rate was determined. Patients intubated were elderly and comorbidities were common. We successfully intubated all patient using level-3 PPE. Hypoxia, hypotension, arrhythmias and unanticipated difficult airway were common events in peri-intubation period.

How to cite this article: Shahzad S, Ali M, Younas T, Butt Y. Institutional experience of Endotracheal Intubation in severe Covid-19 patients at PKLI&RC. Pak Postgrad Med J 2022;33(1): 2-6

DOI: https://doi.org/10.51642/ppmj.v33i01.452

Correspondence to: *Mohsin Ali,*
Medical Officer, Pakistan Kidney and Liver Institute & Research Center, Lahore, Pakistan

Email: *mohsinali@kemu.edu.pk*

INTRODUCTION

Coronavirus disease, a global pandemic, is a respiratory tract infection which originated in Wuhan, China in December 2019[1]. As of 1st November, 2021, it has affected 247,464,037 people globally, with more than 5 million deaths[2]. Coronavirus was announced as an outbreak in January 2020 by World Health Organization (WHO) and later declared pandemic. It gradually spread all over Pakistan, after the first case was reported on 26th February 2020 in Sindh province[3]. As of November 1, 2021, there are 1,273,560 confirmed COVID-19 cases in Pakistan and 28, 456 deaths have occurred with a fatality rate of 2.2%[4].

Coronavirus is an enveloped, single-stranded RNA virus which mutates rapidly[5]. Six coronaviruses have been reported in human history; four (OC43, 229E, NL63, and HKU1) have been known for mild disease, while the other two i.e. severe acute respiratory syndrome coronavirus (SARS-CoV) and Middle East Respiratory Syndrome Coronavirus (MERS-CoV) with zoonotic origins have caused mortality in humans[6]. Several clusters of pneumonia cases were reported in Wuhan city, which were later confirmed as the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). It was initially called as novel coronavirus (2019-nCoV) and later it was named as coronavirus disease-2019 or COVID-19[7].

Patients infected with COVID-19 demonstrate a wide spectrum of clinical features, from being clinically asymptomatic to having mild disease with symptoms of fever, sneezing, dyspnea, dry cough, and diarrhea. In severe cases, the features include severe pneumonia, respiratory failure, multiorgan failure, and septic shock[8]. About 3.2% of COVID-19 patients require endotracheal intubation and mechanical ventilation as part of their management[9].

COVID-19 is mainly transmitted through aerosol droplets or direct contact. Airborne transmission is also

possible in procedures such as endotracheal intubation, open suctioning, bronchoscopy, non-invasive positive-pressure ventilation and tracheostomy. Endotracheal intubation is a high-risk procedure for both COVID-19 patients and for physicians. Patients are at high risk for hypoxemia, hypotension, arrhythmias, pneumothorax, cardiac arrest or even death during and after endotracheal intubation[10]. Endotracheal intubation is an aerosol generating procedure and poses a significant risk for physicians of contacting the disease[11]. Limited data is available in COVID-19 patients in peri-intubation period in Pakistan.

This study was done to explore the clinical data on patient characteristics, clinical features, use of personal protective equipment (PPE), intubation processes, adverse events during and after endotracheal intubation, and healthcare worker infection after endotracheal intubation in COVID-19 patients in our institute. The data will have implications for future planning and management of these patients and precautionary measures for staff.

METHODS

This descriptive case series was conducted at Pakistan Kidney and Liver Institute and Research Center (PKLI&RC), Lahore from March 2020 to August 2020. After Intuitional Review Board (IRB) approval, adult patients of both genders admitted to Intensive Care Unit (ICU) with clinical features of COVID-19 or diagnosed cases of COVID-19 infection confirmed by reverse transcription–polymerase chain reaction (RT–PCR) requiring endotracheal intubation were included in this study. Patients intubated for causes other than COVID-19 were excluded from this study. Clinical data regarding patient's demographics, associated comorbidities, clinical course prior to intubation, use of PPE, management of intubation related adverse events and anesthesiologist infection was retrieved from hospital record. Frequency of comorbidities; first attempt intubation success rate; intubation time; adverse events during intubation (Hypoxemia with SpO2 <80%, Hypotension with BP <90/60 mmHg, arrhythmias, trauma to oral cavity, failed intubation, aspiration, unanticipated difficult airway, cardiac arrest); and adverse events after intubation (persistent hypoxia, persistent hypotension, arrhythmia, cardiac arrest) were determined from clinician notes and medical records. In addition, frequency of COVID-19 symptoms or RT-PCR detection in intubating anesthesiologists were also determined.

Data was checked, coded and entered using SPSS V25.0 (SPSS Inc., Chicago, IL, USA). For qualitative variables frequency and percentages were recorded, while mean and standard deviation were determined for quantitative variables.

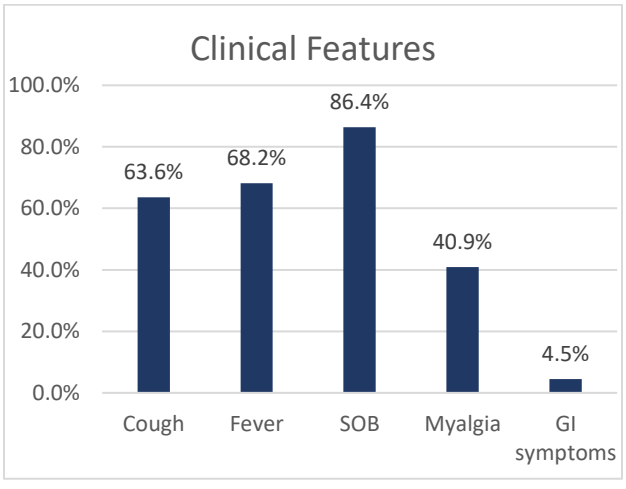
RESULTS

Mean age of patients was 63.6 ± 10.5 years. There was male predominance (72.7% vs 27.3%) in the participants. 90.9% of patients had comorbid conditions with hypertension and diabetes mellitus being the most frequent diseases. Nine patients had ischemic heart disease out of which four patients had recent or past history of angioplasty and one patient had pacemaker. Other significant medical history included chronic kidney disease, stroke, and chronic liver disease. (Table 1)

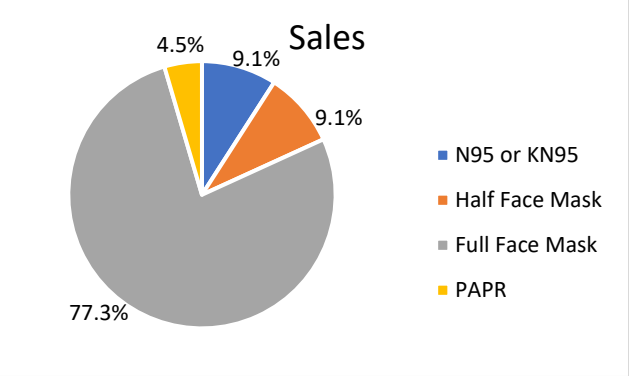
Table 1: Demographics

Age (Mean, SD)	63.64 + 10.5 years
Gender n (%)	
Male	16 (72.7)
Female	6 (27.3)
COVID status n (%)	
Confirmed positive	21 (95.5)
Suspected	1 (4.5%)
Comorbidities n (%)	
Present	20 (90.9)
Absent	2 (9.1)
ICU admission to Intubation Difference (Mean ± SD, Days)	3.09 + 1.2

Clinical features of COVID-19 disease included cough (63.6 %), fever (68.2%) and short of breath (86.4%) of the patients. Other symptoms such as myalgia (40.9%) and GI Symptoms (4.5%) were also present. (Graph 1) Hemodynamic instability was common before induction for endotracheal intubation. Patients had hypoxia (72.7%), PaO2/FiO2 Ratio <150 in 81.8%, hypotension (50.0%) and tachycardia (59.1) before intubation.



Personal Protective Equipment (PPE): Endotracheal intubations were performed by trained anesthesiologists. PPE included KN-95 or N-95 mask (9.1%), half face mask (9.1%), full face mask (77.3%) and PAPR (4.5%). (Graph 2) Face shield and googles were used in 18.2% cases. Gown and shoe cover were used by all physicians and the outer layer of PPE gown was covered by fluid resistant gown. Vision hampered by fogging was reported in 18.2% of cases.



Endotracheal Intubation Process: Patients were receiving respiratory support or supplemental oxygenation through non-invasive ventilation as CPAP or BiPAP (72.7%), a face mask with reservoir bag (22.7%) before requiring endotracheal intubation. Propofol (77.3%), Ketamine (54.5%), Midazolam (90.9%) and fentanyl were used as induction agent while muscle relaxation was achieved with suxamethonium in 86.4% cases after preoxygenation in all patients either by continuing same oxygen device (72.7%) or facemask (27.2%). Video laryngoscope was first intubation device in 50.0% of case while Macintosh laryngoscope was used in 50.0% patients. Endotracheal intubation was successful in first attempt in 90.9% cases, while additional attempts have to be made in remaining patients. Average intubation time was < 1 minute in 45.5% and 1 to 3 minutes in 40.9% patients. Overall, Intubation success rate was 100%.

Adverse Events: During intubation, incidence of adverse events was 31.8%. Desaturation was present in 16 cases (72.7%) whereas hypotension was present in 3 patients (13.6%). Unanticipated difficult intubation was found in two patients (9.1%) but these patients were successfully intubated in subsequent attempt. Another adverse event included transient bradycardia in one patient (4.5%). There was no incident of trauma to oral cavity, aspiration or esophageal intubation.

Following intubation, the overall incidence of adverse events was 22.7%. Persistent hypoxia despite mechanical ventilation was seen in six patients (27.3%) and hypotension in four cases (18.2%). None of the patient had cardiac arrest. (Table 2)

Table 2: Adverse Event During and after Intubation

Adverse Event During Intubation	
Hypoxia	16 (72.7%)
Hypotension	3 (13.6%)
Arrhythmias	1 (4.5%)
Trauma to Oral Cavity	0
Aspiration	0
Unanticipated difficult airway	2 (9.1%)
Cardiac arrest	0
After Event During Intubation	
Persistent Hypoxia	6 (27.3)
Persistent Hypotension	4 (18.2%)
Arrhythmias	0
Cardiac arrest	0

Healthcare Worker Infection: Six anesthesiologist performed intubation in ICU from March to August 2020. No anesthesiologist either experienced sign and symptoms of SARS-CoV-2 infection or had positive RT-PCR.

DISCUSSION

Clinical spectrum of COVID-19 varies from asymptomatic to critically ill. Advanced COVID-19 presents as acute hypoxemic respiratory failure requiring oxygenation and mechanical ventilation therapies. Endotracheal intubation is high risk for compromised COVID-19 patients and attending healthcare persons, especially those performing aerosol generating procedures.

Among our patients, hypertension, diabetes mellitus, ischemic heart disease were common comorbidities. Four patients had a history of recent angioplasty. Asthma, chronic liver disease and chronic kidney disease were other common finding. Sanyaolu et al. reported old age and comorbidities as risk factor for higher intensive care unit (ICU) admission rate and mortality in COVID-19 disease[12].

Management of respiratory failure among COVID-19 patients is difficult because of rapid deterioration of disease and associated diseases that worsen the condition. Initially, increasing oxygen demand is met with high flow through non-rebreathing mask. As the disease progresses, high flow nasal cannula[13] (HFNC) and noninvasive positive pressure ventilation (NPPV) have been used[14]. Wunsch et al reported that mechanical ventilation was required in 89.9% American, 88.5% in Italian and 29.1% of Chinese population admitted in ICU[15].

SARS-CoV-2 spreads mainly through droplets from pharyngeal and airway secretions. Aerosol-generating

procedures such as endotracheal intubation increases the transmission to medical personnel[16]. Endotracheal intubation by experienced physician, proper use of PPE, using rapid sequence induction, use of video laryngoscope, use of endo-tidal carbon dioxide to confirm the proper placement of endotracheal tube and avoiding auscultation method are recommended to reduce the risk of transmission of disease to healthcare personal managing the airway in COVID-19 patients[17-21]. Endotracheal intubation is an aerosol generating procedure, putting anesthesiologist at risk of contracting SARS-CoV-2. American Society of Anesthesiologists (ASA) and Anesthesia Patient Safety Society (APSS) recommend N95 masks or powered air purifying respirators (PAPRs) for highest level of protection against disease transmission[22]. To prevent anesthesiologist from contracting the SARS-CoV-2, a three leveled protection (PPE3) includes N95 mask respirator or equivalent, eye protection goggles, face shield, double gloves, protective clothing, disposable cap and shoe covers. Donning and doffing was supervised by a nurse or other anesthesiologists with particular emphasis on hand hygiene. 3M™ Full Facepiece Reusable Respirator 6900 (50%) or half-face 3M™ Full Facepiece Reusable Respirator 6900. During the first wave in Pakistan, no anesthesiologist contracted the infection in our hospital.

Principle of airway management in COVID-19 patients is to accomplish endotracheal intubation quickly without the need of positive pressure ventilation before endotracheal intubation[23]. Rapid sequence induction (RSI) with or without cricoid pressure is recommended technique to intubate COVID-19 patients. It is advisable to do a preoxygenation for 5 minutes before induction to decrease risk of aerosolization during intubation by avoid manual ventilation[24]. We achieved preoxygenation either by continuing noninvasive ventilation (72.0%), nonrebreathing mask (22.0%) or ventilator circuit (4.5%) followed by RSI and intubation with successful first attempt intubation in 90.1% patients.

During intubation, further drop in oxygen saturation and hypotension during intubation were most commonly reported complication in our study. Severity of hypoxemia shows intrapulmonary shunt due to alveolar changes in COVID-19 patients. Shortage of hospital critical care bed during COVID-19 pandemic, silent hypoxia and trial of noninvasive ventilation and use of high flow nasal oxygenation sometimes delays decision of intubation. Despite pre-oxygenation, patients are prone to develop further hypoxia during apneic period. Obesity and associated respiratory diseases further complicate this situation. A fluid restricted approach further deteriorates hypotension and makes airway management difficult in COVID-patients. These findings make airway management challenging and necessitate an optimal airway management plan. In a study by Yao et al., hypoxemia (73.3%) and hypotension (17.8%) were common findings in COVID-19 patients undergoing endotracheal intubation[10].

Post intubation complication include persistent hypoxia and transient arrythmia. Arrythmias in COVID-19 can be multifactorial: hypoxemia because of respiratory failure, myocarditis, cardiac injury and inflammatory response. Arrhythmias in our patients were short-lived; improved with oxygenation, and none of the patients had a cardiac arrest in peri-intubation period. (26) Post intubation, Hypoxemia (16%), hypotension (22.3%), pneumothorax (5.9%) and cardiac arrest (2.0%) were reported by Yao et al[10].

There are limitations to our study. First, this sample size is small as only 24 intubations were performed at our center. Large multi-centered sample is required to determine the factor effecting complication in the peri intubation period. Secondly, retrospective observational study did not involve any randomization and hence patient outcomes with respiratory support could not be reported.

CONCLUSION

COVID-19 cases with hypoxic respiratory failure requiring endotracheal intubation and ventilation are common in elderly and comorbid patients. Optimal preparation and PPE3 is required for physicians intubating these patients. Hypoxia, hypotension, arrhythmias and unanticipated difficult airway are frequent adverse events during intubation of COVID-19 patients. A protocol-based approach to such patients would be beneficial in order to reduce peri-intubation adverse events and risk of SARS-CoV-2 transmission to health care personnel.

ETHICAL REVIEW BOARD APPROVAL

The study was approved from Institutional Review Board of Pakistan Kidney and Liver Institute & Research Center, Lahore via reference No. PKLI-IRB/AP/025 dated September 9,2020.

REFERENCES

1. Phelan AL, Katz R, Gostin LO. The Novel Coronavirus Originating in Wuhan, China: Challenges for Global Health Governance. JAMA. 2020;323(8):709–710.
2. WHO Coronavirus Disease (COVID-19) Dashboard [Internet]. [cited 2021 Nov 1]. Available from: https://covid19.who.int.

3. Abid K, Bari YA, Younas M, Tahir Javaid S, Imran A. Progress of COVID-19 Epidemic in Pakistan. Asia Pac J Public Health. 2020 May;32(4):154–156.
4. COVID-19 Health Advisory Platform by Ministry of National Health Services Regulations and Coordination [Internet]. [cited 2021 Nov 1]. Available from: https://covid.gov.pk/
5. Decaro N, Mari V, Elia G, Addie DD, Camero M, Lucente MS, et al. Recombinant Canine Coronaviruses in Dogs, Europe. Emerg Infect Dis. 2010;16(1):41–47.
6. Helmy YA, Fawzy M, Elaswad A, Sobieh A, Kenney SP, Shehata AA. The COVID-19 Pandemic: A Comprehensive Review of Taxonomy, Genetics, Epidemiology, Diagnosis, Treatment, and Control. J Clin Med. 2020 Apr 24;9(4):1225.
7. Zhou P, Yang X-L, Wang X-G, Hu B, Zhang L, Zhang W, et al. A pneumonia outbreak associated with a new coronavirus of probable bat origin. Nature. 2020 Mar 12;579(7798):270–273.
8. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. The Lancet. 2020 Feb;395(10223):497–506.
9. Meng L, Qiu H, Wan L, Ai Y, Xue Z, Guo Q, et al. Intubation and Ventilation amid the COVID-19 Outbreak. Anesthesiology. 2020 Jun 1;132(6):1317–1332.
10. Yao W, Wang T, Jiang B, Gao F, Wang L, Zheng H, et al. Emergency tracheal intubation in 202 patients with COVID-19 in Wuhan, China: lessons learnt and international expert recommendations. Br J Anaesth. 2020 Jul;125(1): e28–37.
11. Weissman DN, de Perio MA, Radonovich LJ. COVID-19 and Risks Posed to Personnel During Endotracheal Intubation. JAMA. 2020 May 26;323(20):2027.
12. Sanyaolu A, Okorie C, Marinkovic A, Patidar R, Younis K, Desai P, et al. Comorbidity and its Impact on Patients with COVID-19. SN Compr Clin Med. 2020 Aug;2(8):1069–1076. doi: 10.1007/s42399-020-00363-4
13. Calligaro GL, Lalla U, Audley G, Gina P, Miller MG, Mendelson M, et al. The utility of high-flow nasal oxygen for severe COVID-19 pneumonia in a resource-constrained setting: A multi-centre prospective observational study. EClinicalMedicine. 2020 Nov; 28:100570.https://doi.org/10.1016/j.eclinm.2020.100570
14. Baillard C, Fosse J-P, Sebbane M, Chanques G, Vincent F, Courouble P, et al. Noninvasive Ventilation Improves Preoxygenation before Intubation of Hypoxic Patients. Am J Respir Crit Care Med. 2006 Jul 15;174(2):171–177. https://doi.org/10.1164/rccm.200509-1507OC
15. Wunsch H. Mechanical Ventilation in COVID-19: Interpreting the Current Epidemiology. Am J Respir Crit Care Med. 2020 Jul 1;202(1):1–4. doi: 10.1164/rccm.202004-1385ED
16. Jiang B, Yao W, Wang T, Cook TM, Behringer E, Wei H. Tracheal intubation in COVID-19 patients: update on recommendations. Response to Br J Anaesth 2020; 125: e28–37. Br J Anaesth. 2020 Nov;125(5): e424–6.
17. Szarpak L, Drozd A, Smereka J. Airway management and ventilation principles in COVID-19 patients. J Clin Anesth. 2020 Oct; 65:109877. VI. doi: 10.1016/j.jclinane.2020.109877
18. Liu Z, Wu Z, Zhao H, Zuo M. Personal protective equipment during tracheal intubation in patients with COVID-19 in China: a cross-sectional survey. Br J Anaesth. 2020 Nov;125(5): e420–2. VII. doi: 10.1016/j.jclinane.2020.109954
19. Saracoglu KT, Saracoglu A, Demirhan R. Airway management strategies for the Covid 19 patients: A brief narrative review. J Clin Anesth. 2020 Nov; 66:109954. VIII. https://doi.org/10.1097/ALN.0000000000003389
20. Zeidan A, Bamadhaj M, Al-Faraidy M, Ali M. Videolaryngoscopy Intubation in Patients with COVID-19. Anesthesiology. 2020 Aug 1;133(2):481–483. IX. doi: 10.1016/j.amjms.2020.07.006
21. Patel L, Gandhi D, Beddow D. Controversies on the Stethoscope During COVID-19: A Necessary Tool or an Unnecessary Evil? Am J Med Sci. 2020 Jul; S0002962920302974.
22. The Use of Personal Protective Equipment by Anesthesia Professionals during the COVID-19 Pandemic [Internet]. [cited 2021 Jan 17]. Available from: https://www.asahq.org/about-asa/newsroom/news-releases/2020/03/the-use-of-personal-protective-equipment-by-anesthesia-professionals-during-the-covid-19-pandemic
23. Brewster DJ, Chrimes N, Do TB, Fraser K, Groombridge CJ, Higgs A, et al. Consensus statement: Safe Airway Society principles of airway management and tracheal intubation specific to the COVID -19 adult patient group. Med J Aust. 2020 Jun;212(10):472–481.
24. Orser BA. Recommendations for Endotracheal Intubation of COVID-19 Patients: Anesth Analg. 2020 May;130(5):1109–1110.

AUTHOR'S CONTRIBUTIONS

SS: Manuscript writing, Data collection
MA: Manuscript writing, Correspondence
TY: Manuscript writing
YB: Statistical analysis