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Intubation and Ventilation Challenges in COVID-19 Patients: Review Article

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ABSTRACT

Background: COVID-19 infection, which appeared for the first time in December 2019 in China as a combination of severe respiratory symptoms among which is pneumonia. A very common and severe complication of COVID-19 severe illness is the respiratory failure or acute hypoxemic respiratory insufficiency. This complication requires ventilation therapies to supply adequate oxygen for the patient. The World health organization (WHO) recommends the performing of endotracheal intubation in hypoxemic respiratory failure patients with acute respiratory distress syndrome who continue to have breathing problems however they received standard therapy of oxygen.

Objective: This study aimed to assess the challenges related to intubation and ventilation, when to start intubation and how to deal with different outcomes and problems related to them.

Methods: These databases were searched for studies published between December 2015 and April 2022 that had been peer-reviewed and had been published in English in the two databases: PubMed and Google Scholar. More synonymous key words had been used for searching such as intubation and ventilation challenges, ICU, ARDS and COVID-19 patients. Documents written in a language other than English have been disregarded since no sources for interpretation were discovered. Dissertations, conversations, conference abstract papers, and anything other than the primary scientific investigations had been disqualified.

Conclusion: Early intubation is recommended over late intubation. The intensivist, ICU nurse, and respiratory therapist (RT) are crucial team members to manage intubation and ventilation. Prone positioning is an important aspect to be applied. Lung injury occurs often in serious COVID-19 patients due to the severe and protracted respiratory failure that occurs in these patients. Majority of PE patients experience some degree of hypoxia as a result of ventilation-perfusion mismatch and intrapulmonary shunting.

Keywords: Intubation and ventilation challenges, ICU, ARDS, COVID-19 patients.

INTRODUCTION

COVID-19 infection, which appeared for the first time in December 2019 in China as a combination of severe respiratory symptoms among which is pneumonia[1, 2].

It has greatly spread with a high speed and marked by the World Health Organization (WHO) as a pandemic. As of 2nd January 2023, there have been 665,339,248 cases worldwide, with 6,698,470 deaths [3]. The healthcare system is still facing a very dangerous challenge to deal with this highly infectious virus [4].

Many symptoms are associated with COVID-19 infection ranging from mild symptoms to severe symptoms and illness leading to mortality. Symptoms of severe COVID-19 infection can occur very rapidly leading to acute respiratory distress syndrome (commonly known as ARDS) and can lead to other serious complication that end up with multi organ failure and death. Therefore, it is critical to manage the severe cases of COVID-19 by ICU admission, follow up, diagnosis at the correct time and starting the treatment immediately [5–7].

A very common and severe complication of COVID-19 severe illness is the respiratory failure or acute hypoxemic respiratory insufficiency. This complication requires ventilation therapies to supply adequate oxygen for the patient. Anesthetists and intensive care health care team are at high risk of acquiring infection as a result of aerosol producing procedures such as intubation and extubation. Invasive ventilation using an endotracheal tube is very common during COVID-19 outbreak [8].

COVID-19 patients eligible for intubation and ventilation

Taking the decision to intubate a patient with COVID-19 is a complex one and depends on many various factors. The Chinese Society of Anaesthesiology Task Force on Airway Management put the recommendations to intubate patients who don't show improvement in respiratory distress and oxygen insufficiency or with a respiratory rate of greater than 30 per minute. Patients with poor oxygenation whose partial oxygen pressure to fraction of inspired oxygen ratio is less than 150 mmHg despite 2 hours of oxygen flow therapy [9].

These suggestions are similar to those made in the surviving sepsis organization's guidelines, which state that intubation should be carried out if acute hypoxemic failure worsens despite receiving high flow nasal cannula (HFNC), conventional oxygen therapy, and a trial of nasal intermittent positive pressure ventilation [10]. The World health organization recommends the performing of endotracheal intubation is hypoxemic respiratory failure patients with acute respiratory distress syndrome who continue to have breathing problems however they received standard therapy of oxygen.

The consensus is to intubate patients whose acute hypoxemic respiratory failure in ARDS caused by

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COVID-19 worsens despite normal oxygen treatment or NIV, notwithstanding discrepancies in the definitions' criteria. However, since there isn't much study to back them up, ideas rely mostly on empirical evidence [11].

Invasive mechanical ventilation is necessary in cases of severe hypoxemia, further end-organ failure, or contraindications like delirium. The most experienced member of a small, well-trained team should quickly intubate the patient, preferably without the use of bag-mask ventilation and with the assistance of a safety equipment, end-tidal capnometry, video-laryngoscopy, and a rapid induction procedure [12].

When to start intubation

Early intubation is recommended over late intubation, despite the fact that endotracheal intubation timing is rarely discussed in the literature. This may partially be explained by the fact that COVID-19 patients lose the mechanisms of compensation and the respiratory reserve becomes depleted as the disease worsens [13]. Intubation should be carried out early in the course of the disease to avoid having to intubate patients with severe hypoxemia and to reduce the risk of cardiovascular collapse during intubation, both of which may ultimately serve to minimize mortality. Brazilian and Chinese clinicians offered recommendations that were comparable to one another. A prospective observational study that looked at clinical outcomes in patients with ARDS found that an early intubation was linked to a noticeably reduced 60-day mortality rate than a late intubation. Therefore, similar outcomes following intubation may be expected in COVID-19 patients [1, 14–17].

For clinicians who elect to intubate patients ahead of time rather than do so in an emergency, early intubation may also be advantageous. Medical staff intubation may expose them to COVID-19 aerosol, as was previously mentioned. The timing of intubation is a crucial concern for the safety of both patients and staff since it could put doctors under additional time strain and increase the likelihood that they would lose their personal protection equipment (PPE). Early intubation is typically seen as superior to late intubation in order to decrease patient mortality and safeguard the safety of medical workers. The concept of "early" is still up for debate as this is happening [1].

Intubation and ventilation are cooperation of a big team

Furthermore, it's vital to keep in mind that providing IMV life support to a severely ill patient necessitates a team of medical experts dedicated to identifying even the smallest changes in ventilatory needs and anticipating potential injury. The intensivist, ICU nurse, and respiratory therapist (RT) are crucial team members [18,19]. Hospitals are forced to stick to crisis standards of care and apply a high surge. They should make an evaluation regarding their ability to manage the cases in the hospital in terms of space, healthcare staff and medical supplies. Standard crisis protocols may help with the management of space, medical resources, and human resources in addition to helping with the treatment of patients who are more gravely ill [20].

There is currently no specific guidance for adjusting ICU staff to deliver the highest level of care for patients and to be able to assist a large number of patients, making it challenging. Every COVID-19 patient who is critically ill should be under the supervision of an intensivist whether they are getting care locally or remotely. ICU physician leads usually employ a pyramidal organisational structure, with the most experienced doctor being a leader of a group of medical healthcare team with different specialties and experience in ICU and critical care. This team includes nurses, clinical pharmacists, fellows, attending physicians, residents and physician assistants [18, 20–22]. These qualified but inexperienced carers may be in charge of a lower layer of extenders, such as medical specialists from several professions or other doctors in advanced practice, who are less adept at delivering basic care [18].

So we can see that medical ventilation is not considered the intubation process only but it includes the continuous and aware monitoring of each case for the whole day in order to control the amount of oxygen, treat other symptoms and prevent complications [18].

Risk factors of infection for healthcare team

The main means of COVID-19 transfer are droplets and fomites. Droplet transmission may be brought on by close contact or bacterial contamination. COVID-19 disease is a highly contagious infection with a high mortality rate that puts medical workers as well as the healthcare system in jeopardy. Healthcare professionals are more prone to become ill when caring for patients with severe COVID-19 and carrying out procedures that produce patient aerosols. In addition to the hazards to the health of the infected healthcare staff, the sickness and quarantine periods may also restrict the resources available for patient care at times of high demand [23–25].

Personal protective equipment should be worn adequately by health care professionals to avoid being infected by the droplets or airborne infection by the COVID-19 patients during intubation or ventilation. Prior to airway intervention, a precise airway examination is crucial. It is strongly recommended that modified fast sequence induction be utilised instead of waking up patients with a normal airway in order to intubate them. Muscle relaxants should be administered in accurate doses before intubation. Before carrying out the processes of intubation and ventilation the equipment used should be appropriately set up and a proper plan should be put in order to minimize any further failures [23,26].

Mental wellbeing of the healthcare staff should be prioritized with their physical health as well. A study

showed that 65% of the anesthetists and ICU staff had suffered from mental disturbance and psychological problems as a result of dealing with COVID-19 patients [27]. The mental health of healthcare personnel should come before their physical health. Another study carried out in Wuhan, China the core of COVID-19 had reported the same findings regarding bad mood and psychological outcomes of health care professionals dealing with COVID-19 patients in their hospital settings. The bad psychological outcome is due to being worried to infect their loved people due to their daily contact with COVID-19 patients.

A Study showed that third-year anesthesiology residents will acquire great skills and become highly expertise in the field of COVID-19 patients management after a month of unsupervised employment in the field. As a result the problem of decreased human resources will be solved [23, 27, 28].

Prone positioning while ventilation

Prone positioning is an important aspect to be discussed. It increases elasticity of chest wall, makes the tidal volume better, and increases the end-expiratory volume of the lung [29]. There is a previously published meta-analysis that discussed the usefulness of the use of prone positioning and found the reduction of mortality if it was performed in the early stages of the disease. This study made a recommendation to apply prone positioning for at least 12 hours per day [30].

Another study showed the useful effect of self-prone positioning in awake patients where it showed the increase of median oxygen saturation in emergency department [31]. COVID-19 is a challenging disease and prone positioning needs to be well studied regarding long-term effects on severity of the disease and mortality of patients [32].

Ventilator induced injuries

Lung injury—with an overt barotrauma frequency > 10%—occurs often in serious COVID-19 patients due to the severe and protracted respiratory failure that occurs in these patients [33]. Numerous COVID-19 patients getting mechanical ventilation have been found to have low pulmonary compliance and excessive airway pressures.

Numerous pathophysiologic elements connected to ventilator-induced lung injury, such as regional lung overdistention, may be brought on by these conditions (VILI) [34]. Although pneumomediastinum and pneumothorax may be obvious symptoms, the clinical and radiological features of VILI can readily resemble those of the underlying ARDS and present as a chronic or progressive illness. Mechanical ventilation and diaphragm dysfunction may contribute to weaning challenges and extended stays in the critical care unit [35].

Hypoxia in pulmonary embolism patients on ventilator

Since the majority of PE patients experience some degree of hypoxia as a result of ventilation-perfusion mismatch and intrapulmonary shunting, a recently discovered or incorrectly identified PE may have accelerated the clinical deterioration of a critically ill patient who tested positive for COVID-19. Systemic anticoagulation is usually necessary for DVT patients who have not undergone imaging tests for pulmonary embolism but who might in the future [35].

CONCLUSION

Intubation and ventilation are not a matter of just only improving oxygenation but they are considered complex procedures for the patients and the health care staff that require adequate experience and continuous monitoring in order to achieve the best outcomes and prevent complications.

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REFERENCES

1. **Harahwa T, Khan I, Harky A (2020):** Ventilatory support for COVID-19 patients. Acta Bio Medica Atenei Parm., 91 (4): 1–6.
2. **Huang C, Wang Y, Li X *et al.* (2020):** Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet (London, England), 395 (10223): 497-502.
3. **WHO (2022):** Coronavirus (COVID-19) Dashboard With Vaccination Data. https://covid19.who.int/
4. **WHO (2020):** Coronavirus disease 2019 (COVID-19): situation report, 51: 9. https://apps.who.int/iris/handle/10665/331475
5. **Turan S, Sevim Yakin S, Yamanel L (2021):** The timing of intubation and principles of ICU care in COVID-19. Turkish J Med Sci., 51 (7): 3340-49.
6. **Grasselli G, Zangrillo A, Zanella A *et al.* (2020):** Baseline Characteristics and Outcomes of 1591 Patients Infected With SARS-CoV-2 Admitted to ICUs of the Lombardy Region, Italy. JAMA., 323 (16): 1574-81.
7. **Guan W, Ni Z, Hu Y *et al.* (2020):** Clinical Characteristics of Coronavirus Disease 2019 in China. N Engl J Med., 382 (18): 1708–20.
8. **Meng L, Qiu H, Wan L *et al.* (2020):** Intubation and Ventilation amid the COVID-19 Outbreak: Wuhan's Experience. https://pubmed.ncbi.nlm.nih.gov/32195705
9. **Zuo M, Huang Y, Ma W *et al.* (2020):** Expert Recommendations for Tracheal Intubation in Critically ill Patients with Noval Coronavirus Disease 2019. Chinese Med Sci J., 35 (2): 105–9.
10. **Poston J, Patel B, Davis A (2020):** Management of Critically Ill Adults With COVID-19. JAMA., 323 (18): 1839–41.
11. **Zhao W, Zhang J, Meadows M *et al.* (2020):** A systematic approach is needed to contain COVID-19 globally. Sci Bull., 65 (11): 876–8.
12. **Möhlenkamp S, Thiele H (2020):** Ventilation of COVID-19 patients in intensive care units. Herz, 45 (4): 329-31.
13. **Meng L, Qiu H, Wan L *et al.* (2020):** Intubation and Ventilation amid the COVID-19 Outbreak: Wuhan's

Experience. Anesthesiology, 132 (6): 1317–32.
14. **Kangelaris K, Ware L, Wang C *et al.* (2016):** Timing of intubation and clinical outcomes in adults with acute respiratory distress syndrome. Crit Care Med., 44 (1): 120–9.
15. **Cheung J, Ho L, Cheng J *et al.* (2020):** Staff safety during emergency airway management for COVID-19 in Hong Kong. Lancet Respir Med., 8 (4): e19. doi: 10.1016/S2213-2600(20)30084-9.
16. **Mendes J, Mergulhão P, Froes F *et al.* (2020):** Recommendations from the Sociedade Portuguesa de Cuidados Intensivos and Infection & Sepsis Group for intensive care approach to COVID-19. Rev Bras Ter intensiva., 32 (1): 2–10.
17. **Yao W, Wang T, Jiang B *et al.* (2020):** Emergency tracheal intubation in 202 patients with COVID-19 in Wuhan, China: lessons learnt and international expert recommendations. Br J Anaesth., 125 (1): 28–37.
18. **Dar M, Swamy L, Gavin D *et al.* (2021):** Mechanical-Ventilation Supply and Options for the COVID-19 Pandemic Leveraging All Available Resources for a Limited Resource in a Crisis. Ann Am Thorac Soc., 18 (3): 408–16.
19. **Ajao A, Nystrom S, Koonin L *et al.* (2015):** Assessing the Capacity of the US Health Care System to Use Additional Mechanical Ventilators During a Large-Scale Public Health Emergency. Disaster Med Public Health Prep., 9 (6): 634–41.
20. **Abir M, Nelson C, Chan E *et al.* (2020):** Critical Care Surge Capacity in U.S. Hospitals: Strategies for Responding to the COVID-19 Pandemic. Crit Care Surge Capacit US Hosp Strateg Responding to COVID-19 Pandemic. Pp: 1-4. https://www.rand.org/pubs/research_briefs/RBA164-1.html
21. **Harris G, Baldisseri M, Reynolds B *et al.* (2020):** Design for Implementation of a System-Level ICU Pandemic Surge Staffing Plan. Crit care Explor., 2 (6): e0136. doi: https://pubmed.ncbi.nlm.nih.gov/32695999/
22. **Kumaraiah D, Yip N, Ivascu N *et al.* (2020):** Innovative ICU Physician Care Models: Covid-19 Pandemic at NewYork-Presbyterian. NEJM Catalyst Connect, https://catalyst.nejm.org/doi/full/10.1056/CAT.20.0158
23. **Rahmani F, Mahmoodpoor A, Salmasi S *et al.* (2021):** Safety of Healthcare Workers During the Airway Management in Adult and Pediatric Patients with COVID-19. Anesthesiol Pain Med., 11 (2): 112508. doi: 10.5812/aapm.112508
24. **Brewster D, Chrimes N, Do T *et al.* (2020):** Consensus statement: Safe Airway Society principles of airway management and tracheal intubation specific to the COVID-19 adult patient group. Med J Aust., 212 (10): 472–81.
25. **Aminnejad R, Hashemi S, Safari S *et al.* (2021):** Impact of COVID-19 on Advanced Cancer Patients' Pain Care: Warning About Chloroquine and Hydroxychloroquine. Anesthesiol pain Med., 11 (1): 1–2.
26. **Zuo M, Huang Y, Ma W *et al.* (2021):** Expert Recommendations for Tracheal Intubation in Critically ill Patients with Noval Coronavirus Disease 2019. Chinese Med Sci J., 35 (2): 105–9.
27. **Ali H, Ismail A, Abdalwahab A (2020):** Mental Stress in Anesthesia and Intensive Care Physicians During COVID-19 Outbreak. Anesthesiol pain Med., 10 (5): 1–6.
28. **Dabbagh A, Ahmadizadeh S, Asgari S *et al.* (2020):** Attitudes of the Third-Year Clinical Anesthesiology Residents Toward an Independent Clinical Practice Rotation in COVID-19 Pandemic in Iran. Anesthesiol pain Med., 10 (6): 1–6.
29. **Kallet R (2015):** A Comprehensive Review of Prone Position in ARDS. Respir Care, 60 (11): 1660–87.
30. **Mora-Arteaga J, Bernal-Ramírez O, Rodríguez S (2015):** The effects of prone position ventilation in patients with acute respiratory distress syndrome. A systematic review and metaanalysis. Med Intensiva, 39 (6): 352–65.
31. **Caputo N, Strayer R, Levitan R (2020):** Early Self-Proning in Awake, Non-intubated Patients in the Emergency Department: A Single ED's Experience During the COVID-19 Pandemic. Acad Emerg Med., 27 (5): 375–8.
32. **Harahwa T, Khan I, Harky A (2020):** Ventilatory support for COVID-19 patients. Acta Bio Medica Atenei Parm., 91(4):1–6.
33. **Rajdev K, Spanel A, McMillan S *et al.* (2021):** Pulmonary Barotrauma in COVID-19 Patients With ARDS on Invasive and Non-Invasive Positive Pressure Ventilation. J Intensive Care Med., 36 (9): 1013–7.
34. **Slutsky A, Ranieri V (2013):** Ventilator-induced lung injury. N Engl J Med., 369 (22): 2126–36.
35. **Maslove D, Sibley S, Boyd J *et al.* (2022):** Complications of Critical COVID-19: Diagnostic and Therapeutic Considerations for the Mechanically Ventilated Patient. Chest, 161 (4): 989-98.