

Abstract

The novel coronavirus disease 2019 (COVID-19) can lead to acute respiratory distress syndrome (ARDS) and even death. These complications require treatment and solidified universal plan has not yet been created to handle these patients. This leads to the question: When should COVID-19 positive patients be intubated in order to reduce the detrimental effects of ARDS and prolong longevity post extubation? The sooner patients are put on non-invasive ventilatory support (NIV) or intubated depending on their respiratory needs, the less likely they are to experience complications that lead to death. Patients were followed from admission with a chief complaint of COVID-19 until they were either discharged or succumb to the virus. These patients all initially received NIV therapy, and those who did not have any increase in SpO2 as a result, were either intubated immediately, or were monitored for 24 hours and then intubated. The patients who were responsive to NIV therapy had the best outcome, followed by the patients who were intubated immediately. The patients who were monitored for an extended period of time before being intubated had the highest mortality rates.

Introduction

The novel coronavirus disease 2019 (COVID-19) can lead to severe complications such as the development of acute respiratory distress syndrome (ARDS). It is estimated that 20-30% of the patients who are hospitalized due to COVID-19 develop ARDS (Meng et al., 2020; Hyman et al, 2020). ARDS can be resolved with ventilatory support, and this is often achieved with endotracheal intubation (Meng et al., 2020). ARDS not due to COVID has increased mortality in conjunction with delayed or late intubation, and ARDS due to COVID seems to react equivalently (Daniel et al., 2021). While some patients require emergent intubation due to rapid decline resulting in a patient losing control of their airway of going into cardiopulmonary arrest, other patients need to be intubated because they have poor oxygenation, respiratory distress, or depleted respiratory reserves (Meng et al., 2020). On average patients are not intubated until their third day in the hospital, and those patients remain intubated for an average of five days (Arvind et al., 2021). Studies have shown, however, that intubation should be performed on the first day of presentation to the hospital, and patients should be intubated conservatively for 3-4 weeks to decrease mortality post extubation (Hyman et al., 2020). Intubation has always been an appropriate treatment for ARDS; however, it has been discovered that non-invasive ventilatory (NIV) support is another possible treatment for patients who are developing ARDS as a result of COVID-19.

Non-invasive ventilatory (NIV) support was seen to decrease overall mortality when compared to endotracheal intubation in patients who progress to ARDS as a result of a COVID-19 infection (Daniel et al., 2021). NIV is not an appropriate treatment of ARDS that develops due to other respiratory conditions, and because of this it was initially avoided as a treatment in COVID-19 patients. The time of intubation being prolonged is potentially due to the increased risk of mortality in COVID patients who are intubated, however this late intubation could also be leading to mortality at a higher incidence than early intubation would. The risk of mortality was decreased in patients who underwent NIV in coordination with high flow oxygen therapy as opposed to patients who were intubated, so it is a good treatment, but physicians are still struggling to determine when each method should be utilized over the other (Daniel et al., 2021).

Intubated patients require more supervision than patients on NIV, creating a strain of resources. Nurses are being spread thin since these patients require constant observation, and nurses are already short staffed (Daniel et al., 2021). While NIV support seems to be a good step in reducing the contamination risks associated with intubation, by reducing the need for intubation, it has been linked to increased aerosol production, creating a contamination risk of its own (Daniel et al., 2021). NIV support is an effective way to manage patients who develop ARDS with COVID-19 as it allows for the patient's lungs to recover, without requiring invasive intubation. NIV support, however, is not a good enough treatment in all patients, and patients with severe cases will still require intubation. This means the following question remains. When should COVID-19 positive patients be intubated in order to reduce the detrimental effects of ARDS and prolong longevity post extubation?

Review of Literature

The purpose of these studies were to determine at which stage in advanced COVID-19 patients should be intubated in order to reduce mortality rates. Once ARDS is reached, and progresses, the chance of multi-organ failure increases, leading to further complications ultimately leading to mortality. If we can prevent this stage from increasing by properly intubating these patients before ARDS, hypoxia, and tracheal edema can progress then the patients may have a better chance of making it off the ventilators alive. In conjunction with timing, proper intubation, and rapid sequence induction (RSI) can all lead to prolonged longevity post extubation in COVID-19 patients (Zheng Et Al., 2020).

Treatments for COVID-19 Patients with Positive Outcomes

1. Non-invasive ventilatory support (NIV)
2. Emergent Endotracheal Intubation

Noneffective COVID-19 Treatments

1. Delayed intubation
2. Intubation after a diagnosis of ARDS

Discussion

We expect to see a decrease in the mortality rate for patients who are on NIV therapy for the duration of their hospital stay when compared to patients who require intubation. If we can start treating the impending hypoxia as soon as they are hospitalized, we can avoid a depleted oxygen reserve which will weaken the cardiopulmonary system. If we can promote oxygenation in patients with NIV mask ventilation rather than endotracheal intubation, we will be able to shorten the length of hospital stay and reduce mortality in these severely inflicted individuals. If we reduce the number of patients who need to be intubated, we also reduce the risk of spreading COVID-19 to the intubating staff. This will also decrease the strain on nurses that intubated patients create. We expect some patients to not respond to NIV support. If we can intubate these patients who have a decreased SpO2 that is not resolved with NIV early, we can decrease post extubation mortality as well. Once these patients have depleted oxygen storage intubation poses a risk. If patients are not responding to NIV treatment, then we can still intubate them before they have a significant depletion of their respiratory reserve. This early intubation should decrease the mortality rates that are seen with intubation as a whole. There have not been studies to distinguish between early and late intubation, so this study will be able to provide data regarding early intubation. Conservative methods will increase the length patients remain intubated; however, this will also decrease the risk of post extubation mortality so it will also be beneficial.

Results

Patients who began NIV therapy as soon as they were admitted to the hospital were able to replenish their oxygen store depletion. This allowed them to recover without the need of invasive intubation. The patients who were not responsive to NIV were intubated. Those who were rapidly intubated at the first signs that NIV therapy was not working had a decreased risk of mortality post extubation. In figure 1 the mortality risks associated with each day patients were hospitalized before being intubated are extrapolated showing that there was an increased risk for mortality each day necessary intubation was postponed.

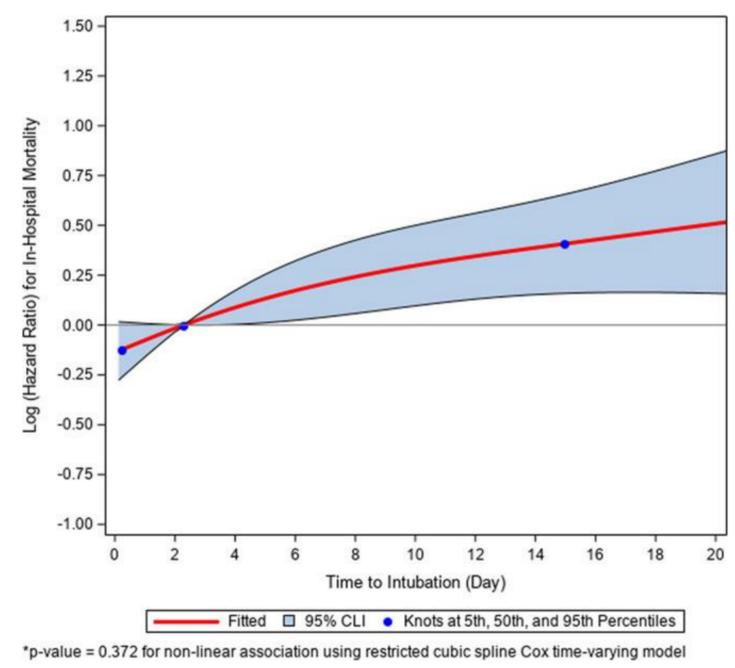


Figure 1: Spine chart demonstrating the mortality risk compared to when patients were intubated post hospital admission (Hyman et al., 2020)

Conclusion

Patients who progress into ARDS as a result of COVID-19 can be treated with non-invasive ventilatory (NIV) support, or they may require endotracheal intubation as a treatment. If patients do not respond to NIV within the first few hours of starting therapy, endotracheal intubation is the next progressive treatment option. Patients who receive this support before their third day of being hospitalized have a statistically significant decreased risk of mortality from COVID-19 complications. If NIV therapy alone is an effective treatment, those patients have the lowest risk of mortality from COVID-19. If patients are started on NIV, but then become intubated they have decreased mortality rates if they are intubated soon after NIV is started and is deemed ineffective. Patients who are intubated after unsuccessful treatment, or over 24 hours into their hospital stay have the highest mortality rate.

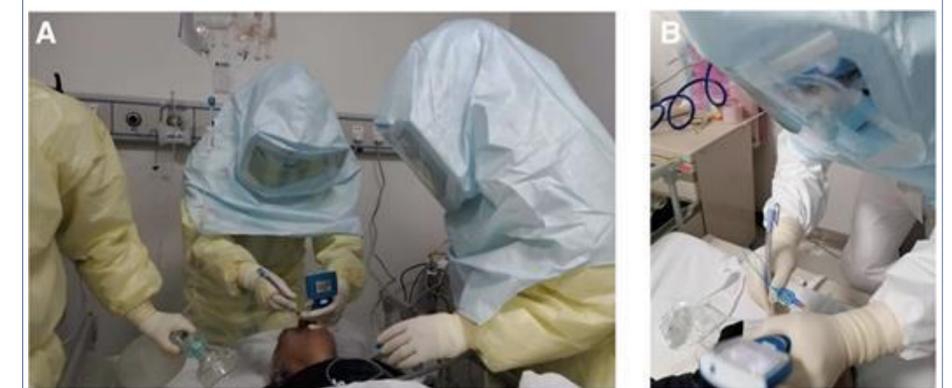


Figure 2: COVID-19 positive patients being intubated with video laryngoscopy, while maintaining COVID-19 safe PPE protocols (Meng et al., 2020).

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